



## UNIVERSAL DESTINATIONS & EXPERIENCES UK PROJECT

Former Kempston Hardwick Brickworks  
and adjoining land, Bedford

### Environmental Statement Volume 3

## Appendix 9.4 - Operational Noise Assessment

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# CONTENTS

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<b>1.</b>	<b>INTRODUCTION</b>	<b>1</b>
<b>1.2.</b>	<b>EXTENT OF THE STUDY AREA</b>	<b>1</b>
<b>2.</b>	<b>SCOPE OF ASSESSMENT</b>	<b>2</b>
<b>2.2.</b>	<b>IDENTIFIED NOISE SOURCES</b>	<b>6</b>
<b>3.</b>	<b>ASSESSMENT METHODOLOGY AND CRITERIA</b>	<b>8</b>
<b>3.2.</b>	<b>RECEPTOR CONTROL LOCATIONS</b>	<b>18</b>
<b>4.</b>	<b>NOISE PROPAGATION MODELLING</b>	<b>21</b>
<b>4.1.</b>	<b>PURPOSE OF NOISE PROPAGATION MODEL</b>	<b>21</b>
<b>5.</b>	<b>NOISE IMPACT ASSESSMENT</b>	<b>25</b>
<b>5.2.</b>	<b>POTENTIAL MITIGATION</b>	<b>36</b>
<b>5.3.</b>	<b>DEMONSTRATION OF COMPLIANCE WITH CORE ZONE NOISE LIMITS</b>	<b>38</b>
<b>5.4.</b>	<b>RESIDUAL EFFECTS</b>	<b>38</b>

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## TABLES

Table 3-1 - Core Zone Noise Magnitude of Impact Criteria - Daytime	13
Table 3-2 - Core Zone Noise Magnitude of Impact Criteria - Night-time	13
Table 3-3 - Core Zone Noise Matrix of Significance of Effect - Daytime	14
Table 3-4 - Core Zone Noise Matrix of Significance of Effect - Night-time	14
Table 3-5 - Utility Compound Noise Magnitude of Impact Criteria	17
Table 3-6 - Utility Compound Noise Significance of Effect	18
Table 3-7 - Receptor Control Locations (RCLs)	19
Table 4-1 - Core Zone Source Noise Levels Incorporated into the Propagation Test Model	22

Table 4-2 - Utility Compound Source Noise Levels Incorporated into the Propagation Test Model	23
Table 5-1 - Core Zone Noise Assessment for Typical Noise Levels at each RCL	27
Table 5-2 - Core Zone Significance of Effect for Typical Noise Levels at each RCL	28
Table 5-3 - Core Zone Noise Assessment for Maximum Allowable Noise Levels at RCL02-04	31
Table 5-4 - Core Zone Significance of Effect for Maximum Allowable Noise Levels at RCL02-04	32

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## ***IMAGES***

Image 2-1 - Parameter Plan - Utility Compound Plan	4
Image 3-1 - Monitoring Locations at Universal Studios Hollywood	10
Image 3-2 - Receptor Control Locations	20
Image 4-1 - Parameter Plan - Utility Compound Plan	24

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## ***ANNEXES***

### ANNEX A

#### COMMUNITY NOISE MONITORING DATA AT UNIVERSAL STUDIOS HOLLYWOOD

### ANNEX B

#### NOISE PROPAGATION MODEL - ASSUMPTIONS TABLES

## 1. INTRODUCTION

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- 1.1.1. This appendix provides the noise impact assessment for the Operational Phase of the Proposed Development, except for the Operational Road Traffic Noise assessment which is included in **Appendix 9.3: Construction and Operational Road Traffic Noise Assessment (Volume 3)**.

### 1.2. EXTENT OF THE STUDY AREA

- 1.2.1. The Operational Phase of the Proposed Development has the potential to adversely impact existing noise sensitive receptors (NSRs) located around the Site. The study area for detailed operational noise predictions at sensitive receptors extends to 300m from the Site boundary, as it is considered this would most effectively capture the cautious worst case (that provides a robust assessment of likely significant effects) impacts based on professional judgement.

## 2. SCOPE OF ASSESSMENT

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- 2.1.1. This assessment primarily covers operation of the Core Zone Theme Park complex and Lake Zone, the locations of which are shown on **Zonal Plan (Document Reference 1.8.0)**.
- 2.1.2. Noise from the following sources has been considered within this assessment:
- Operational noise associated with the Core Zone;
  - Noise from 'third shift' activities within the Core Zone; and
  - Noise from the Utility Compound located in the Lake Zone.
- 2.1.3. This assessment considers only the impact of noise on human receptors. The impact of noise on ecological receptors is considered within **Chapter 6: Ecology and Nature Conservation (Volume 1)**.

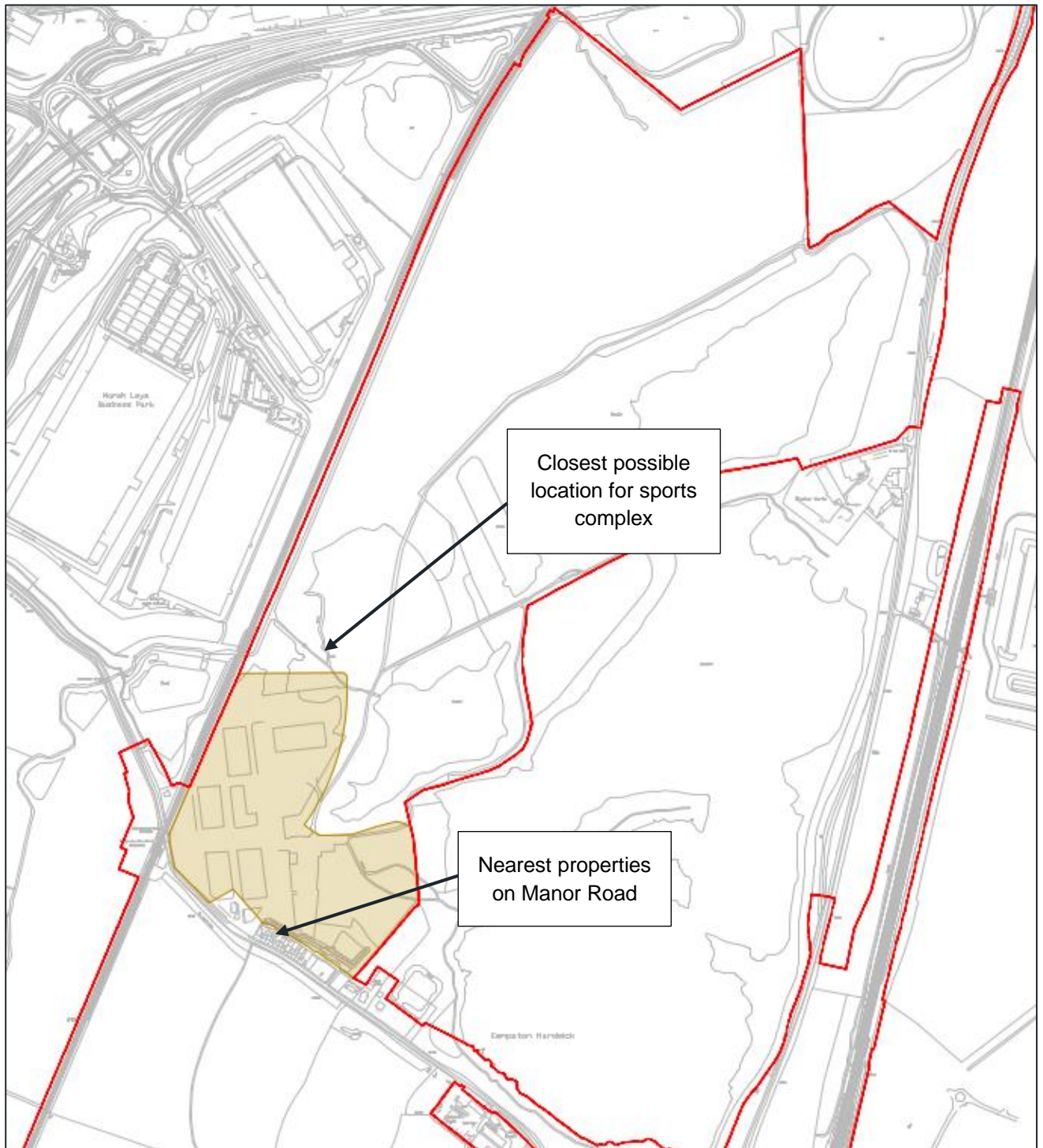
### Visitor Accommodation, Retail, Dining and Entertainment

- 2.1.4. The Entertainment Resort Complex (ERC) allows for the development of visitor accommodation, retail, dining and entertainment in the Core Zone, Lake Zone and/or West Gateway Zone. These have the potential to generate noise, mostly from building services plant, e.g. heating, ventilation and cooling (HVAC) equipment not already served by the energy centre located within the utility compound.
- 2.1.5. With the exception of properties on Manor Road, as identified in **Image 2-1**, it is unlikely that visitor accommodation, retail, dining and entertainment operations will be located within 100m of an existing sensitive receptor. Manor Road will be subject to separate noise limits applicable to the operation of the Core Zone and to the operation of the nearby Utility Compound (see **Section 3**).
- 2.1.6. At the West Gateway Zone, the nearest properties are >200m from the Site boundary and are close to both the A421 and the nearby distribution centres at Commercial Park, which are currently, and will continue to be, the dominant sources of noise in this area for these noise sensitive receptors.
- 2.1.7. Therefore, based on professional judgment, it is considered that additional noise limits for visitor accommodation, retail, dining and entertainment operations are not necessary and thus noise from these sources may be scoped out of the assessment.
- 2.1.8. Hotels will, however, be treated as sensitive receptors and as such will be designed to achieve the guideline internal noise levels referenced in BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings*, unless the hotel operator has its own design code which includes internal noise limits for bedrooms.

### Recreational Sports Noise

- 2.1.9. The Entertainment Resort Complex allows for the development of a sports complex with indoor and/or outdoor playing fields within the Lake Zone. Although the exact nature of the sporting activities on offer has not yet been determined, it is assumed that these will include sports pitches. A sensitivity check was therefore undertaken by modelling noise from five full-size football pitches in use concurrently, using guidance provided in the Sport England Design Guidance Note Artificial Grass Pitches (AGP) Acoustics - Planning Implications, a document often used in the UK when determining the potential impact of noise from sports pitches.

- 2.1.10. In line with the Guidance Note, each pitch was modelled with a noise level of 58 dB  $L_{Aeq,1hr}$  generated at a distance of 10m from the centre line of the pitch. Subsequently, the minimum distance from the pitch was determined based on achieving a guideline noise level of 50 dB  $L_{Aeq,1hr}$  at the nearest sensitive receptor. This distance was determined to be approximately 80m from the nearest pitch.
- 2.1.11. Due to Site constraints, the possible location for a sports complex with indoor and/or outdoor playing fields is restricted to the area of the Lake Zone north of the Utility Compound area, as shown in **Image 2-1** below. The nearest dwellings to the area of the Site within which the sports complex can be located are those on Manor Road which are around 400m away from the closest possible location for the sports pitches. Noise from this source has, therefore, been discounted from the assessment.



**Image 2-1 - Parameter Plan - Utility Compound Plan**



## Operational Road and Rail Traffic Noise

- 2.1.12. Noise impacts arising from additional road traffic resulting from the operation of the Proposed Development, and from new connections, alterations and improvements to the existing road network have been assessed separately (see **Chapter 9: Noise and Vibration (Volume 1)** and **Appendix 9.3: Construction and Operational Road Traffic Noise Assessment (Volume 3)**).
- 2.1.13. Noise impacts arising from additional rail traffic resulting from the operation of the Proposed Development have been scoped out of the assessment. The ES assumes the following with regards to rail services, as set out in **Appendix 2.1: Environmental Statement Basis for Assessment:**

Rail Line and Station	Assumed services for the purposes of assessment
Midland Main Railway Line - Wixams Station	Serviced by between four and eight East Midlands Railway (EMR) and Thameslink trains currently operating on the line, which will in the future be able to stop at the new station.
Marston Vale Railway Line - East West Rail Station	If constructed, it is assumed that the station would be serviced by three trains per hour in each direction as per <i>The Network Rail (East West Rail) (Bicester to Bedford Improvements) Order 2020</i> .

- 2.1.14. The Proposed Development does not consent or require additional rail traffic on either of the local railway lines (on the basis that additional movements have been consented and assessed as required by the rail operators) and so noise levels generated by the lines will not be affected.

## Noise from Onsite Car Parks

- 2.1.15. Several car parks are to be provided for use by employees and visitors. These are likely to be a combination of surface and multi-storey and may be constructed within each of the four Zones associated with the Proposed Development. Noise levels generated by slow moving traffic ingressing and egressing car parks is relatively low due to the considerably slower speeds compared with new sections of highway. Because of this, car parks can often provide helpful buffers when located between more significant sources of noise and sensitive receptors.
- 2.1.16. Car parks located within each Zone of the Proposed Development are unlikely to generate noise levels at nearby sensitive receptors of sufficient magnitude that would result in an increase in ambient noise level above what has already been predicted in **Appendix 9.3: Construction and Operational Road Traffic Noise Assessment (Volume 3)**. One exception might be NSR06 (Broadmead Farm) which is located close to the southern boundary of the Core Zone and has relatively low existing ambient noise levels. However, the Core Zone noise limits applicable at this receptor would adequately control noise from any nearby car parks.
- 2.1.17. As such, noise from car parks has been scoped out of the assessment.

## Fireworks

- 2.1.18. No regular firework displays are proposed as part of the day-to-day operation of the Proposed Development. Use of fireworks will be subject to the requirements and restrictions of the *Fireworks Regulations 2004* as described in and controlled by the Design Standards (**Document Reference 6.3.0**).
- 2.1.19. Day-to-day pyrotechnic effects are expected to operate in very short bursts and not continuously but have been taken into consideration within the assessment.

2.1.20. As such, noise from fireworks has been scoped out of the assessment.

## 2.2. IDENTIFIED NOISE SOURCES

### Core Zone

2.2.1. Based on discussions with UDX, several sources have been identified as the most significant likely contributors to noise generated by the Core Zone:

- Outdoor rides such as roller coasters, which would include a combination of mechanical noise generated by the roller coaster travelling along the track and occasional patron noise i.e. screams, at certain sections of the ride;
- General Site noise from patrons, for example such as that associated with gatherings of people at outdoor events;
- 'Immersion zones' which may involve live shows, parades, entertainers, water, and special effects etc.;
- Noise from drone displays (which will only take place within airspace above UDX property) and non-firework pyrotechnics. Typically, small battery powered, and computer controlled drones are utilised which generate relatively low levels of high frequency noise; and
- Outdoor event stages hosting live shows, which may include amplified music with a low frequency (bass) component.

2.2.2. Noise limits applicable to the Core Zone are discussed in **Section 3**.

### 'Third Shift' Activities

2.2.3. Activities associated with the 'third shift' during the evening and night include:

- Routine maintenance within the Core Zone and safety critical repairs; and
- Testing of roller coasters without passengers.

2.2.4. Each roller coaster is sent on a daily test run without passengers prior to the opening of the park. The roller coaster test is likely to be the loudest individual noise source during third shift activities. The routine procedures for roller coasters during the third shift include the following:

- Pre-opening: Start-up cycling of roller coasters prior to patrons arriving - up to 3 hours in total;
- Post-close: Cycling guests out (i.e. clearing patrons from roller coasters prior to closing) and shutdown procedure - up to 2 hours in total; and
- Overnight: Track is typically locked out overnight with no vehicle movements on the track. Some vehicle motion can be required occasionally overnight for repairs, testing or maintenance.

2.2.5. Third shift activities fall within the definition of night-time operational noise sources and the noise limit applicable to the third shift is therefore the same as the night-time Core Zone noise limit, as discussed in **Section 3**. However, noise levels generated by third shift activities are anticipated to be significantly lower than those generated by other operational noise sources due to greatly reduced operations of outdoor attractions (e.g. testing and maintenance/repair only) and the omission of most other noise sources, including patrons, pyrotechnics, immersion zones, live shows, etc.

### Utility Compound

2.2.6. The Utility Compound will include buildings, structures and facilities comprising:

- An EHV power substation;

- Energy centre (less than 50MW in combination) that serve a defined district heating, cooling, and power network, comprising heat pumps (air, water, or ground geothermal), heat recovery, electric boilers, thermal storage, electric chillers, gas boilers (which might be required for one year following opening year);
- A water collection system and processing plant for the treatment and re-use of harvested non-potable water; and
- Utility metering equipment.

2.2.7. It is not yet determined whether or not a Battery Energy Storage Facility will be provided, however, the Utility Compound could include the development of:

- A Battery Energy Storage System (BESS) compound, including—
- Transformers, inverters and associated switchgear;
- Underground EHV, HV, and LV lines; and
- Plant and building structures.

2.2.8. The BESS has been considered within the noise assessment as a cautious worst-case scenario.

2.2.9. Noise limits applicable to the Utility Compound are discussed in **Section 3**.

### 3. ASSESSMENT METHODOLOGY AND CRITERIA

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- 3.1.1. It is appropriate to set noise limits against which the assessment can be undertaken, as the layouts for both the Core Zone and the Utility Compound will be defined during the detailed design process.
- 3.1.2. There are currently no recognised standards or assessment methodologies applicable specifically to operational noise generated by a Theme Park. The assessment criteria for the Core Zone noise have been derived considering typical noise levels generated at other UDX parks, evidence on acceptable noise limits drawing on UK British Standards and guidance documents and World Health Organisation publications and the anticipated change in noise level at receptors.
- 3.1.3. The assessment criteria for the Utility Compound have been derived considering typical noise levels generated at other UDX parks and the assessment framework detailed in British Standard BS4142:2014+A1:2019<sup>1</sup>. This Standard describes methods for rating and assessing sound of an industrial and/or commercial nature and is the most appropriate methodology for assessing noise from the Utility Compound.
- 3.1.4. Section 1.3 of BS4142:2014+A1:2019 states that the Standard is not intended to be applied to the rating and assessment of sound from, amongst others:
  - Recreational activities; and
  - Music and other entertainment.
- 3.1.5. For this reason, BS4142:2014+A1:2019 ('BS4142') has not been used to assess noise from the Core Zone.
- 3.1.6. It was determined that noise from the Utility Compound should be subject to different limits, set with reference to BS4142, than noise from the Core Zone for the following reasons:
  - The Utility Compound will operate in some capacity 24 hours a day, 7 days a week and as such has the potential to change the background noise conditions for receptors in the vicinity of the compound; and
  - Proposing a noise limit relative to the pre-development background sound level for this type of noise will result in careful control of Utility Compound noise at receptors in the vicinity.
- 3.1.7. The approach to each of the above is described in more detail below.

#### Noise Limits

##### Core Zone

- 3.1.8. The following noise limits for the operation of the Core Zone apply at the Receptor Control Locations (RCLs) as described in **Section 3.2**:
  - Daytime (from 07:00 to 23:00 hours):
    - 60 dB LAeq,1hour
    - 79 dB Leq,1hour at 63 Hz
    - 69 dB Leq,1hour at 125 Hz

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<sup>1</sup> BS 4142:2014+A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound

- Night-time (from 23:00 to 07:00 hours) - applicable to all RCLs with the exception of RCL04 (Wixams) and RCL05 (Stewartby):
  - 55 dBLAeq,15minutes
  - 74 dB Leq,15minutes at 63 Hz
  - 64 dB Leq,15minutes at 125 Hz
- Night-time (from 23:00 to 07:00 hours) - applicable to RCL04 (Wixams) and RCL05 (Stewartby) only:
  - 50 dBLAeq,15minutes
  - 70 dB Leq,15minutes at 63 Hz
  - 59 dB Leq,15minutes at 125 Hz

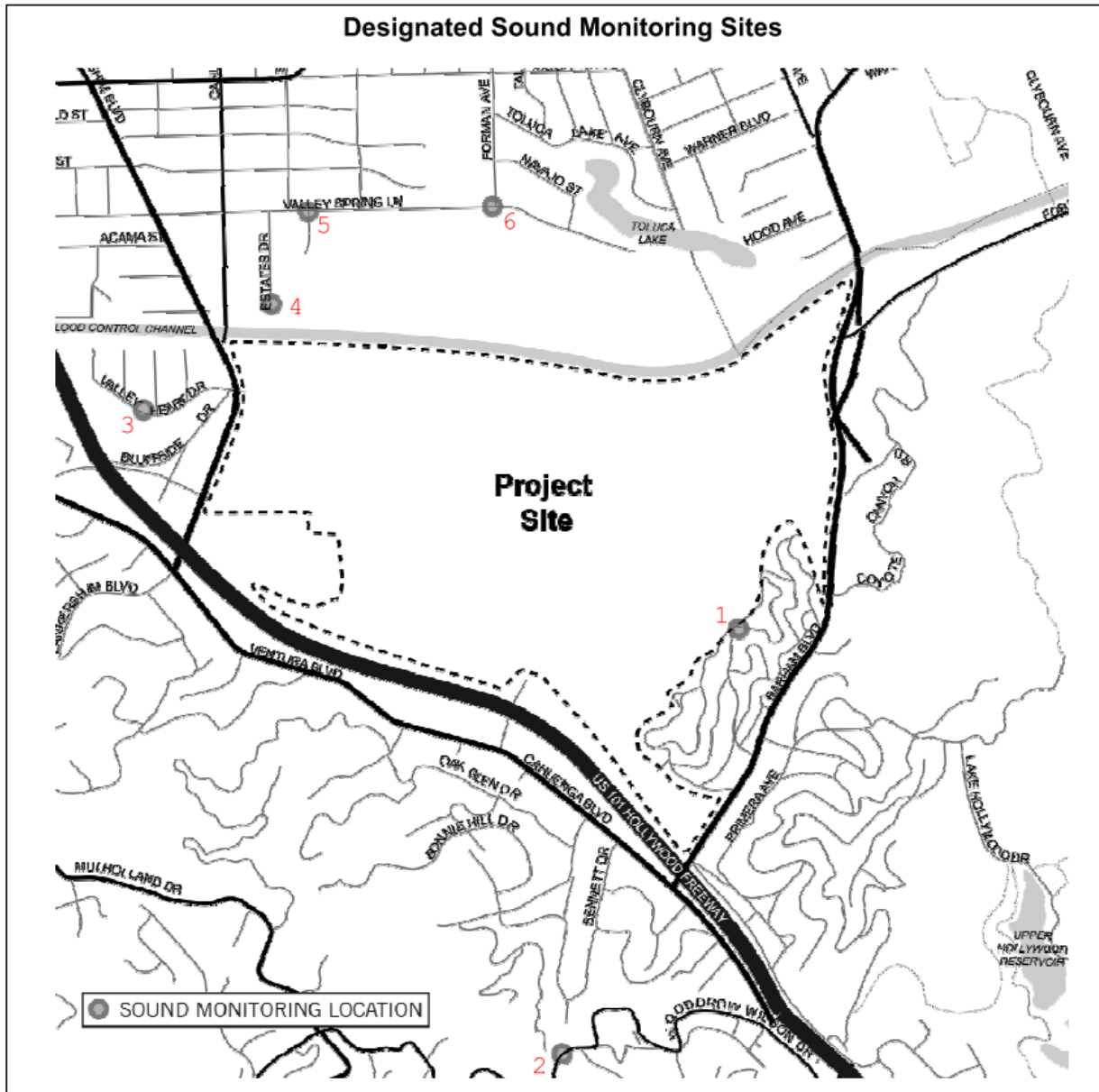
- 3.1.9. The A-weighted limits apply to all forms of noise associated with the Core Zone, including screams from riders of roller coasters. The frequency specific noise limits apply only to amplified music in the Core Zone area. Based on WSP's professional judgment regarding the noise to be generated by operations in the Core Zone, the low frequency noise limits are only required for outdoor amplified music within the Core Zone, as other activities will not generate noise levels at these frequencies that would be expected to be problematic.
- 3.1.10. The low frequency noise limits have been derived by reference to Noise Rating Curves<sup>2</sup> corresponding to the A-weighted noise limits for which consent is being sought. Therefore, the broadband noise limit is not exceeded due to contributions in the 63 Hz and 125 Hz frequency bands - i.e. the low frequency noise limits proposed do not compromise the broadband noise limits being achieved.
- 3.1.11. The reasons for adopting a lower night-time Core Zone noise limit at RCL04 and RCL05 are discussed in **Section 5**.
- 3.1.12. The A-weighted noise limits are similar to those established for other UDX parks, namely:
- Universal Epic Universe: 60 dBA daytime and 55 dBA night-time; and
  - Universal Studios Japan: daytime ranges from 60 dBA to 65 dBA and 55 dBA night.
- 3.1.13. The noise limits are also verified as suitable based on noise monitoring data that has been provided for the Universal Studios Hollywood park as set out below.
- 3.1.14. Some UDX parks are exempt from noise standards. In these cases, UDX self-regulates noise to mitigate impacts to adjacent residential communities. In its experience, noise levels consistent with those proposed for the Core Zone are sufficient to achieve such mitigation.

#### **Noise monitoring at Universal Studios Hollywood**

- 3.1.15. Noise monitoring was undertaken at several locations within the community adjacent to UDX's Entertainment Resort Complex at Universal Studios Hollywood over a 24-hour period commencing Friday 23 August 2024. The locations are identified in **Image 3-1** below:

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<sup>2</sup> Noise Rating (NR) Curve – a range of octave band curves often used to represent the acceptability of indoor acoustic environments with weightings provided to reflect the sensitivity of the ear to different frequencies of sound.



**Image 3-1 - Monitoring Locations at Universal Studios Hollywood**

- 3.1.16. The results from the noise monitoring at the two locations closest to the Universal Studios Hollywood site boundary (namely Location 1, approximately 140m from the site boundary and Location 4, approximately 110m from the site boundary) are presented graphically in **ANNEX A** of this Appendix.
- 3.1.17. These results indicate the measured daytime  $L_{Aeq,1hr}$  noise levels were below the 60 dB  $L_{Aeq,1hr}$  daytime Core Zone noise limit for the majority of the measurement period, and the night-time  $L_{Aeq,1hr}$  noise levels were below the 55 dB  $L_{Aeq,15min}$  night-time Core Zone noise limit (assuming the  $L_{Aeq,1hr}$  equates to the  $L_{Aeq,15min}$  during the night). Furthermore, the measurement data indicates the 50  $L_{Aeq,15min}$  night-time limit for which consent is being sought at RCL04 and RCL05 would also be met for the majority of the night-time period.



- 3.1.18. Monitoring data at both locations includes contributions from sources other than those within the Universal Studios Hollywood Entertainment Resort Complex and nevertheless demonstrate that the noise limits for which consent is being sought are achievable at locations in the community close to the site boundary.

### Standards and Guidance

- 3.1.19. The following British Standards and guidance documents have been used to inform the assessment criteria:
- British Standard 8233:2014 Guidance on sound insulation and noise reduction for buildings (BS8233);
  - World Health Organisation's Guidelines for community noise;
  - World Health Organisation's Night Noise Guidelines;
  - World Health Organisation's Noise Guidelines for the European Union (known as the "2018 Guidelines"); and
  - IEMA Guidelines for Environmental Noise Impact Assessments.
- 3.1.20. The existing ambient noise levels in the area are of relevance in understanding the potential change in noise levels resulting from the operation of the Core Zone. These existing noise levels have been quantified through either baseline noise surveys, as detailed in **Appendix 9.1: Baseline Noise Survey Details (Volume 3)** or by referencing the Round 4 Defra Noise Maps shown in **Figure 9.2: DEFRA Road and Rail Noise Mapping - Daytime Ambient Noise Level (Volume 2)** and **Figure 9.3: DEFRA Road and Rail Noise Mapping - Nighttime Ambient Noise Level (Volume 2)**.
- 3.1.21. The Defra noise maps include road traffic and rail noise levels which are presented in separate maps; there is currently no facility available to present noise levels from a combination of both road and rail. An approximate ambient noise level has, therefore, been derived by logarithmically adding the road and rail noise levels at the RCLs. The methods for deriving the existing ambient noise levels at each of the RCLs are shown in **Section 5**.
- 3.1.22. There is no useable and published guidance on noise from theme parks. Therefore, when deriving the Core Zone assessment criteria, consideration has been given to other published guidance, and this has been applied using professional judgement.
- 3.1.23. The bringing together of absolute noise levels and the change in noise levels to derive the assessment criteria is described below.

### Determination of Magnitude of Impact

- 3.1.24. BS 8233 contains information on acceptable conditions for residential development and these broadly align with other, similar documents. BS 8233 states for noise levels in external amenity areas "For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB  $L_{Aeq,T}$ , with an upper guideline value of 55 dB  $L_{Aeq,T}$  which would be acceptable in noisier environments". The acceptability of an external daytime noise level of 55 dB  $L_{Aeq,T}$  has informed the boundary of significant and not significant effects. This is for the following reasons:
- BS 8233 states the following in relation to how a partially open window impacts the sound insulation of a façade: "If partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB"; and

- Research findings reported in NANR116: Open Closed Windows Research document produced by Napier University on behalf of DEFRA also support this reduction in noise levels from outside to inside with a partially open window.
- 3.1.25. Therefore, with an external noise level of 55 dB  $L_{Aeq,T}$  and a partially open window, the indoor noise levels would be 40 dB  $L_{Aeq,1hr}$  during the daytime and 35 dB  $L_{Aeq,15mins}$  at night; the night-time level is 5 dB below the daytime, based on the noise limits for which consent is being sought. BS 8233 also states "Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels (35 dB daytime and 30 dB night) may be relaxed by up to 5 dB and reasonable internal conditions still achieved." The 5 dB relaxation of internal target noise levels therefore aligns with external noise levels of 55 dB  $L_{Aeq,T}$  during the daytime and 50 dB  $L_{Aeq,T}$  at night and it is reasonable to define these levels as the point at which significant effects arise at the RCLs.
- 3.1.26. Night-time noise health effects are referenced in the WHO Night Noise Guidelines (NNG) in terms of the  $L_{night}$  metric which aligns with the  $L_{Aeq,8hour}$  metric used in the UK planning system. Note, as with BS 8233, that the NNG relate to anonymous noise sources (i.e. those without specific character).
- 3.1.27. The NNG presents the following summaries which have influenced the assessment criteria:
  - As reported in Table 5.4 of the NNGs, an average night-time external noise level of above 55 dB  $L_{night}$  is considered increasingly dangerous for public health. Adverse health effects are reported, and the population can be highly annoyed and sleep disturbed. Health effects at noise levels of 40 to 55 dB are also observed and many people adapt their lives to cope with noise at night, through measures such as closing windows to reduce noise.
- 3.1.28. There are various documents that describe magnitudes of impact in relation to the change in noise level, including the IEMA Environmental Noise Impact Assessment Guidelines. The IEMA Guidelines provide short-term and long-term impacts from the change in sound levels, the principle being that over time people become habituated (i.e. more accepting) of noise. To present a robust assessment, the short-term change criteria have been incorporated into the assessment criteria.
- 3.1.29. It is recognised that the noise levels in BS 8233 and other similar documents relate to anonymous noise sources - i.e. those without a specific character (not irregular, tonal or containing strong low-frequency content). Many of the noise sources included in the Core Zone are not anonymous, therefore, controlling the noise limits through use of the time period over which they apply has been included. The daytime noise limits are set over one-hour periods and the night-time in 15-minute periods. As such, within each hour during the day and 15 minutes at night, the noise limits will apply. Using the time period as a method of controlling the Core Zone noise is appropriate, given that the Core Zone includes sources which are not anonymous.
- 3.1.30. The magnitude of impact of daytime and night-time noise criteria from the operations associated with the Core Zone are defined in **Table 3-1** and **Table 3-2** respectively.



**Table 3-1 - Core Zone Noise Magnitude of Impact Criteria - Daytime**

Impact Magnitude	Broadband Noise <sup>(1)</sup>		Low Frequency Noise <sup>(3)</sup>	
	Core Zone Noise Level, dB L <sub>Aeq,1hr</sub>	Increase in Ambient Noise Level, dB L <sub>Aeq,T</sub> <sup>(2)</sup>	63 Hz dB L <sub>eq,1hr</sub>	125 Hz dB L <sub>eq,1hr</sub>
High	≥ 60	≥ 5	≥ 79	≥ 69
Medium	≥ 55 and < 60	≥ 3 and < 5	≥ 74 and < 79	≥ 64 and < 69
Low	≥ 50 and < 55	≥ 1 and < 3	≥ 70 and < 74	≥ 59 and < 64
Very Low	< 50	≥ 0 and < 1	< 70	< 59

Notes

(1) The interaction of Core Zone noise level and the increase in ambient noise level is addressed in the Matrix of Significance of Effect tables.

(2) Scales informed by IEMA, Design Manual for Roads and Bridges (DMRB) LA111: Noise and Vibration and from specific developments such as High Speed 2.

(3) Applies only to amplified music within the Core Zone.

**Table 3-2 - Core Zone Noise Magnitude of Impact Criteria - Night-time**

Impact Magnitude	Broadband Noise <sup>(1)</sup>		Low Frequency Noise <sup>(3)</sup>	
	Core Zone Noise Level, dB L <sub>Aeq,15min</sub>	Increase in Ambient Noise Level, dB L <sub>Aeq,T</sub> <sup>(2)</sup>	63 Hz dB L <sub>eq,15min</sub>	125 Hz dB L <sub>eq,15min</sub>
High	≥ 55	≥ 5	≥ 74	≥ 64
Medium	≥ 50 and < 55	≥ 3 and < 5	≥ 70 and < 74	≥ 59 and < 64
Low	≥ 45 and < 50	≥ 1 and < 3	≥ 65 and < 70	≥ 54 and < 59
Very Low	< 45	≥ 0 and < 1	< 65	< 54

Notes

(1) The interaction of Core Zone noise level and the increase in ambient noise level is addressed in the Matrix of Significance of Effect tables.

(2) Scales informed by IEMA, Design Manual for Roads and Bridges (DMRB) LA111: Noise and Vibration and from specific developments such as High Speed 2.

(3) Applies only to amplified music within the Core Zone.

- 3.1.31. The significance of effect criteria have been derived through the use of matrices that combine the magnitude of impact relating to the absolute noise level from the Core Zone and the impact relating to the change in existing ambient noise level at the RCL. The matrices are presented in **Table 3-3** for the daytime and **Table 3-4** for the night-time.
- 3.1.32. As set out in **Chapter 3: Approach to EIA (Volume 1)** effects described as moderate or major (positive or adverse) are deemed to be significant. Effects that are minor (positive or adverse), or negligible, are considered not significant. .

**Table 3-3 - Core Zone Noise Matrix of Significance of Effect - Daytime**

Increase in Ambient Noise Level, dB $L_{Aeq,T}$	Core Zone Noise Level, dB $L_{Aeq,1hr}^{(1),(2)}$			
	$\geq 60$ (high impact)	$\geq 55$ and $< 60$ (medium impact)	$\geq 50$ and $< 55$ (low impact)	$< 50$ (negligible impact)
$\geq 5$ (high impact)	Major	Major/Moderate	Moderate/Minor	Negligible
$\geq 3$ and $< 5$ (medium impact)	Major/Moderate	Moderate	Moderate/Minor	Negligible
$\geq 1$ and $< 3$ (low impact)	Moderate	Moderate/Minor	Minor	Negligible
$\geq 0$ and $< 1$ (negligible impact)	Moderate/Minor	Moderate/Minor	Minor/Negligible	Negligible
<p>Notes</p> <p>The above matrix is based on the assumption that all receptors have high sensitivity to noise.</p> <p>(1) Low frequency noise is excluded from the matrix above, with the approach taken in determination of the significance of effect described below.</p>				

**Table 3-4 - Core Zone Noise Matrix of Significance of Effect - Night-time**

Increase in Ambient Noise Level, dB $L_{Aeq,T}$	Core Zone Noise Level, dB $L_{Aeq,15min}$			
	$\geq 55$ (high impact)	$\geq 50$ and $< 55$ (medium impact)	$\geq 45$ and $< 50$ (low impact)	$< 45$ (negligible impact)
$\geq 5$ (high impact)	Major	Major/Moderate	Moderate/Minor	Negligible
$\geq 3$ and $< 5$ (medium impact)	Major/Moderate	Moderate	Moderate/Minor	Negligible
$\geq 1$ and $< 3$ (low impact)	Moderate	Moderate/Minor	Minor	Negligible
$\geq 0$ and $< 1$ (negligible impact)	Moderate/Minor	Moderate/Minor	Minor/Negligible	Negligible
<p>Notes</p> <p>The above matrix is based on the assumption that all receptors have high sensitivity to noise.</p> <p>(1) Low frequency noise is excluded from the matrix above, with the approach taken in determination of the significance of effect described below.</p>				

- 3.1.33. This approach recognises that in areas exposed to existing noise levels which are close to the Core Zone noise limits, the increases to the ambient noise level will be lower than for areas where existing noise levels are already low. The determination of the significance of effect therefore considers the change in noise level likely to be experienced at the RCL as a result of the introduction of Core Zone noise. This determination is referred to as the 'Stage 1 significance determination'.
- 3.1.34. A second round of determination of significance of effect considers factors other than noise alone which may affect the assessment outcome. This is referred to as the 'Stage 2 significance determination'. These other factors taken into consideration at Stage 2 may include:
- Whether the receptors in the area have a direct line of sight to the Core Zone or if their line of sight is obscured due to topography, other buildings between the Core Zone and the RCL etc.;
  - Consideration of whether the receptors in the area are likely to have habitable rooms (bedrooms, living rooms and dining rooms) facing the site or less sensitive rooms/areas (bathrooms, hallways etc) or no windows in the façade facing the Core Zone;
  - If they are in, or close to, an area identified as a Noise Important Area (NIA); and
  - Distance between the Core Zone and RCLs. The compliance with noise limits at the closer RCLs to the Core Zone are likely to result in the noise levels at the RCLs farther from the site being lower than the limits for which consent is being sought.
- 3.1.35. Professional judgment has then been used to determine whether the application of any of the above factors alter the outcome of the Stage 1 determination of significance of effect. The residual effect for each receptor is a result of the Stage 2 significance determination.
- 3.1.36. Again, as set out above, noise impacts that are determined to be moderate or major following the Stage 2 significance determination are considered to be **Significant** with impacts that are minor or negligible considered to be **Not Significant**.

#### Utility Compound Noise Limits

- 3.1.37. The following noise limits for the normal operation of the Utility Compound are proposed at the location of the nearest sensitive receptors, namely dwellings on Manor Road as represented by RCL01:
- Noise associated with the operation of the Utility Compound, when assessed in accordance with BS4142:2014+A1:2019, will not exceed the following rating levels:
    - 56 dB L<sub>Ar,Tr</sub> during the day and 47 dB L<sub>Ar,Tr</sub> at night.
- 3.1.38. This is based on the measured noise levels at location MP2b (dwellings on Manor Road) reported in **Appendix 9.1: Baseline Noise Survey Details (Volume 3)** and is equivalent to a rating level of +10 dB above the representative background sound levels.
- 3.1.39. If the Utility Compound is to be located on the western side of Public Road B, Segment 1, the receptor at NSR13, as identified in **Image 3-2**, may experience higher noise levels than RCL01. If this is the case, the limits would apply at both RCL01 and NSR13.

- 3.1.40. It is considered appropriate to base this limit on the background sound levels determined at properties on Manor Road for the following reasons:
- The measured background sound levels were derived from a relatively long measurement period (~12 days) and included measurements during periods when easterly winds were experienced (i.e. upwind from the dominant A421 noise source) in addition to periods where prevailing westerly winds were experienced (i.e. downwind of the A421), thereby accounting for both positive and negative wind vectors; and
  - This location is relatively distant from the A421, the dominant transport noise source in the area, and therefore the underlying background sound level is less influenced by this source resulting in lower background sound levels compared with sources closer to the road and, therefore, robust noise limits.
- 3.1.41. The BS4142:2014+A1:2019 assessment methodology is described below.
- British Standard 4142 Assessment Methodology**
- 3.1.42. BS 4142:2014+A1:2019 *Methods for Rating and Assessing Industrial and Commercial Sound* provides an assessment method for noise arising from commercial noise sources, including external plant, on-site vehicle movements and unloading, at residential receptors.
- 3.1.43. It is a relative assessment approach whereby the predicted commercial sound level (suitably penalised for potentially annoying characteristics if appropriate) is compared with the prevailing background noise level. A summary of the BS 4142 approach is set out below:
- establish the specific sound level for the source(s);
  - measure the representative background sound level;
  - correct the specific sound level for on-time and any noise contributions from unrelated sources if necessary;
  - rate the specific sound level to account for distinguishing characteristics;
  - estimate the impact by subtracting the background sound level from the rating level; and
  - consider the initial impact estimation in the context of the noise and its environs.
- 3.1.44. Where the sound source is not yet present, the specific sound level is established by calculation. The representative background sound level is established by measurement at the receptor location.
- The specific sound level is rated using the penalties below:
 

▪ Tonality	up to 6 dB
▪ Impulsivity	up to 9 dB
▪ Other sound characteristics	up to 3 dB
▪ Intermittency	3 dB
- 3.1.45. An initial estimate of the impact of the specific sound is obtained by subtracting the measured background sound level from the rating level as described in section 11 of BS 4142:2014+A1:2019. The results of this comparison are assessed on the basis of the following guidance:
- Typically, the greater the difference, the greater the magnitude of impact;
  - A difference of around + 10 dB or more is likely to be an indication of a significant adverse impact; depending on the context;

- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound sources 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 the context.

3.1.46. All pertinent contextual considerations should be taken into account including the following:

- The absolute level of the sound;
- The character and level of the residual sound compared to the character and level of the specific sound; and
- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

### Magnitude of Impact and Significance Criteria

3.1.47. The magnitude of impact of noise from the Utility Compound is defined in **Table 3-5** below:

**Table 3-5 - Utility Compound Noise Magnitude of Impact Criteria**

Impact Magnitude	Increase of Rating Level over Representative Background Sound Level, dB <sup>(1), (2)</sup>
High	≥ +10
Medium	≥ +5 and < +10
Low	≥ 0 and < +5
Very Low	< 0
<b>Notes</b> <p>(1) The above criteria apply equally to the daytime or night-time condition, i.e. daytime rating level, dB <math>L_{Ar,Tr}</math>, when compared with the daytime representative background sound level, dB <math>L_{A90,T}</math>; or the night-time rating level, dB <math>L_{Ar,Tr}</math>, when compared with the night-time representative background sound level, dB <math>L_{A90,T}</math>.</p> <p>(2) The representative daytime and night-time background sound levels are derived using the <math>L_{A90,15min}</math> metric and following the procedure described in BS4142:2014+A1:2019</p>	

3.1.48. The matrix of significance of effect is provided in **Table 3-6**, below:

**Table 3-6 - Utility Compound Noise Significance of Effect**

Impact Magnitude	Level of Significance, Relative to Sensitivity of Receptor		
	Low	Medium	High
High	Moderate	Moderate/Major	Major
Medium	Minor	Moderate	Moderate
Low	Negligible	Minor	Minor
Very Low	Negligible	Negligible	Negligible

3.1.49. All receptors are assumed to have a high sensitivity to noise from the Utility Compound. For the purposes of this assessment, noise impacts that are determined to be moderate or major are considered to be **Significant** with impacts that are minor or negligible considered to be **Not Significant**.

## 3.2. RECEPTOR CONTROL LOCATIONS

- 3.2.1. In order to determine compliance with the Core Zone noise limits set out in **Section 3**, a series of Receptor Control Locations (RCLs) is proposed. These are locations beyond the Site boundary that represent the nearest residential communities to the Proposed Development.
- 3.2.2. The purpose of the RCLs is two-fold: firstly, they will act as verification points for future noise modelling that will be implemented and developed as the detailed design of the theme park progresses. Secondly, the RCLs are publicly accessible and therefore may be used as future noise monitoring locations in order to confirm compliance with the Core Zone noise limits (see **Section 5.3**).
- 3.2.3. The locations of the proposed Receptor Control Locations are described in **Table 3-7** and identified in **Figure 9.8: Receptor Control Locations (Volume 2)**. For ease of reference, these are also identified in **Image 3-2** below.

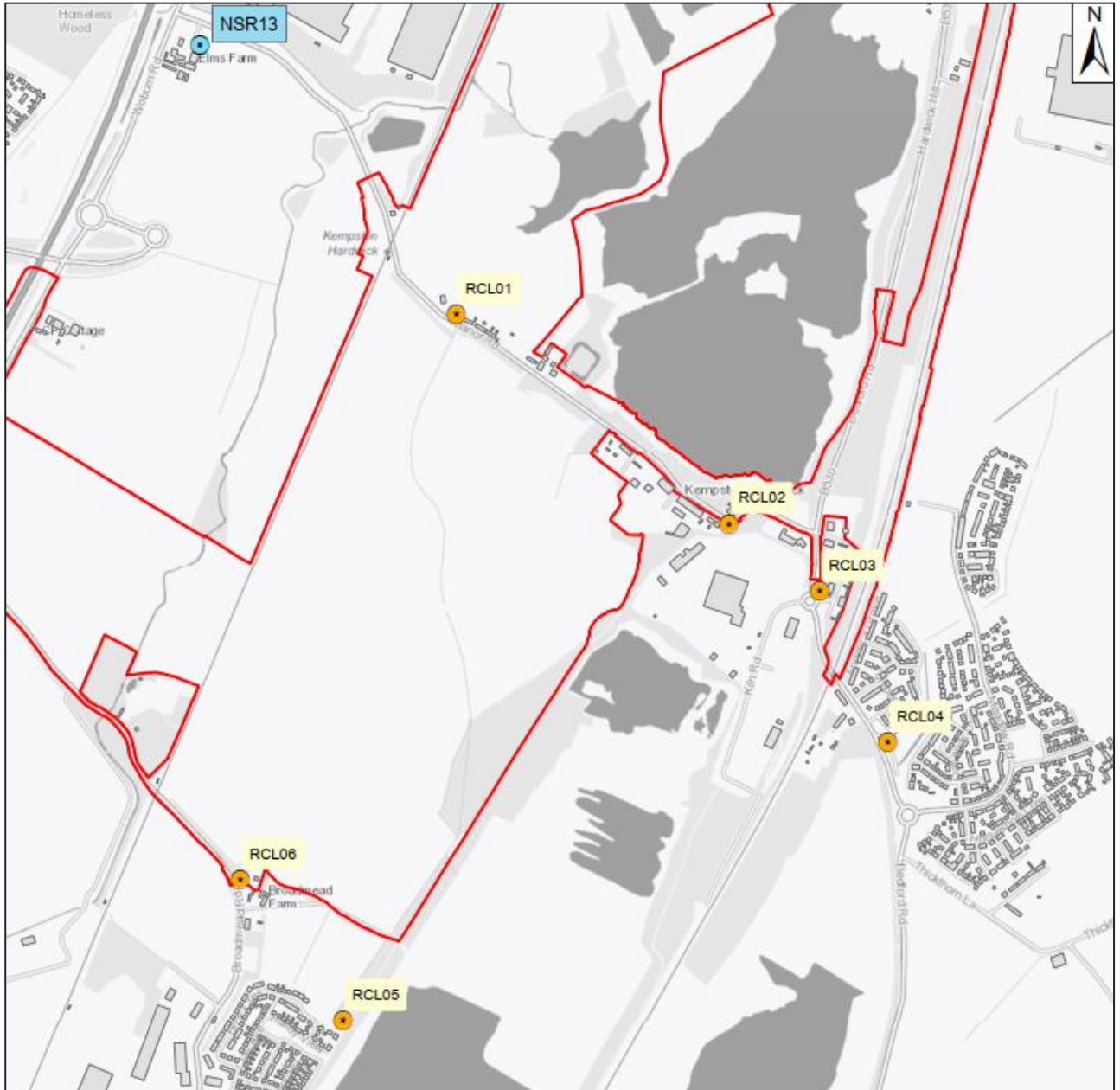
**Table 3-7 - Receptor Control Locations (RCLs)**

RCL Ref.	Description	Approximate Distance from Core Zone <sup>(1)</sup>	Coordinates, British National Grid	
			X (m)	Y (m)
RCL01	Manor Road. Represents the residential properties located along the western stretch and on the northern side of Manor Road.	100m	502752	244667
RCL02	Manor Road, west of B530. Represents the dwellings located along the eastern stretch and to the south of Manor Road.	200m	503445	244228
RCL03	Amphill Road, north. Represents the travellers' site located between the Midland Main Line railway and the B530 Amphill Road.	450m	503607	244024
RCL04	Amphill Road, south. Represents the Wixams community to the immediate northeast of B530 Amphill Road, east of the Midland Main Line railway. <sup>(2)</sup>	780m	503765	243673
RCL05	Brick Crescent, Stewartby. Represents the community of north Stewartby located to the east of Broadmead Road	250m	502493	243019
RCL06	Broadmead Farm, Stewartby. Represents the residential dwelling at Broadmead Farm to the east of Broadmead Road.	50m	502252	243350

**Notes**

- (1) This is the approximate distance to the closest boundary of the Core Zone
- (2) Sensitivity checks were undertaken to determine if additional RCLs would be needed to represent dwellings located farther east from this position. However, checks on topography and intervening structures indicated that the RCL at this location would be appropriate to represent where the likely highest Core Zone noise level could be anticipated and that dwellings farther east of RCL04 would be subject to lower noise levels. Therefore, additional RCLs in the Wixams area were not considered necessary.





**Image 3-2 - Receptor Control Locations**

- 3.2.4. Note that in **Image 3-2**, NSR13 is identified with reference to Utility Compound noise limits only.

#### **Community at Wooton**

- 3.2.5. Consideration was given to including an RCL to represent the Wooton community to the west of the Proposed Development. However, given the large distance from the nearest sensitive receptors to the Core Zone and the presence of the A421, the dominant source of ambient noise, between Wooton and the Core Zone it was concluded that noise from the Core Zone is unlikely to result in an adverse effect and noise limits would not be applicable

#### **Residential Status of Properties represented by RCLs**

- 3.2.6. The Core Zone noise limits would only apply to an RCL for as long as any of the properties associated with that RCL remain in residential use.



## 4. NOISE PROPAGATION MODELLING

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### 4.1. PURPOSE OF NOISE PROPAGATION MODEL

- 4.1.1. A 3D noise model of the Site and the surrounding area has been produced using the CadnaA noise prediction software, which implements the ISO 9613-2 calculation methodology to determine how noise may propagate to and within the nearest communities, taking account of geometric spreading, topography, screening and meteorological conditions, to assist in determining the extent of significant effects. The noise model did not include any Core Zone layout considerations. It is acknowledged that noise calculation methodologies other than ISO 9613-2 may also be appropriate in predicting noise levels from the Core Zone.
- 4.1.2. Detailed noise modelling of the Proposed Development was not undertaken as the layout has not been finalised and any model developed around a generic and non-specific theme park layout would be inherently misleading and inaccurate. A noise model will, however, be developed as the design progresses and will be used as a verification tool when demonstrating compliance with the Core Zone noise limits (see **Section 5.3**).
- 4.1.3. The noise model was also utilised to test potential layout options for the Utility Compound. As there is no detailed information available at this stage on the likely noise sources, a list of generic plant items was compiled based on similar sized energy centres and substations of which WSP have had previous assessment experience.
- 4.1.4. Assumptions tables, providing details of modelling assumptions, input data and output data that were utilised in subsequent assessment is provided in **Annex B** of this Appendix.

### MODEL SETTINGS

- 4.1.5. Details of the settings used in the noise propagation model are summarised as follows:
- Default ground absorption:  $G=0.5$  (representing mixed ground);
  - One order of reflection (buildings are reflective);
  - ISO 9613-2 propagation model;
  - Topography data are included in the model;
  - Off-Site receptor locations derived from satellite imagery;
  - Existing building outlines have been incorporated into the noise model based on the OS MasterMap buildings layer. Smaller buildings with an area of less than 30m<sup>2</sup> have been assigned a height of 4m, all other buildings have been assigned a height of 8m, although a limited number of adjustments to heights have been made using web-based street-view and aerial photography;
  - RCLs have been assigned a height of 1.5m;
  - Predicted sound levels are free-field levels at the receptor façades; and
  - Sound power level data for the Core Zone noise source derived from discussions with UDX and noise measurements at similar existing theme parks operated by UDX (as discussed below).
- 4.1.6. Potential mitigation measures that may be employed in order to achieve the Core Zone noise limits are discussed in **Section 5.2**.

## NOISE SOURCES

### Core Zone

- 4.1.7. The source noise levels incorporated into the Core Zone noise propagation model are provided in **Table 4-1** below. As noted above, the purpose of including the noise sources is to understand how the noise propagates into the communities and not to predict noise levels.

**Table 4-1 - Core Zone Source Noise Levels Incorporated into the Propagation Test Model**

Description	Octave Band Sound Power Level, dB								dB L <sub>WA</sub>
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Roller coaster - mechanical noise <sup>(1)</sup>	115	109	120	112	103	98	97	94	114
Roller coaster - patron noise <sup>(1)</sup>	110	104	115	107	122	121	115	96	126

(1) Sound power level determined from measured L<sub>max</sub> sound pressure level. Data provided by UDX for existing theme park roller coaster

- 4.1.8. The above sources were utilised for the purposes of testing sound propagation to both nearby and wider communities for the following reasons:
- Roller coaster noise at an existing UDX theme park was measured and assessed at multiple locations providing an accurate representation of how noise is generated by this type of source that is specific to the development;
  - Nearly 60 source points are incorporated into the roller coaster noise model, representing each zone or stage of the ride where noise is generated. The multiple heights of source points in the model provides what is considered a worst-case scenario for how and where noise is generated and was considered to be the most appropriate way to determine how noise would propagate from the Development;
  - On-time corrections were applied to each noise source point to account for the speed of the roller coaster, the duration of a single ride and the number of rides per hour in order to derive the resultant L<sub>Aeq</sub> level;
  - The sound power levels for both screams and mechanical noise associated with the roller coaster were derived from measured octave band L<sub>max</sub> sound pressure levels which may slightly over-estimate the L<sub>Aeq</sub> level (on which noise limits are based) but provides a robust and cautious worst-case assessment; and
  - Each collection of noise source points was duplicated, rotated and transposed to various notional locations around the Site boundary and within the closest developable area to the Core Zone boundary, as identified within the Maximum Height Strategy shown in **Image 2-1**, such that the Core Zone noise limits were not exceeded at any RCL. This subsequently allowed community noise levels to be estimated and compared with existing ambient noise levels.

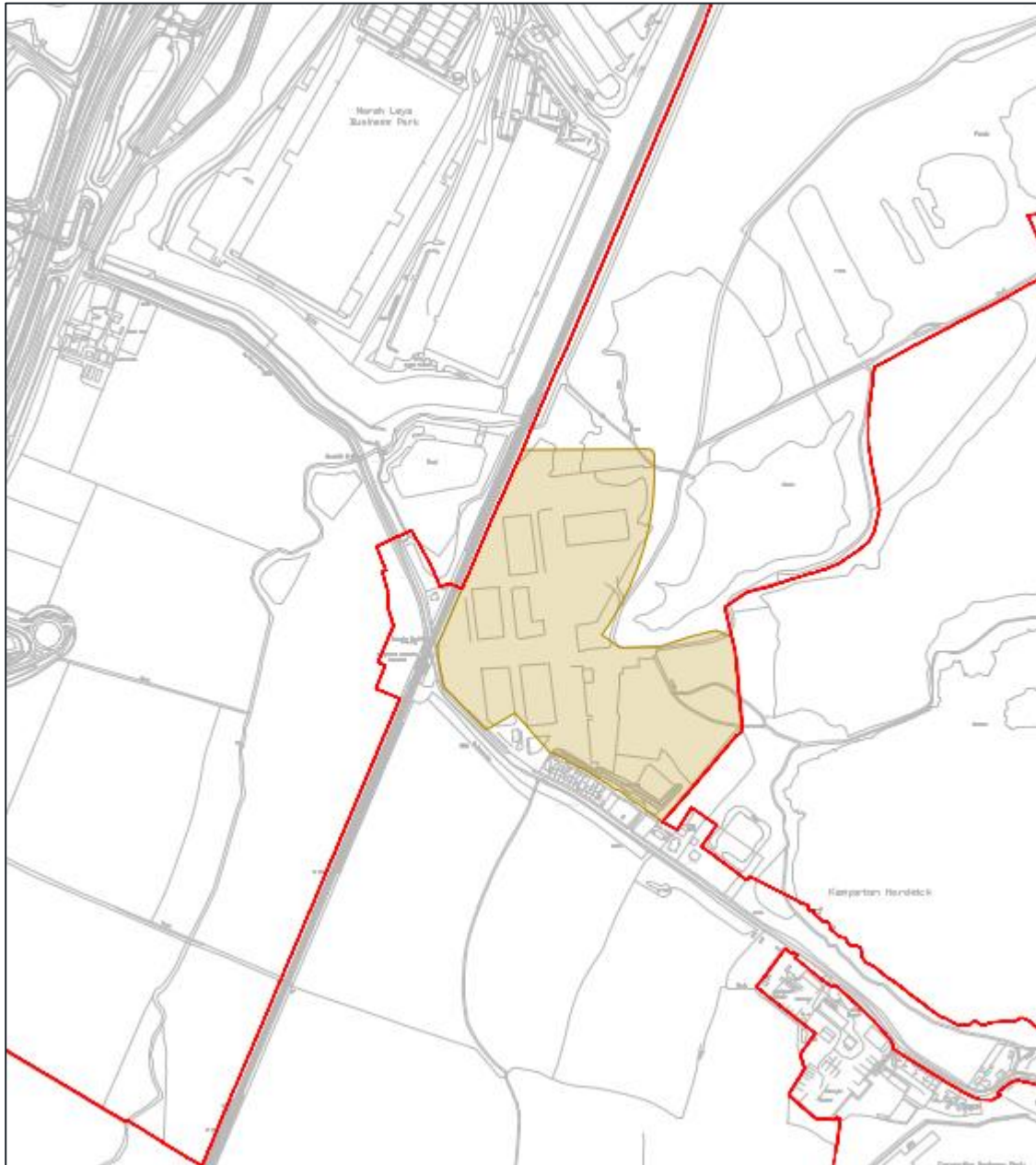
### Utility Compound

- 4.1.9. The source noise levels incorporated into the Utility Compound propagation model are provided in **Table 4-2**, below:

**Table 4-2 - Utility Compound Source Noise Levels Incorporated into the Propagation Test Model**

Description	Location	Assumed Sound Power Level, dBA	No. of Items
ASHP heat collector	Energy centre, roof level	83	88
Air cooled chiller	Energy centre, ground level	96	18
Ventilation louvres	Energy centre, building facade	(1)	Full width of energy centre (100m) x 5m high
40MVA transformer	Substation	91	3
BESS Megapack	BESS	77	10
Supergrid transformer	BESS	81	1
<b>Notes</b> (1) Ventilation louvres assumed to be ducted from plant rooms within energy centre with attenuators achieving 25dB insertion loss overall. Reverberant sound pressure level in plant rooms assumed to be 85dBA.			

- 4.1.10. It has been assumed that pumps associated with the water collection system and processing plant will be located within a pump house building and so do not contribute significantly to the noise climate.
- 4.1.11. The approximate location of the Utility Compound is shown in **Image 4-1**. Whilst the locations and orientations of each principal element of the compound have not yet been determined (and will be formalised as the design progresses), for the purposes of this exercise locations were adjusted as necessary to achieve the noise limits stated in **Section 3**. The actual locations of each element of the Utility Compound have yet to be determined and will likely vary as the design progresses.



**Image 4-1 - Parameter Plan - Utility Compound Plan**

## 5. NOISE IMPACT ASSESSMENT

### 5.1. CORE ZONE NOISE

- 5.1.1. The Core Zone Noise Limits identified in **Section 3** apply to all noise sources operating within the Core Zone, under all conditions. **Appendix 2.1: Environmental Statement Basis of Assessment (Volume 3)** sets out the detail on hours that the Theme Park ticketed area is open to the public as follows:

Relevant Operations	Hours
Normal hours Theme Park ticketed area is open to the public	07:00 - 23:00
Halloween Horror Nights (or other seasonal event)	Open until 02:00 up to 60 days/year
Holidays	Open up to 01:00 up to 5 days/year
Special Events (including private events)	Open up to 01:00 up to 30 times/year
Outdoor amplified music	Up to 23:00, except that during the Halloween Horror Nights, Holidays, and Special Events referenced above, such music may extend up to 00:30

- 5.1.2. During Normal Hours, the specialist additional offerings associated with Halloween Horror Nights, Holidays and Special events will be absent. As a result, the noise levels generated during normal operation of the theme park will be lower than the Core Zone Noise Limits for which consent is being sought, particularly at night.
- 5.1.3. For all RCLs the night-time Core Zone noise limits are set lower than the daytime Core Zone noise limit. For all RCLs except RCL04 (Wixams) and RCL05 (Stewartby), the night-time Core Zone noise limit is set at 5 dB lower than the daytime Core Zone limit. For RCL04 and RCL05, the night-time Core Zone noise limit was further reduced and set at 10 dB lower than the daytime Core Zone noise limit. A lower noise limit has been set at RCL04 and RCL05 in consideration of:
- The relatively large sizes of the communities at RCL04 (Wixams) and RCL05 (Stewartby), as opposed to isolated dwellings;
  - The proximity of RCL05 to the Core Zone boundary;
  - The fact that the night-time ambient noise at Wixams is driven in part by rail traffic, which is intermittent and irregular at night resulting in quieter periods during lulls in rail traffic; and
  - The relatively low night-time ambient noise levels at Stewartby due to the distance from major transportation noise sources.
- 5.1.4. The application of a stricter night-time noise limit at RCL04 and RCL05 will therefore result in a reduced noise impact in the community, with fewer properties significantly affected.

- 5.1.5. Assessments have been undertaken of daytime and night-time noise impacts at the nearest RCLs resulting from the operation of the Core Zone at its anticipated maximum allowable noise level, (the Core Zone noise limits) which for this assessment is defined as occurring during the Halloween Horror Night, Holidays and Special Events. The noise levels experienced at RCLs located farther from the Core Zone boundary are unlikely to be as high as the Core Zone limits. Whilst the noise limits for which consent is being sought are the same for all RCLs (with the exception of RCL04 and RCL05, as described above), it is appropriate to also present a more likely and realistic assessment for these more distant RCLs. The assessment provides an approximate outcome based only on the noise propagation model results and not on a final theme park layout. The model results for the more distant RCLs are referred to as the 'typical' noise levels. Since the closer RCLs, which for this assessment are RCL01 (Manor Road), RCL05 and RCL06 (north of Stewartby), are the controlling receptors, the typical noise levels here equate to the Core Zone Noise Limits.
- 5.1.6. By applying the Matrix of Significance of Effect in **Table 3-3** and **Table 3-4**, the initial significance of effect - referred to as the 'Stage 1' significance - was determined, prior to consideration of factors other than noise levels alone which may influence the final significance outcome. The final significance assessment outcome is defined in the 'Stage 2' determination of significance.
- 5.1.7. The assessment of typical noise impacts at nearby communities is provided in **Table 5-1** with the determination of the significance of effect in **Table 5-2**.
- 5.1.8. As noted above, it is acknowledged that the Core Zone noise limits for which consent is being sought are to be applied to each RCL, even those at greater distances from the Core Zone boundary. The noise impacts considering the farther away RCLs - namely, RCL02-04, would be higher than those presented in **Table 5-1** and **Table 5-2**. The assessments for the Core Zone noise limits (i.e. the maximum allowable noise levels) at RCL02-04 are provided in **Table 5-3** and **Table 5-4** for context.

**Table 5-1 - Core Zone Noise Assessment for Typical Noise Levels at each RCL**

Community	Location	Period	Typical Core Zone Noise Level <sup>(1)</sup> , dB L <sub>Aeq,T</sub>	Baseline Noise Level <sup>(2)</sup> , dB L <sub>Aeq,T</sub>	Baseline Noise Level Derivation Method <sup>(3)</sup>	Combined Noise Level, dB L <sub>Aeq,T</sub> <sup>(4)</sup>	Change in Noise Level, dB <sup>(5)</sup>
Manor Road dwellings	North of Core Zone, near RCL01	Day	60	65	Measured at MP2b	66.2	1.2
		Night	55	56		58.5	2.5
Isolated Manor Road dwellings west of B530 Ampthill Road	Northeast of Core Zone, near RCL02	Day	56	53	DEFRA	57.8	4.8
		Night	51	49		53.1	4.1
Travelers site east of B530 Ampthill Road	Northeast of Core Zone, near RCL03	Day	53	64	DEFRA	64.3	0.3
		Night	48	59		59.3	0.3
Residential community south of Wixams	East of Core Zone, near RCL04	Day	50	61	DEFRA	61.3	0.3
		Night	45	57		57.3	0.3
Residential community north of Stewartby	South of Core Zone, near RCL05	Day	60	51	Measured at MP4	60.5	9.5
		Night	50	45		51.2	6.2
Single dwelling at Broadmead Farm	South of Core Zone, near RCL06	Day	60	51	Measured at MP4	60.5	9.5
		Night	55	45		55.4	10.4

**Notes**

- (1) Based on the more likely level where noise levels at farther RCLs are determined by RCLs closest to the Core Zone boundary. Any stated Core Zone noise levels at RCLs that are below the noise limits are indicative only and actual levels will depend on park layout, screening from intervening buildings etc. Core Zone noise limits are: 60 dB L<sub>Aeq,1hr</sub> during the day and 55 dB L<sub>Aeq,15min</sub> during the night for all RCLs except RCL04 and RCL05, where night-time limit



Community	Location	Period	Typical Core Zone Noise Level <sup>(1)</sup> , dB L <sub>Aeq,T</sub>	Baseline Noise Level <sup>(2)</sup> , dB L <sub>Aeq,T</sub>	Baseline Noise Level Derivation Method <sup>(3)</sup>	Combined Noise Level, dB L <sub>Aeq,T</sub> <sup>(4)</sup>	Change in Noise Level, dB <sup>(5)</sup>
<p>is 50 dB L<sub>Aeq,15min</sub>.</p> <p>(2) Daytime noise level: dB L<sub>Aeq,16hr</sub> and night-time noise level: dB L<sub>Aeq,8hr</sub>.</p> <p>(3) Baseline noise levels derived from DEFRA noise maps are determined from the logarithmic addition of road noise and rail noise at each location for daytime and night-time periods.</p> <p>(4) Combined noise level determined from the logarithmic addition of baseline noise level and Core Zone noise level at each location for daytime and night-time periods.</p> <p>(5) Combined noise level minus baseline noise level, dB.</p>							

**Table 5-2 - Core Zone Significance of Effect for Typical Noise Levels at each RCL**

Community	Period	Typical Core Zone Noise Level <sup>(1)</sup> , dB L <sub>Aeq,T</sub>	Change in Noise Level, dB	Stage 1 Significance Determination	Additional information for Context	Stage 2 Significance Determination
Manor Road dwellings, RCL01	Day	60	1.2	Moderate adverse	South facing facades will experience the highest noise levels from the Core Zone. However, north-facing facades to the rear will be impacted by noise from the utility compound so no 'quiet' façade available. However, ambient noise already high for south facing facades. Maximum allowable noise level only likely to occur during special events with all sources operating.	Moderate adverse <b>(Significant)</b>
	Night	55	2.5	Moderate adverse		Moderate adverse <b>(Significant)</b>
Isolated Manor Road dwellings west of the B530	Day	56	4.8	Moderate adverse	Rear facades of dwellings face Core Zone. Ambient noise levels from Manor Road are lower at rear façade than front. Rear	Moderate adverse <b>(Significant)</b>



Community	Period	Typical Core Zone Noise Level <sup>(1)</sup> , dB L <sub>Aeq,T</sub>	Change in Noise Level, dB	Stage 1 Significance Determination	Additional information for Context	Stage 2 Significance Determination
Ampthill Road, RCL02	Night	51	4.1	Moderate adverse	gardens have line of sight to Core Zone. Dwellings benefit from interrupted line of sight from intervening buildings. Maximum allowable noise level only likely to occur during special events with all sources operating.	Moderate adverse <b>(Significant)</b>
Travelers site east of the B530 Ampthill Road, RCL03	Day	53	0.3	Minor adverse/ Negligible	Noise from the Core Zone is unlikely to reach the maximum allowable of 60 dBA as other RCLs closer to the site will likely dictate the maximum noise level generated by the Core Zone. Existing noise levels are already high with rail noise important area (NIA) close to this location. Results in negligible increase in ambient noise level.	Negligible <b>(Not Significant)</b>
	Night	48	0.3	Minor adverse/ Negligible		Negligible <b>(Not Significant)</b>
Residential community south of Wixams, RCL04	Day	50	0.3	Minor adverse/ Negligible	Noise from the Core Zone is unlikely to reach the maximum allowable of 60 dBA during the day and 50 dBA at night as other RCLs closer to the site will dictate the maximum noise level generated by the Core Zone. Existing noise levels are already high with rail NIA close to this location. Results in negligible increase in ambient noise level.	Negligible <b>(Not Significant)</b>
	Night	45	0.3	Minor adverse/ Negligible		Negligible <b>(Not Significant)</b>
Residential community north	Day	60	9.5	Major adverse	A lower (50 dBA) night-time noise limit applicable at RCL05 compared with other RCLs. Exposed, north facing facades	Major adverse <b>(Significant)</b>

Community	Period	Typical Core Zone Noise Level <sup>(1)</sup> , dB L <sub>Aeq,T</sub>	Change in Noise Level, dB	Stage 1 Significance Determination	Additional information for Context	Stage 2 Significance Determination
of Stewartby, RCL05	Night	50	6.2	Major/moderate adverse	experience highest Core Zone noise levels. South facing 'quiet' facades or facades with glancing angles of incidence have the lowest noise levels. The maximum allowable noise level only likely to occur during special events with all sources operating.	Moderate adverse <b>(Significant)</b>
Single dwelling at Broadmead Farm, RCL06	Day	60	9.5	Major adverse	Single property impacted. Property located within 30m of site boundary. Will be quiet façade to front of property although garden to rear is north facing towards the development. The maximum allowable noise level only likely to occur during special events with all sources operating.	Major adverse <b>(Significant)</b>
	Night	55	10.4	Major adverse		Major adverse <b>(Significant)</b>
Notes						
(1) Based on the more likely level where noise levels at farther RCLs are determined by RCLs closest to the Core Zone boundary. Any stated Core Zone noise levels at RCLs that are below the noise limits of 60 dB L <sub>Aeq,1hr</sub> during the day and 55 dB L <sub>Aeq,15min</sub> at night (or 60 dB L <sub>Aeq,1hr</sub> during the day and 50 dB L <sub>Aeq,15min</sub> at night at RCL04 and RCL05) are indicative only and actual levels will depend on park layout, screening from intervening buildings etc.						

**Table 5-3 - Core Zone Noise Assessment for Maximum Allowable Noise Levels at RCL02-04**

Community	Location	Period	Maximum Allowable Core Zone Noise Level <sup>(1)</sup> , dB L <sub>Aeq,T</sub>	Baseline Noise Level <sup>(2)</sup> , dB L <sub>Aeq,T</sub>	Baseline Noise Level Derivation Method <sup>(3)</sup>	Combined Noise Level, dB L <sub>Aeq,T</sub> <sup>(4)</sup>	Change in Noise Level, dB <sup>(5)</sup>
Isolated Manor Road dwellings west of B530 Ampthill Road	Northeast of Core Zone, near RCL02	Day	60	53	DEFRA	60.8	7.8
		Night	55	49		56.0	7.0
Travelers site east of B530 Ampthill Road	Northeast of Core Zone, near RCL03	Day	60	64	DEFRA	65.5	1.5
		Night	55	59		60.5	1.5
Residential community south of Wixams	East of Core Zone, near RCL04	Day	60	61	DEFRA	63.5	2.5
		Night	50	57		57.8	0.8

**Notes**

- (1) Core Zone noise limit: 60 dB L<sub>Aeq,1hr</sub> during the day and 55 dB L<sub>Aeq,15min</sub> during the night at all RCLs except RCL04 and RCL05 where the limits are 60 dB L<sub>Aeq,1hr</sub> during the day and 50 dB L<sub>Aeq,15min</sub> at night
- (2) Daytime noise level: dB L<sub>Aeq,16hr</sub> and night-time noise level: dB L<sub>Aeq,8hr</sub>
- (3) Baseline noise levels derived from DEFRA noise maps are determined from the logarithmic addition of road noise and rail noise at each location for daytime and night-time periods.
- (4) Combined noise level determined from the logarithmic addition of baseline noise level and Core Zone noise level at each location for daytime and night-time periods
- (5) Combined noise level minus baseline noise level, dB

**Table 5-4 - Core Zone Significance of Effect for Maximum Allowable Noise Levels at RCL02-04**

Community	Period	Maximum Allowable Core Zone Noise Level <sup>(1)</sup> , dB <i>L<sub>Aeq,T</sub></i>	Change in Noise Level, dB	Stage 1 Significance Determination	Additional information for Context	Stage 2 Significance Determination
Isolated Manor Road dwellings west of B530 Ampthill Road, RCL02	Day	60	7.8	Major adverse	Rear facades of dwellings face the Core Zone. Ambient noise levels from Manor Road are relatively high at front facades but lower at rear façades. Rear gardens have partial line of sight to Core Zone. Maximum allowable noise level only likely to occur during special events with all sources operating.	Major adverse <b>(Significant)</b>
	Night	55	7.0	Major adverse		Major adverse <b>(Significant)</b>
Travellers site east of B530 Ampthill Road, RCL03	Day	60	1.5	Moderate adverse	West facing facades will experience higher noise levels than those facing east. Dwellings further east will also benefit from screening provided by intervening buildings. Existing noise levels are already high with rail NIA close to this location. Maximum allowable noise level only likely to occur during special events with all sources operating.	Moderate adverse <b>(Significant)</b>
	Night	55	1.5	Moderate adverse		Moderate adverse <b>(Significant)</b>
Residential community south of Wixams, RCL04	Day	60	2.5	Moderate adverse	The lower (50 dBA) night-time noise limit is applicable at RCL04. Ambient noise levels are already high at this location. West facing facades will experience higher noise levels than those facing east. Dwellings farther east will also benefit from screening provided by intervening buildings. Gardens of these properties tend to be located away from Ampthill Road and therefore benefit from screening from dwellings. Maximum allowable noise level only likely to occur during special events with	Moderate adverse <b>(Significant)</b>
	Night	50	0.8	Moderate/ minor adverse		Minor adverse <b>(Not Significant)</b>

Community	Period	Maximum Allowable Core Zone Noise Level <sup>(1)</sup> , dB <small>L<sub>Aeq,T</sub></small>	Change in Noise Level, dB	Stage 1 Significance Determination	Additional information for Context	Stage 2 Significance Determination
					all sources operating. There is a rail NIA just west of this location.	
<b>Notes</b> (1) Based on achieving the Core Zone noise limit: 60 dB L <sub>Aeq,1hr</sub> during the day and 55 dB L <sub>Aeq,15min</sub> during the night (or 60 dB L <sub>Aeq,1hr</sub> during the day and 50 dB L <sub>Aeq,15min</sub> at night at RCL04 and RCL05)						

## Additional Assessment at Residential Community North of Stewartby

- 5.1.9. The residential community north of Stewartby (represented by RCL05) is predicted to experience the maximum allowable noise levels, i.e. the Core Zone noise limits for which consent is being sought (60 dB  $L_{Aeq,1hr}$  during the day and the lower night time limit of 50 dB  $L_{Aeq,15min}$  at night), at properties located on Brick Crescent, 210m south of the Site boundary and mostly those with north facing facades. Properties located farther south, and those benefiting from screening provided by intervening dwellings, would experience lower noise levels. Furthermore, not all facades of each property would be equally impacted, with south facing facades experiencing lower noise levels than north facing facades due to the self-screening effect of the property. South facing gardens will also benefit from this effect.
- 5.1.10. The Core Zone noise propagation model was used to determine where noise levels are likely to fall below certain thresholds, namely 55 dB  $L_{Aeq,1hr}$  /45 dB  $L_{Aeq,15min}$  day/night, and 50 dB  $L_{Aeq,1hr}$  / 40 dB  $L_{Aeq,15min}$  day / night. These were identified as follows:
- 55 dB  $L_{Aeq,1hr}$  /45 dB  $L_{Aeq,15min}$  day/night - likely to be achieved at properties south of Chimney Way and north of Kiln Drive approximately 310m south of the Site boundary; and
  - 50 dB  $L_{Aeq,1hr}$  /40 dB  $L_{Aeq,15min}$  day/night - likely to be achieved at properties south of Kiln Drive approximately 500m south of the Site boundary.
- 5.1.11. Dwellings approximately north of Kiln Drive would be exposed to a major or moderate significance of effect which is considered **Significant**. Dwellings to the south of this area are likely to be exposed to minor or negligible significance of effect which is **Not Significant**.
- 5.1.12. The magnitude of impact criteria and significance of effect matrices are based on noise levels external to a property but assessed inside buildings with the assumption that windows are open for the purposes of ventilation. With windows closed, indoor noise levels - and hence the magnitude of impact - will be lower. In addition, indoor noise levels will also depend on the materials used for the construction of the building envelope.
- 5.1.13. Properties in the northern area of Stewartby, having been built within the previous 10 years, have been constructed with modern materials, to current Building Regulations, with good levels of sound insulation - for example, thermal double glazing rather than single glazed windows - and as such would experience lower indoor noise levels with windows closed than within many traditional properties with original features.

## Further Commentary on Core Zone Noise Impacts

- 5.1.14. As identified in **Table 5-1** and **Table 5-2**, noise levels at communities located farther from the Core Zone will be determined by RCLs closest to the Core Zone, i.e. RCL01 (Manor Road) and RCL05/RCL06 (north of Stewartby). Therefore, the maximum allowable noise levels (i.e. noise levels equivalent to the Core Zone noise limits) will likely affect a relatively small proportion of the surrounding residential communities resulting in a limited number of properties experiencing an adverse impact that was significant. It is acknowledged that UDX has purchased several of the most significantly impacted properties on Manor Road, which would not, on completion of the Proposed Development, continue to be used as dwellings.
- 5.1.15. Due to the controlling effect of the RCLs closest to the Core Zone, it is highly unlikely that all other RCLs would experience noise levels equivalent to the Core Zone noise limits for which consent is being sought of 60 dB  $L_{Aeq,1hr}$  /55 dB  $L_{Aeq,15min}$  during the day/night (at all RCLs other than RCL04

and RCL05, where the limits are 60 dB  $L_{Aeq,1hr}$  / 50 dB  $L_{Aeq,15min}$  during the day / night). However, in the unlikely event that this did occur there would be a greater number of properties experiencing a significant effect.

- 5.1.16. Furthermore, under Normal Hours Theme Park operation (which make up the majority of the year), Core Zone noise levels would be anticipated to be lower than during Halloween Horror Nights, Holidays and Special Events, particularly during the night and the extent of significant effects will be reduced.

### Noise from Utility Compound

- 5.1.17. The proposed location of the Utility Compound relative to the properties on Manor Road results in rear (north) facing facades of these properties experiencing higher noise levels from the Utility Compound than front (south) facing facades, which benefit from self-screening.
- 5.1.18. The Utility Compound will be designed so that noise at the most exposed façades of the nearest residential properties on Manor Road do not exceed the noise limits stated in **Section 3**, i.e. 56 dB  $L_{Ar,Tr}$  / 47 dB  $L_{Ar,Tr}$  during the day/night which would equate to +10 dB above the background sound level and would equate to the onset of a **Major Adverse** effect, which would be **Significant**. The noise propagation model indicates that all dwellings on Manor Road within around 350m of the Utility Compound could experience noise levels up to these limits, indicating a **Moderate Adverse** effect, which would be **Significant**.
- 5.1.19. The next closest sensitive receptors, namely dwellings located farther east along Manor Road near to RCL02, are likely to experience daytime/night-time noise levels of up to around 50 dB  $L_{Ar,Tr}$  / 40 dB  $L_{Ar,Tr}$  respectively, equating to levels that are less than +5 dB above background. This represents a **Minor Adverse** effect which is **Not Significant**.
- 5.1.20. The in-combination effects of noise from both the Core Zone and the Utility Compound have been considered. The facades of Manor Road properties most exposed to Core Zone noise are those facing south, i.e. those also exposed to the lowest levels of noise from the Utility Compound. The noise propagation model has been utilised to predict the combined noise level due to the contributions from both types of noise source at front and rear facades. This indicates that the predicted noise level from both sources combined would not exceed the Core Zone noise limits at either front or rear façades of affected properties.

### Proposed camping accommodation within Lake Zone

- 5.1.21. The ERC allows for the development of camping accommodation within the Lake Zone. It is assumed that visitors to a theme park who are prepared to camp overnight would have a reasonable expectation that there are likely to be elevated noise levels from the development at night and as such would be tolerant to such an eventuality, much as visitors to a festival featuring live music would. Moreover, most nights of the year, the gated attractions area within the Theme Park would not be open to the public during the night-time, greatly reducing night-time noise generation.

## 5.2. POTENTIAL MITIGATION

- 5.2.1. Rather than relying on and committing to specific mitigation measures, three primary measures are proposed to control noise from the operation of the Proposed Development:
- The compliance with the Core Zone noise limits set out in **Section 3**;
  - Demonstrating compliance through a limited period of noise monitoring following Grand Opening of the development; and
  - Following completion of the noise monitoring period, undertaking predictive noise modelling whenever a new ride is proposed to demonstrate ongoing compliance with the noise limits.
- 5.2.2. With respect to demonstrating compliance with the noise limits, UDX targets the Grand Opening of its entertainment resort complexes during the spring or summer when visitation is highest, and therefore when noise tends to be elevated as compared to slower periods in the autumn or winter. In the unlikely event that the Grand Opening of the Entertainment Resort Complex did not occur during the Spring or Summer, then the proposed monitoring would be extended to a sufficient period to ensure that the first summer period is included within the monitoring period.
- 5.2.3. The above principles are discussed in more detail in **Appendix 9.5: Demonstration of compliance with Operational Phase noise limits (Volume 3)**.
- 5.2.4. Mitigation measures may be required to achieve the noise limits and therefore this section summarises the potential mitigation measures that will be considered as part of detailed design and those mitigation measures that have already been embedded into the Proposed Development. This includes learning from UDX's experience of operating other theme parks around the world.
- 5.2.5. Examples are provided below on mitigation that will be employed at the outset and therefore are regarded embedded. The need for any other mitigation measures will be determined as the design of the park progresses and are therefore listed as optional.

### Embedded Mitigation

- 5.2.6. Of the potential examples of mitigation that could be employed if and when required to reduce noise, the measures that will be employed as part of the primary Core Zone design and which, therefore, may be regarded as embedded include:
- Speaker and PA system directional placement to avoid projecting into the community;
  - Use of buildings around the park to act as noise barriers;
  - Event stages are strategically placed to direct sound away from sensitive areas;
  - Significant noise generating attractions and events will have a predictive noise assessment completed to mitigate noise levels;
  - Damping of roller coaster beams and rails to reduce structure-radiated noise; and
  - Park perimeter berm in selected areas.

### Optional Mitigation

- 5.2.7. Optional mitigation measures that could be deployed in the Proposed Development, if required, could include:

### Roller Coasters

- Limiting high sections of roller coasters;



- Increasing dispatch intervals for noisier attractions during evening hours;
- Roller coasters designed to project screams and mechanical noise into the park property; and
- Limiting the routine testing of roller coasters to daytime hours where possible.

#### **Noise barriers**

- Temporary sound barriers located for special events;
- Designing park features or design elements that would act as sound barriers; and
- Strategically locating noisiest sources to optimise sound levels.

#### **Operational Controls**

- Noise hotline for the community to call;
- Active community engagement to ensure the community is aware of special events that may increase park hours or generate incremental noise;
- Limiting noisier night-time activities; and
- Noise monitoring during special events for active compliance in the community.

#### **Specific Examples**

- 5.2.8. This section provides specific examples of noise barrier designs utilised at existing Universal theme parks and which may be employed within the Site if required.
- 5.2.9. Physical barriers are highly effective at mitigating ground level noise. Operational “Back of House” service areas are typically isolated with solid fencing to minimise visual sight lines of workers’ activities and the noise generated around those activities.
- 5.2.10. Other barriers include:
- Park perimeter berm: earthen berm with fencing and planting;
  - Solid fencing;
  - Temporary sound barriers located for special events: these have been constructed of shipping containers stacked on top of each other and draped with noise dampening acoustic blankets;
  - Park features such as faux building façade walls and scenic trompe l’oeil walls; and
  - Use of buildings around the park to act as noise barriers.

#### **Utility Compound**

- 5.2.11. The following examples of mitigation could potentially be implemented, if required, to reduce noise levels from the Utility Compound affecting nearby sensitive receptors on Manor Road:
- Locate Utility Compound as far from Manor Road properties as practicable;
  - Where feasible, locate ERC buildings that generate relatively low levels of noise (e.g. warehousing) between the Utility Compound and houses on Manor Road. Locate service yards to the north of warehouses to maximise screening opportunities;
  - Locate the noisiest chiller units at ground level and to the north of the energy centre within the Utility Compound, using this building to screen properties on Manor Road; and
  - Where feasible, locate ventilation louvres on north facing façades of the energy centre.

## Other Mitigation

- 5.2.12. Separate to the above considerations regarding the Core Zone noise limits and potential Utility Compound Mitigation, embedded mitigation that must be employed (and is secured by the **Design Standards (Document Reference 6.3.0)**) is as follows:
- 5.2.13. The following examples of embedded mitigation would control the break-in of external noise to bedrooms within hotels and to control structure borne noise and vibration from building services plant:
  - Hotel facades will be designed to achieve the guideline internal noise levels referenced in BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings*, unless the hotel operator has its own design code which includes internal noise limits for bedrooms; and
  - Where vibration isolation is required, e.g. plant rooms within hotels, then the guidance provided in CIBSE Guide B4 *Noise and vibration control for building services systems 2016* should be followed.

## 5.3. DEMONSTRATION OF COMPLIANCE WITH CORE ZONE NOISE LIMITS

- 5.3.1. In order to demonstrate compliance with the Core Zone noise limits set out in **Section 3**, a combination of noise modelling and monitoring is proposed. Full details are provided in **Appendix 9.5: Demonstration of compliance with Operational Phase noise limits (Volume 3)**.

## 5.4. RESIDUAL EFFECTS

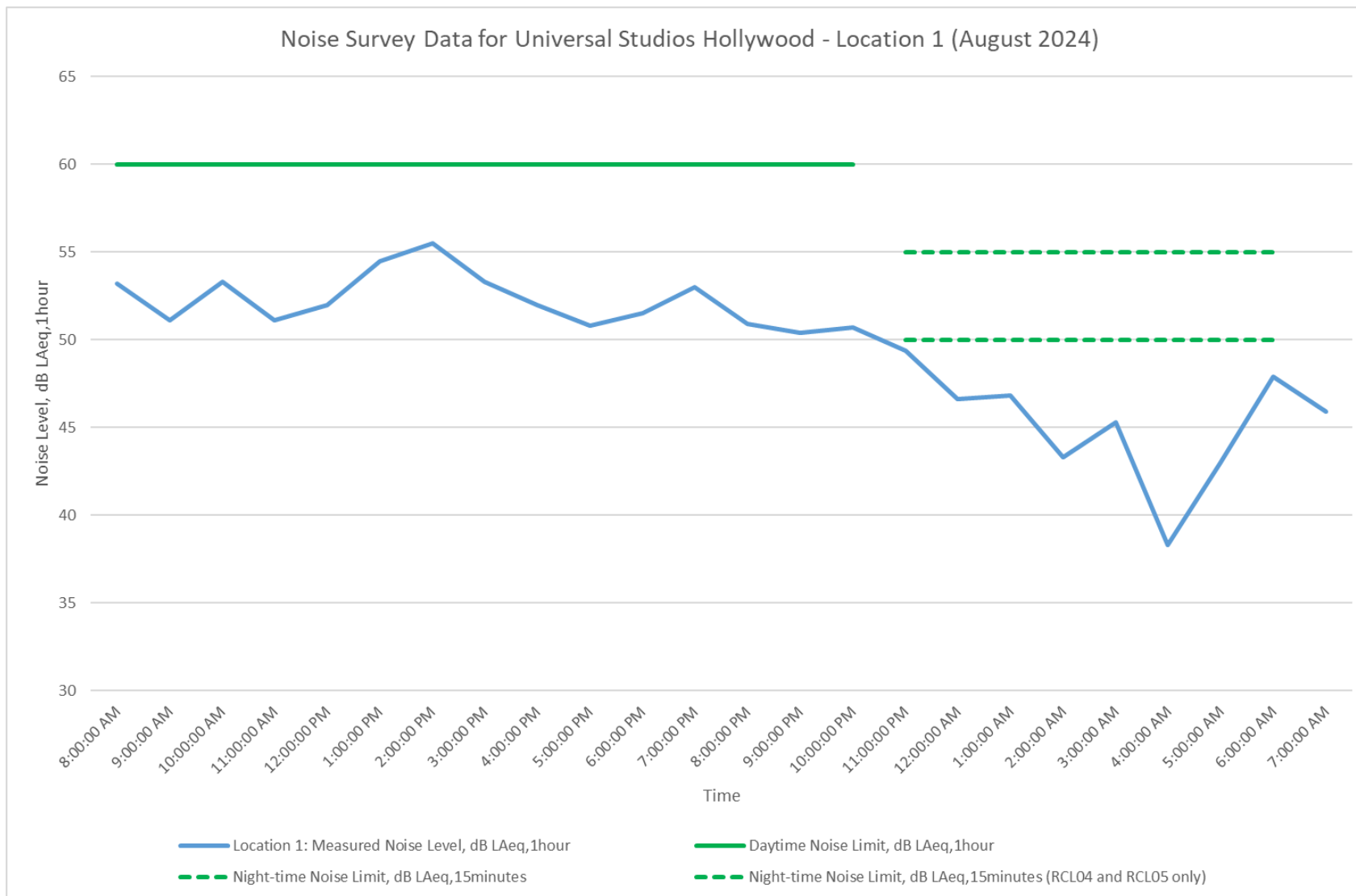
- 5.4.1. The noise impact assessment has been based on achieving a Core Zone noise limit of 60 dB  $L_{Aeq,1hr}$  during the day and 55 dB  $L_{Aeq,15min}$  during the night (and associated low frequency noise limits for amplified music) at the nearest RCLs (other than RCL04 and RCL05, where the noise limits are 60 dB  $L_{Aeq,1hr}$  during the day and 50 dB  $L_{Aeq,15min}$  during the night), for which consent is being sought. This represents a cautious worst case and would include contributions from all Core Zone activities, including Halloween Horror Nights, Holidays and Special Events.
- 5.4.2. Mitigation measures have been proposed that that could be utilised where required to achieve the Core Zone noise limits at RCLs. Several of these measures have been identified as embedded mitigation.
- 5.4.3. When achieving these noise limits, a relatively small number of properties centred on RCL01 (properties on Manor Road), several of which are owned by UDX, are predicted to experience a residual **Major Adverse** effect which is **Significant**.
- 5.4.4. In the case of properties north of Stewartby centred on RCL05 and RCL06, only a relatively small number, i.e. a single property at Broadmead Farm and properties on the northern edge of Stewartby with northern aspects and line of sight to the Development, are predicted to experience a residual **Moderate to Major Adverse** effect which is **Significant**. A selection of properties located farther south are predicted to experience a **Moderate Adverse** effect which is **Significant** with the majority experiencing either a **Minor Adverse** or **Negligible** effect which is **Not Significant**.
- 5.4.5. The Core Zone noise levels at RCL01, RCL05 and RCL06 will likely determine the noise levels at other, more distant, RCLs. At the dwellings on Manor Road near RCL02, a residual **Moderate Adverse** effect which is **Significant** is identified.

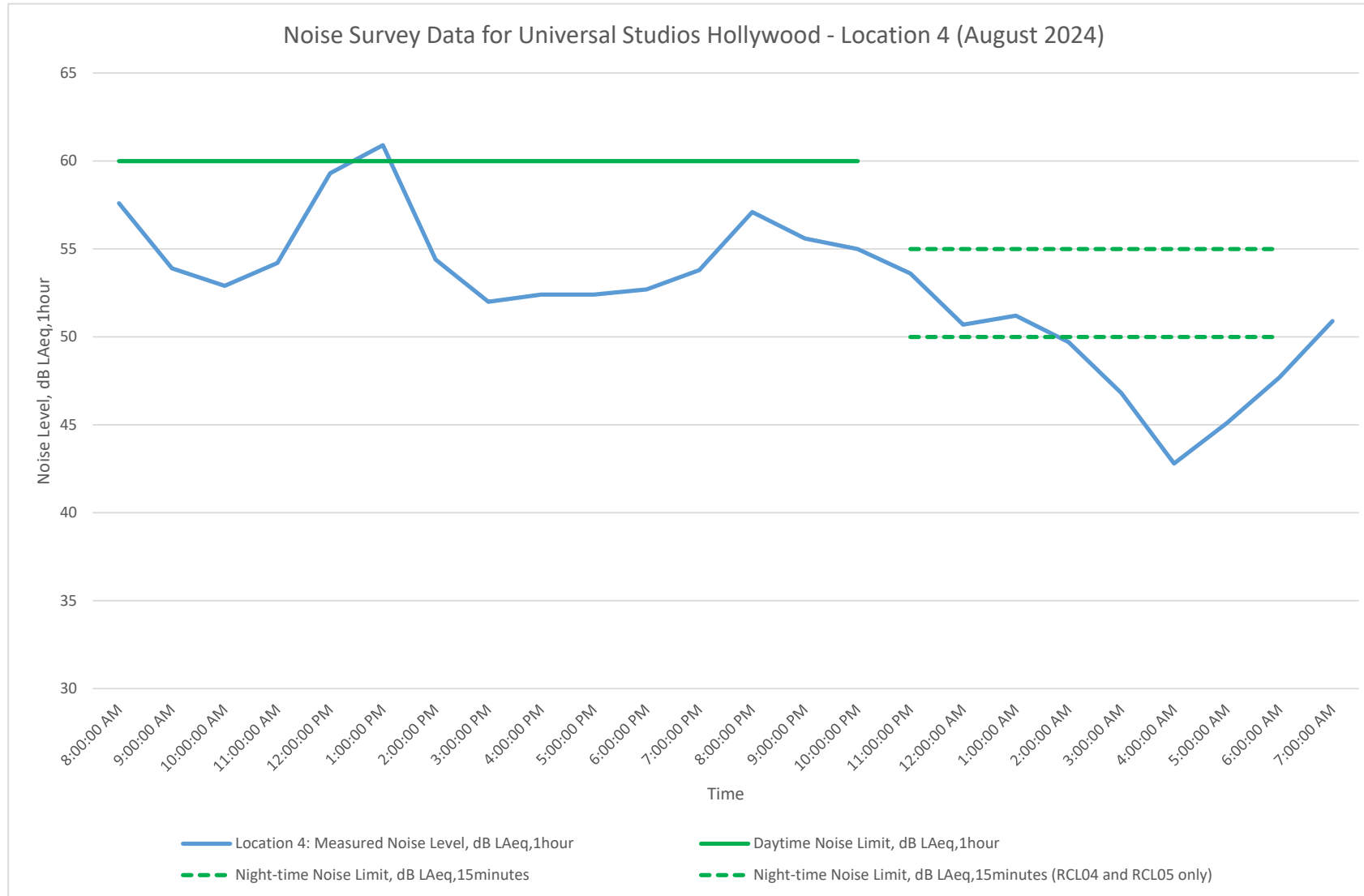
- 5.4.6. At the travellers' site on Ampthill Road near RCL03, a residual **Negligible** effect is identified which is **Not Significant**. At the residential community south of Wixams near RCL04, a residual **Negligible** effect is identified which is **Not Significant**.
- 5.4.7. Sensitive receptors, i.e. residential properties, within around 350m of the Utility Compound are predicted to experience a **Moderate Adverse** effect which is **Significant**. Sensitive receptors beyond this distance are predicted to experience a **Minor Adverse** or **Negligible** effect which is **Not Significant**.

# ANNEX A

## **COMMUNITY NOISE MONITORING DATA AT UNIVERSAL STUDIOS HOLLYWOOD**

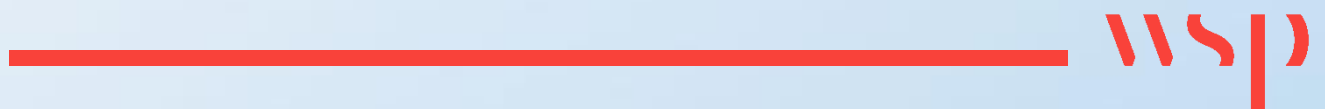






# Annex B

## **NOISE PROPAGATION MODEL - ASSUMPTIONS TABLES**





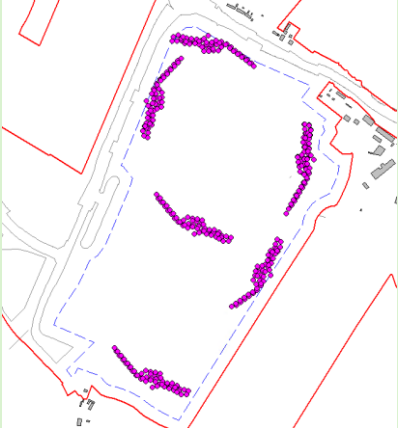
## Noise Propagation Model

Noise Modelling Software				
Type	Version	Calculation Method	Applicable Model	Comments/Justification
Datakustik Cadna-A	2025 (64 bit) (build: 209.5501)	ISO 9613-2: 1996 <sup>(1)</sup>	Core Zone indicative propagation noise model	ISO 9613-2:1996 utilised by HMMH <sup>(2)</sup> within Soundplan to model roller coaster noise sources. Verification exercises undertaken by HMMH and reviewed by WSP indicate good correlation between this prediction method and measured levels in the community at Universal Studios Hollywood. It is, therefore, considered a robust approach to use ISO 9613-2:1996 as the prediction methodology.
Datakustik Cadna-A	2025 (64 bit) (build: 209.5501)	ISO 9613-2: 2024 <sup>(3)</sup>	Utility Compound noise model	ISO 9613-2:2024 used for prediction of industrial plant noise from the Utility Compound in line with current best practice.
Datakustik Cadna-A	2025 (64 bit) (build: 209.5501)	Calculation of Road Traffic Noise (CRTN) <sup>(4)</sup>	Construction and operational road traffic noise model	In line with guidance within CRTN and DMRB <sup>(5)</sup>
<b>Notes</b> (1) ISO 9613-2: 1996 Acoustics — Attenuation of sound during propagation outdoors Part 2: General method of calculation (withdrawn) (2) HMMH - Harris Miller Miller and Hanson Inc. Acoustic consultants in the US undertaking acoustic design work on behalf of UDX (3) ISO 9613-2: 2024 Acoustics — Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors (4) CRTN - Calculation of Road Traffic Noise, 1988 (5) DMRB - Design Manual for Roads and Bridges LA 111 - Noise and vibration, 2020				

## Noise Propagation Model

Noise Model Configurations			
Applicable Model	Configuration Setting	Input Selected	Comments/Justification
Core Zone indicative propagation noise model	Ground absorption	0.5	To represent mixed ground cover.
	Orders of reflection	2	In line with normal best practice. Buildings are reflective. No buildings assumed within Core Zone.
	No subtraction of negative ground attenuation	Selected	In line with best practice so as not to over estimate attenuation from screening and ground absorption over large propagation distances.
	Ground attenuation	Spectral, all sources	In line with best practice as spectral source levels have been modelled.
Utility Compound noise model	Ground absorption	0.5	To represent mixed ground cover.
	Orders of reflection	2	In line with normal best practice. Buildings are reflective. No buildings assumed within Core Zone.
	Ground attenuation	Spectral, all sources	In line with best practice as spectral source levels have been modelled.
Construction and operational road traffic noise model	Ground absorption	0.5	To represent mixed ground cover.
	Calculation metric	L10	In line with guidance within CRTN.
	Low traffic correction applied?	Yes	In line with Clause 30 of CRTN.
	Reflection via correction (1.5 dB), not via mirror sources?	Yes	In line with CRTN guidance.
	Calc acc. To DMRB?	Yes	DMRB calculation rules applied.

## Noise Propagation Model

Primary Model Inputs					
Noise Source Levels					
Applicable Areas/Scenarios	Noise Source	Data Origin	Description of Source Location	Graphic Indicating Location of Sources in Model	Comments/Justification
Core Zone indicative propagation noise model	Roller coaster, mechanical noise and occupants' screams	From measurements undertaken by HMMH <sup>(1)</sup> of existing roller coaster at Universal Orlando Resort. See sound power level spectra provided in <b>Appendix 9.4: Operational Noise Assessment (Volume 3), Table 1-8</b> . Note this represents a single specific example of a roller coaster installed at an existing park, rather than any future proposals for the Proposed Development.	Single roller coaster located at various locations around the Core Zone as close to boundary as height strategy permits.	 <p>Note the above graphic represents the six different locations assigned to the roller coaster for the noise propagation exercise. Each coaster location was modelled in isolation.</p>	<p>A roller coaster noise source was selected to represent noise from the Core Zone for the purposes of testing noise propagation to surrounding receptors for the following reasons:</p> <ol style="list-style-type: none"> <li>1) This source is likely to be representative of the most recognisable and identifiable noise source for residents living in the vicinity of the theme park.</li> <li>2) The source is made up of almost 60 individual point sources spatially arranged at varying heights between 0m and 33m above ground level, thereby providing a cautious worst case as the noise source benefits from less screening due to ground topography than other sources located close to the ground.</li> <li>3) This noise source is likely to be the most challenging to mitigate.</li> </ol>

#### Further information on data origin

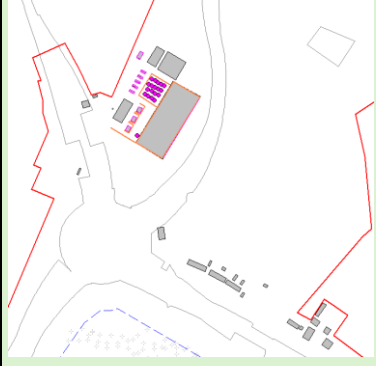
Measurements were made by HMMH of multiple cycles of a roller coaster at Universal Orlando Resort from several locations around the ride, both with and without riders. The 'without riders' scenario utilised weighted sandbags during a 'brake test' as a proxy for riders in order to replicate rider weight and to isolate the mechanical noise contribution, e.g. the interaction of the train with the track and support structure, in the absence of rider screams. The data was distilled into two sets of source data, mechanical noise with rider screams and mechanical noise only, and the third octave band sound power level of each derived from the measured Lmax data. Values of 113 dB Lw for mechanical noise and 125 dB Lw for loud screams were derived.

A single repeating ride cycle was determined as: 1) Train 1 dispatched: 0 seconds; 2) Train 2 dispatched: 35 seconds later; 3) Train 3 dispatched 70: seconds later; and 4) Train 1 back at station unloading/loading: 105 seconds. Based on known dispatch intervals and average train speed, it was determined that 57 ft (17 m) of track was travelled per second. The track was then divided into 57 ft segments each representing an average 1sec of travel. Each segment was modelled as a point source and assigned either mechanical noise or scream, based on the section of track and observation, and a height. The average scream duration was determined to be 3 seconds. An on-time for each discreet source was determined to be 4 minutes per hour which was applied as a correction within the noise model. This allowed the average 1 hr noise level - i.e. equivalent to the LAeq,1hr - to be derived.

The noise model utilised for predictive purposes was Soundplan. Further to the roller coaster noise surveys, additional sound propagation tests were undertaken at the location of a proposed new roller coaster at Universal Studios Hollywood. This involved placing two different noise sources (a yachting cannon to produce a single loud, impulsive sound and an amplified loudspeaker playing a pink noise spectrum) on a roof at a similar height to the peak height of the roller coaster and measuring the noise at various locations in the community. These measurements were then compared with predictions made by Soundplan for the same noise sources using both the General Prediction Method (GPM) and ISO 9613-2 (1996 version) calculation methodologies. These comparisons showed good correlation between measured and predicted levels with a slightly more conservative (i.e. higher) prediction made using the GPM. Both models overpredicted both sound sources at higher frequencies which was determined to be due to local atmospheric conditions at the time of the sound propagation tests.

#### Notes

(1) HMMH - Harris Miller Miller and Hanson Inc. Acoustic consultants in the US undertaking acoustic design work on behalf of UDX

Applicable Areas/Scenarios	Noise Source	Data Origin	Description of Source Location	Graphic Indicating Location of Sources in Model	Comments/Justification
Utility Compound noise model	ASHP <sup>(1)</sup> heat collector	Manufacturer's data for Guntner P10	Energy centre, roof level		Note this layout is purely indicative at this stage and does not reflect the actual layout or final location, nor does it reflect the actual plant selection, which has yet to be finalised. This model is intended to demonstrate in principle that noise limits can realistically be achieved at nearest sensitive receptors.
	Air cooled chiller	Manufacturer's data for Geoclimer ACC	Energy centre, ground level		
	Ventilation louvres	Assumed 20 dB loss. Likely to require fully ducted ventilation system with silencers factored into the system design.	Energy centre, building façade. Louvre assumed to be full width of energy centre building and located on southeast facing façade		
	40MVA transformer	Sound power level derived by prediction using calculation in AS/NZS 60076.10:2009 <sup>(3)</sup>	Substation		
	BESS <sup>(2)</sup> Megapack	Manufacturer's data obtained from Tesla	BESS		
	Supergrid transformer	Manufacturer's test data (Dong Energy)	BESS		

#### Notes

(1)ASHP - air source heat pump

(2)BESS - battery energy storage system

(3)S/NZS 60076.10:2009 Power transformers Determination of sound levels (IEC60076-10, Ed.1 (2001) MOD)

Applicable Areas/Scenarios	Description	Data Origin	Description of Scenarios modelled	Location of Sources in Model
Construction and operational road traffic noise model	Construction road traffic noise	Baseline traffic data and network shapefiles provided by Vectos and dated 31/07/2024	Scenario 1 - 2023 Existing. For the noise assessment, this represents existing baseline traffic conditions in 2023.	As per noise study area stated in <b>Appendix 9.3 Construction and Operational Road Traffic Noise Assessment (Volume 3)</b>
		Peak construction traffic data and network shape files provided by Vectos and dated 31/07/2024 with updates dated 01/10/2024	Scenario 2 - 2023 Existing plus Peak Construction. For the noise assessment, this represents peak construction traffic in 2029.	
	Operational road traffic noise model	Traffic data and network shape files provided by Vectos and dated 31/07/2024, with updates dated 12/08/2024	Scenario 3 – Reference Case. For the noise assessment, this represents the existing road network and traffic plus traffic associated with agreed consented developments but without the Proposed Development.	
			Scenario 4 – Reference Case plus Development. For the noise assessment, this represents the existing road network and traffic plus traffic associated with agreed consented developments plus Opening Year related demands from the Site. This is based on Wixams Station being open, East West Rail (EWR) running between Oxford and Milton Keynes only and the A421 slips being complete. For clarity this assumes no trip generating development on either the Lake Zone or West Gateway Zone (There may be some drainage or other infrastructure works required on the Lake Zone and West Gateway Zone to support the delivery of development on the Core Zone).	
			Scenario 4a – Reference Case plus Development plus Construction. For the noise assessment, this represents the existing road network and traffic plus traffic associated with agreed consented developments plus Opening Year plus 10 years (midpoint between Opening Year and Future Year demands) related demands from the Site. This is based on Wixams Station being open, EWR running between Oxford and Milton Keynes only and the A421 slips being complete. This assumes construction activities in the Core Zone and Lake Zone.	
			Scenario 5 – Future Year - Reference Case plus Development. For the noise assessment, this represents the existing road network and traffic plus traffic associated with agreed consented developments plus Future Year related demands from the Site. This is based on Wixams Station being open, EWR running between Oxford and Milton Keynes only and the A421 slips being complete. This assumes full development of the Lake Zone and West Gateway Zone	
Notes (1) HMMH - Harris Miller Miller and Hanson Inc. Acoustic consultants in the US undertaking acoustic design work on behalf of UDX (2) S/NZS 60076.10:2009 Power transformers Determination of sound levels (IEC 60076-10, Ed.1 (2001) MOD)				

## Noise Propagation Model

Other Model Inputs			
Digital Terrain Map (DTM)			
Applicable Areas/Scenarios	Base Map	Development map	Comments/Justification
Core Zone indicative propagation noise model; Utility Compound noise model; construction road traffic noise model; operational road traffic noise model.	DEFRA Survey Data, LIDAR composite DTM <sup>(1)</sup> , 2m (2022) <sup>(2)</sup>	-	Considered of sufficient accuracy for wider areas beyond the RLB <sup>(3)</sup>
	-	Civil engineering contours for proposed new roads taken from drawing ref. <b>P320-VEC-HGN-XXX-M3-CH-0103</b> .	Includes proposed contours for civils works associated with new roads within the RLB. In the absence of any design contours for the Core Zone is considered sufficient to represent a cautious worst case for the future topography of the development.
Notes (1) DTM - digital terrain map (2) <a href="https://environment.data.gov.uk/survey">https://environment.data.gov.uk/survey</a> (3) RLB - redline boundary			

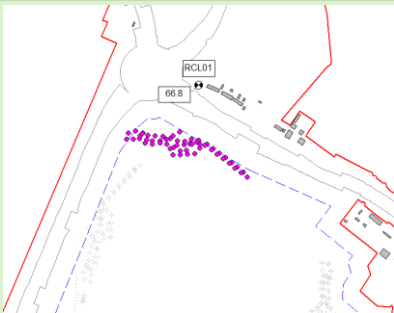
Height Strategy		
Applicable Areas/Scenarios	Drawing Reference	Comments/Justification
Core Zone indicative propagation noise model.	<b>X320-MP-HEIGHT_STRATEGY_20241219</b>	Reference made to height strategy drawing when locating noise sources for the Core Zone indicative propagation noise model

Building Layouts			
Applicable Areas/Scenarios	Base Map	Development map	Comments/Justification
All models	OS Mastermap, default height of buildings is 8.0m with the exception of large industrial warehouses which are assumed to be 15.0m, based on visual assessment.	Not included - no data available	Core Zone modelled with no buildings (i.e. as an open site) as layouts have not been finalised. This presents a cautious worst case without the screening effect of buildings and other infrastructure.

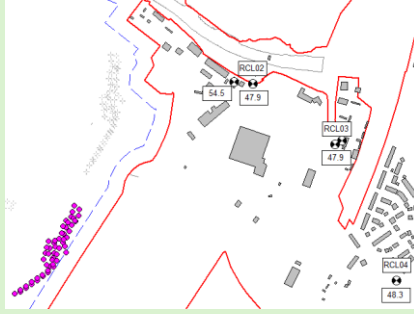
Other Inputs			
Applicable Areas/Scenarios	Item	Description	Comments/Justification
All models	RCLs <sup>(1)</sup>	Incorporated as receiver points, 1.5m high, at the coordinates defined in <b>Appendix 9.4: Operational Noise Assessment (Volume 3), Table 1-7.</b>	The RCLs represent publicly accessible locations in the vicinity of residential receptors and therefore may be used as future noise monitoring locations in order to confirm compliance with the Core Zone noise limits. Any future noise measurements at these locations would be made at a similar height above ground.
	RLB <sup>(2)</sup>	Version dated 09/05/2025.	Incorporated into model for reference only.
Notes (1) RCL - receptor control location (2) RLB - redline boundary			

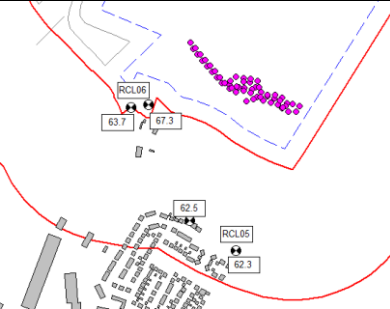


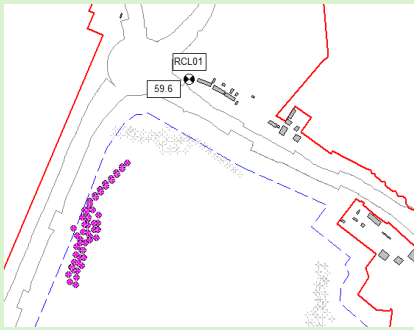
# Noise Propagation Model

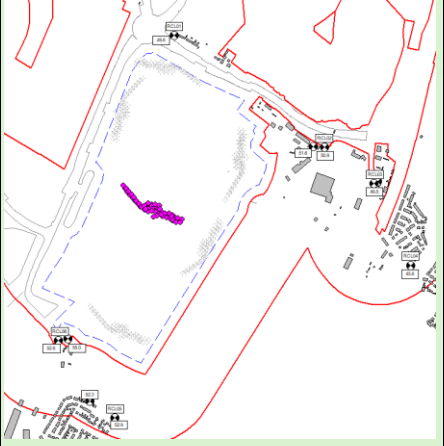
Model Outputs							
Predicted Noise Levels - Core Zone							
Noise Source Description	Location of Source in Model	Daytime and Night-time Noise Limits at Nearest Receptor	Predicted Noise Level at nearest RCL <sup>(1)</sup>	Graphic Indicating Predicted Noise Level	Comments/Mitigation Options to be Considered		
Roller coaster	1) Single roller coaster located at Core Zone northern boundary.	RCL01: 60 dB LAeq,1hr (day); 55 dB LAeq,15min (night)	RCL01: 67 dB LAeq,1hr.		With a roller coaster at this location, around 7 dB attenuation would be required to achieve daytime noise limit at properties along Manor Road and around 12 dB at night. A predictive noise assessment during detailed design will be undertaken for all significant noise generating attractions. Mitigation options that could be investigated include:		
					Mitigation Type	Mitigation Option	Potential Attenuation Achievable <sup>(2)</sup>
					Embedded	Significant noise generating attractions and events will have a predictive noise assessment completed to mitigate noise levels.	Assessment will predict noise levels from significant noise sources, taking into account park layout, location of significant noise sources, intervening structures etc. to identify actual reductions necessary.
					Embedded	Use of buildings around the park to act as noise barriers.	Up to 5 dB, depending on height, orientation and location.
					Embedded	Damping of roller coaster beams and rails to reduce structure-radiated noise.	Up to 3 dB reduction in radiated noise can be achieved by incorporating damping elements and materials into the roller coaster structure.
					Optional	Limiting high sections of roller coasters.	Up to 3 dB, dependent on height and line of sight to sensitive receptors.
					Optional	Increasing dispatch intervals for noisier attractions during evening hours.	Up to 3 dB, depending on interval selected.
					Optional	Roller coasters designed to project screams and mechanical noise into the park property.	Up to 5 dB, compared with screams projecting out into the community.
					Optional	Designing park features or design elements that would act as sound barriers.	Up to 5 dB, depending on height, extent and location relative to source and receiver.
					Optional	Strategically locating noisiest sources to optimise sound levels.	Up to 5 dB, depending on separation distance between source and receiver, roller coaster orientation.

Noise Source Description	Location of Source in Model	Daytime and Night-time Noise Limits at Nearest Receptor	Predicted Noise Level at nearest RCL <sup>(1)</sup>	Graphic Indicating Predicted Noise Level	Comments/Mitigation Options to be Considered		
Roller coaster	2) Single roller coaster located at Core Zone northeastern boundary.	RCL02, RCL03: 60 dB LAeq,1hr (day); 55 dB LAeq,15min (night)	RCL02: 53 LAeq,1hr (nearest dwelling: 57 LAeq,1hr).		With a roller coaster at this location, all RCLs are predicted to achieve the daytime limits with a potential 2 dB reduction required at the dwelling near to RCL02 during night-time operations. A predictive noise assessment during detailed design will be undertaken for all significant noise generating attractions. Mitigation options that could be investigated include:		
			RCL03: 52 LAeq,1hr.				
		RCL04: 60 dB LAeq,1hr (day); 50 dB LAeq,15min (night)	RCL04: 50 LAeq,1hr.				
					Mitigation Type	Mitigation Option	Potential Attenuation Achievable <sup>(2)</sup>
					Embedded	Significant noise generating attractions and events will have a predictive noise assessment completed to mitigate noise levels.	Assessment will predict noise levels from significant noise sources, taking into account park layout, location of significant noise sources, intervening structures etc. to identify actual reductions necessary.
					Embedded	Damping of roller coaster beams and rails to reduce structure-radiated noise.	Up to 3 dB reduction in radiated noise can be achieved by incorporating damping elements and materials into the roller coaster structure.
					Optional	Limiting high sections of roller coasters.	Up to 3 dB, dependent on height and line of sight to sensitive receptors.
					Optional	Increasing dispatch intervals for noisier attractions during evening hours.	Up to 3 dB, depending on interval selected.
					Optional	Designing park features or design elements that would act as sound barriers.	Up to 5 dB, depending on height, extent and location relative to source and receiver.

Noise Source Description	Location of Source in Model	Daytime and Night-time Noise Limits at Nearest Receptor	Predicted Noise Level at nearest RCL <sup>(1)</sup>	Graphic Indicating Predicted Noise Level	Comments/Mitigation Options to be Considered		
Roller coaster	3) Single roller coaster located at Core Zone eastern boundary.	RCL02, RCL03: 60 dB LAeq,1hr (day); 55 dB LAeq,15min (night)	RCL02: 48 LAeq,1hr (nearest dwelling: 55 LAeq,1hr).		With a roller coaster at this location, all RCLs are predicted to achieve the daytime and night-time limits. No mitigation required. A predictive noise assessment during detailed design will be undertaken for all significant noise generating attractions.		
			RCL03: 48 LAeq,1hr.		Mitigation Type	Mitigation Option	Potential Attenuation Achievable <sup>(2)</sup>
		RCL04: 60 dB LAeq,1hr (day); 50 dB LAeq,15min (night)	RCL04: 48 LAeq,1hr.				

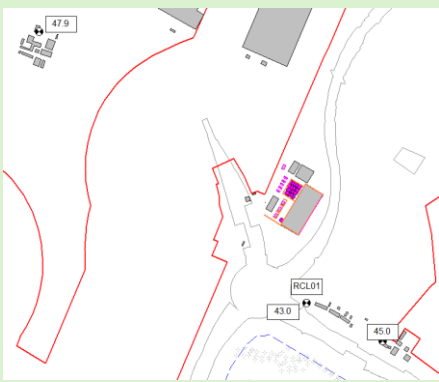
Noise Source Description	Location of Source in Model	Daytime and Night-time Noise Limits at Nearest Receptor	Predicted Noise Level at nearest RCL <sup>(1)</sup>	Graphic Indicating Predicted Noise Level	Comments/Mitigation Options to be Considered																											
Roller coaster	4) Single roller coaster located at Core Zone southern boundary.	RCL05: 60 dB LAeq,1hr (day); 50 dB LAeq,15min (night)	RCL05: 62 dB LAeq,1hr.		With a roller coaster at this location, around 7 dB attenuation would be required to achieve daytime noise limit at the farmhouse adjacent to the Core Zone boundary at RCL06 and around 12 dB at night. At RCL05, around 2-3 dB attenuation during the day and 12-13 dB attenuation at night would be required to achieve the applicable noise limits. A predictive noise assessment during detailed design will be undertaken for all significant noise generating attractions. Mitigation options that could be investigated include:																											
		RCL06: 60 dB LAeq,1hr (day); 55 dB LAeq,15min (night)	RCL06: 64 dB LAeq,1hr. Note: RCL06 benefits from screening from nearby farmhouse with roller coaster at this location. Adjacent receptor without screening: 67 dB LAeq,1hr.																													
					<table><tr><th>Mitigation Type</th><th>Mitigation Option</th><th>Potential Attenuation Achievable<sup>(2)</sup></th></tr><tr><td>Embedded</td><td>Significant noise generating attractions and events will have a predictive noise assessment completed to mitigate noise levels.</td><td>Assessment will predict noise levels from significant noise sources, taking into account park layout, location of significant noise sources, intervening structures etc. to identify actual reductions necessary.</td></tr><tr><td>Embedded</td><td>Use of buildings around the park to act as noise barriers.</td><td>Up to 5 dB, depending on height, orientation and location.</td></tr><tr><td>Embedded</td><td>Damping of roller coaster beams and rails to reduce structure-radiated noise.</td><td>Up to 3 dB reduction in radiated noise can be achieved by incorporating damping elements and materials into the roller coaster structure.</td></tr><tr><td>Optional</td><td>Limiting high sections of roller coasters.</td><td>Up to 3 dB, dependent on height and line of sight to sensitive receptors.</td></tr><tr><td>Optional</td><td>Increasing dispatch intervals for noisier attractions during evening hours.</td><td>Up to 3 dB, depending on interval selected.</td></tr><tr><td>Optional</td><td>Roller coasters designed to project screams and mechanical noise into the park property.</td><td>Up to 5 dB, compared with screams projecting out into the community.</td></tr><tr><td>Optional</td><td>Designing park features or design elements that would act as sound barriers.</td><td>Up to 5 dB, depending on height, extent and location relative to source and receiver.</td></tr><tr><td>Optional</td><td>Strategically locating noisiest sources to optimise sound levels.</td><td>Up to 5 dB, depending on separation distance between source and receiver, roller coaster orientation.</td></tr></table>	Mitigation Type	Mitigation Option	Potential Attenuation Achievable <sup>(2)</sup>	Embedded	Significant noise generating attractions and events will have a predictive noise assessment completed to mitigate noise levels.	Assessment will predict noise levels from significant noise sources, taking into account park layout, location of significant noise sources, intervening structures etc. to identify actual reductions necessary.	Embedded	Use of buildings around the park to act as noise barriers.	Up to 5 dB, depending on height, orientation and location.	Embedded	Damping of roller coaster beams and rails to reduce structure-radiated noise.	Up to 3 dB reduction in radiated noise can be achieved by incorporating damping elements and materials into the roller coaster structure.	Optional	Limiting high sections of roller coasters.	Up to 3 dB, dependent on height and line of sight to sensitive receptors.	Optional	Increasing dispatch intervals for noisier attractions during evening hours.	Up to 3 dB, depending on interval selected.	Optional	Roller coasters designed to project screams and mechanical noise into the park property.	Up to 5 dB, compared with screams projecting out into the community.	Optional	Designing park features or design elements that would act as sound barriers.	Up to 5 dB, depending on height, extent and location relative to source and receiver.	Optional	Strategically locating noisiest sources to optimise sound levels.	Up to 5 dB, depending on separation distance between source and receiver, roller coaster orientation.
	Mitigation Type	Mitigation Option	Potential Attenuation Achievable <sup>(2)</sup>																													
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	Embedded	Use of buildings around the park to act as noise barriers.	Up to 5 dB, depending on height, orientation and location.																													
	Embedded	Damping of roller coaster beams and rails to reduce structure-radiated noise.	Up to 3 dB reduction in radiated noise can be achieved by incorporating damping elements and materials into the roller coaster structure.																													
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Optional	Strategically locating noisiest sources to optimise sound levels.	Up to 5 dB, depending on separation distance between source and receiver, roller coaster orientation.																														

Noise Source Description	Location of Source in Model	Daytime and Night-time Noise Limits at Nearest Receptor	Predicted Noise Level at nearest RCL <sup>(1)</sup>	Graphic Indicating Predicted Noise Level	Comments/Mitigation Options to be Considered		
Roller coaster	5) Single roller coaster located at Core Zone western boundary.	RCL01: 60 dB LAeq,1hr (day); 55 dB LAeq,15min (night)	RCL01: 60 dB LAeq,1hr.		With a roller coaster at this location, RCL01 is predicted to achieve the daytime limit with a 5 dB reduction required during night-time operations. A predictive noise assessment during detailed design will be undertaken for all significant noise generating attractions. Mitigation options that could be investigated include:		
					Mitigation Type	Mitigation Option	Potential Attenuation Achievable <sup>(2)</sup>
					Embedded	Significant noise generating attractions and events will have a predictive noise assessment completed to mitigate noise levels.	Assessment will predict noise levels from significant noise sources, taking into account park layout, location of significant noise sources, intervening structures etc. to identify actual reductions necessary.
					Embedded	Damping of roller coaster beams and rails to reduce structure-radiated noise.	Up to 3 dB reduction in radiated noise can be achieved by incorporating damping elements and materials into the roller coaster structure.
					Optional	Limiting high sections of roller coasters.	Up to 3 dB, dependent on height and line of sight to sensitive receptors.
					Optional	Increasing dispatch intervals for noisier attractions during evening hours.	Up to 3 dB, depending on interval selected.
					Optional	Designing park features or design elements that would act as sound barriers.	Up to 5 dB, depending on height, extent and location relative to source and receiver.

Noise Source Description	Location of Source in Model	Daytime and Night-time Noise Limits at Nearest Receptor	Predicted Noise Level at nearest RCL <sup>(1)</sup>	Graphic Indicating Predicted Noise Level	Comments/Mitigation Options to be Considered		
Roller coaster	6) Single roller coaster located in centre of Core Zone	RCL05: 60 dB LAeq,1hr (day); 50 dB LAeq,15min (night)	RCL05: 53 dB LAeq,1hr.		With a roller coaster at this location, RCL05 is predicted to achieve the daytime limit with a 3 dB reduction required during night-time operations. RCL06 is predicted to achieve daytime and night-time noise limits. A predictive noise assessment during detailed design will be undertaken for all significant noise generating attractions. Mitigation options that could be investigated include:		
		RCL06: 60 dB LAeq,1hr (day); 55 dB LAeq,15min (night)	RCL06: 53 dB LAeq,1hr. Note: RCL06 benefits from screening from nearby farmhouse with roller coaster at this location. Adjacent receptor without screening: 55 dB LAeq,1hr.		Mitigation Type	Mitigation Option	Potential Attenuation Achievable <sup>(2)</sup>
					Embedded	Significant noise generating attractions and events will have a predictive noise assessment completed to mitigate noise levels.	Assessment will predict noise levels from significant noise sources, taking into account park layout, location of significant noise sources, intervening structures etc. to identify actual reductions necessary.
					Embedded	Damping of roller coaster beams and rails to reduce structure-radiated noise.	Up to 3 dB reduction in radiated noise can be achieved by incorporating damping elements and materials into the roller coaster structure.
					Optional	Limiting high sections of roller coasters.	Up to 3 dB, dependent on height and line of sight to sensitive receptors.
					Optional	Increasing dispatch intervals for noisier attractions during evening hours.	Up to 3 dB, depending on interval selected.
					Optional	Designing park features or design elements that would act as sound barriers.	Up to 5 dB, depending on height, extent and location relative to source and receiver.

Noise Source Description	Location of Source in Model	Daytime and Night-time Noise Limits at Nearest Receptor	Predicted Noise Level at nearest RCL <sup>(1)</sup>	Graphic Indicating Predicted Noise Level	Comments/Mitigation Options to be Considered		
Roller coaster	7) Four roller coasters modelled together with one located at each of the four main Core Zone boundary locations. Mitigation assumed such that no RCL exceeds the maximum permissible noise levels, i.e. the Core Zone noise limits. The assessment of operational noise from the Core Zone presented in <b>Appendix 9.4: Operational Noise Assessment (Volume 3)</b> is based on noise predictions from this scenario.	RCL01: 60 dB LAeq,1hr (day); 55 dB LAeq,15min (night)	RCL01: 60 dB LAeq,1hr		This model scenario indicates that two RCLs (RCL01 and RCL05) act as 'controlling RCLs' as once noise from roller coasters is attenuated such that the Core Zone noise limits are achieved, the noise levels at all other RCLs will be lower. The possible exception is RCL06 which is located closer to the Core Zone than RCL05 and may require additional localised mitigation to achieve the daytime noise limit. A predictive noise assessment during detailed design will be undertaken for all significant noise generating attractions. Mitigation options that could be investigated include:		
		RCL02: 60 dB LAeq,1hr (day); 55 dB LAeq,15min (night)	RCL02: 52 LAeq,1hr (nearest dwelling: 55		Mitigation Type	Mitigation Option	Potential Attenuation Achievable <sup>(2)</sup>
		RCL03: 60 dB LAeq,1hr (day); 55 dB LAeq,15min (night)	RCL03: 52 dB LAeq,1hr		Embedded	Significant noise generating attractions and events will have a predictive noise assessment completed to mitigate noise levels.	Assessment will predict noise levels from significant noise sources, taking into account park layout, location of significant noise sources, intervening structures etc. to identify actual reductions necessary.
		RCL04: 60 dB LAeq,1hr (day); 50 dB LAeq,15min (night)	RCL04: 50 dB LAeq,1hr		Embedded	Damping of roller coaster beams and rails to reduce structure-radiated noise.	Up to 3 dB reduction in radiated noise can be achieved by incorporating damping elements and materials into the roller coaster structure.
		RCL05: 60 dB LAeq,1hr (day); 50 dB LAeq,15min (night)	RCL05: 60 dB LAeq,1hr		Optional	Limiting high sections of roller coasters.	Up to 3 dB, dependent on height and line of sight to sensitive receptors.
		RCL06: 60 dB LAeq,1hr (day); 54 dB LAeq,15min (night)	RCL06: 62 dB LAeq,1hr		Optional	Increasing dispatch intervals for noisier attractions during evening hours.	Up to 3 dB, depending on interval selected.
					Optional	Designing park features or design elements that would act as sound barriers.	Up to 5 dB, depending on height, extent and location relative to source and receiver.
Notes							
(1) RCL - Receptor control location							
(2) Note that these are indicative levels only. Actual attenuation levels likely to be achieved will depend on multiple, interconnecting factors. The stated potential attenuation levels are not additive in a linear fashion.							



Predicted Noise Levels - Utility Compound					
Noise Source Description	Location of Source in Model	Daytime and Night-time Noise Limits at Nearest Receptor	Predicted Noise Level at nearest RCL <sup>(1)</sup>	Graphic Indicating Predicted Noise Level	Comments/Mitigation Options to be Considered
ASHP heat collector	Energy centre, roof level	Nearest sensitive receptors, i.e. those associated with RCL01 on Manor Road: 56 dB LAr,Tr (day); 47 dB LAr,Tr (night)	RCL01: 43 dB LAeq,T (highest level at nearest dwelling: 48 dB LAeq,T)		The predicted noise level at the nearest dwellings meets the daytime noise limit, assuming the noise can be controlled such that acoustic feature corrections do not need to be applied. A slight exceedance of 1 dB at night is predicted. The model illustrates that in principle, the utility compound can be designed so as to achieve the daytime noise limits with only a marginal exceedance at night. With the utility compound orientated as shown in the graphic, noise levels are predicted to be highest at an isolated farmhouse to the west of the compound, located adjacent to the A421 and where background noise levels will be higher than those measured on Manor Road that informed the noise limits. However, the layout shown here is purely indicative and does not represent the final design. The utility compound will be the subject of detailed noise modelling as the design progresses.
Air cooled chiller	Energy centre, ground level				
Ventilation louvres	Energy centre, building façade. Louvre assumed to be full width of energy centre building and located on				
40MVA transformer	Substation				
BESS	BESS				
Supergrid transformer	BESS				
Notes (1) RCL - Receptor control location					



WSP House  
70 Chancery Lane  
London  
WC2A 1AF

**wsp.com**

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