Report

Hillingdon Water Sports Facility and Activity Centre, Broadwater Lake, Moorhall Road, Harefield

Noise Assessment

For London Borough of Hillingdon

8 July 2025

Noise CONSULTANTS | PART OF Logika Group

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1 Introduction

1.1.1 Noise Consultants Ltd, part of Logika Group, has been instructed to assess the impacts associated with the proposed recreational development at Hillingdon Water Sports Facility and Activity Centre (HWSFAC), Broadwater Lake, Moorhall Road, Harefield, UB9 6PE (the 'Site'). The proposed development is described as (hereafter referred to as the 'Development'):

"Redevelopment of the site to create the Hillingdon Watersports Facility and Activity Centre including demolition of existing Broadwater Lake Sailing Club (BSC) clubhouse at the north of the lake and erection of a building including changing facilities, meeting rooms, storage, Workshop and seasonal worker accommodation (sui generis), activity shelters; installation of pontoons and slipways; boat shed; equipment storage huts; boat parking and racking areas; camping area; outdoor activity areas; ecological enhancement throughout the site; new pedestrian routes through the peninsula; landscaping including new woodland, dense vegetation screens and boundary treatment; access road; localised dredging and land reclamation; relocation of existing sailing area and creation of floating reedbeds within the lake; coach drop off and turning area; vehicle parking; cycle parking; and associated works."

1.1.2 The following sections present the findings of a baseline sound survey, assessments of construction and operational noise impacts on existing residential noise sensitive receptors (NSRs) and an assessment of the suitability of the site for the staff accommodation.

1.2 Existing Site

1.2.1 **Figure 1-1** shows the existing site and surrounding area. The site is in a semi-rural setting. Adjacent to the southern Site boundary is Moorhall Road and the western boundary, at its closest point, sits about 100m from the HS2 Phase 1 Colne Valley viaduct which is currently under construction.

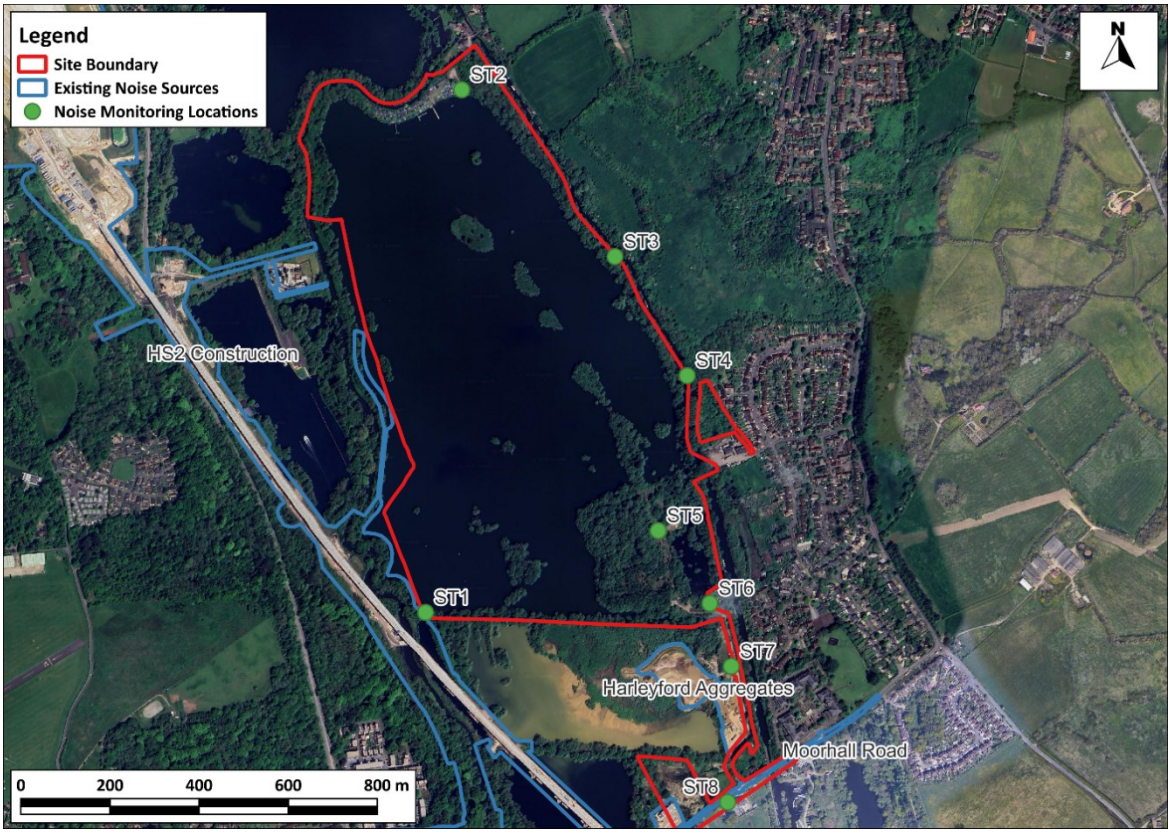


Figure 1-1: Existing Site Location Plan

1.3 Proposed Development

1.3.1 **Figure 1-2** shows the proposed Development and the surrounding area.

1.3.2 The proposed main building and boat storage yards will be located on the southern peninsula, east of the existing woodland. To the south of the existing woodland, an activities field is proposed comprising a camping area, caving, and woodland activities. Proposed activities on the lake are split between the Eastern Channel, and Sailing Area. One island within the Eastern Channel will be removed, and other existing islands retained within the Sailing Zone with some reshaping to create shallow bays for ecological purposes. The Development also involves the demolition of the existing Broadwater Sailing Club (BSC) club house and removal of associated car/boat parking.

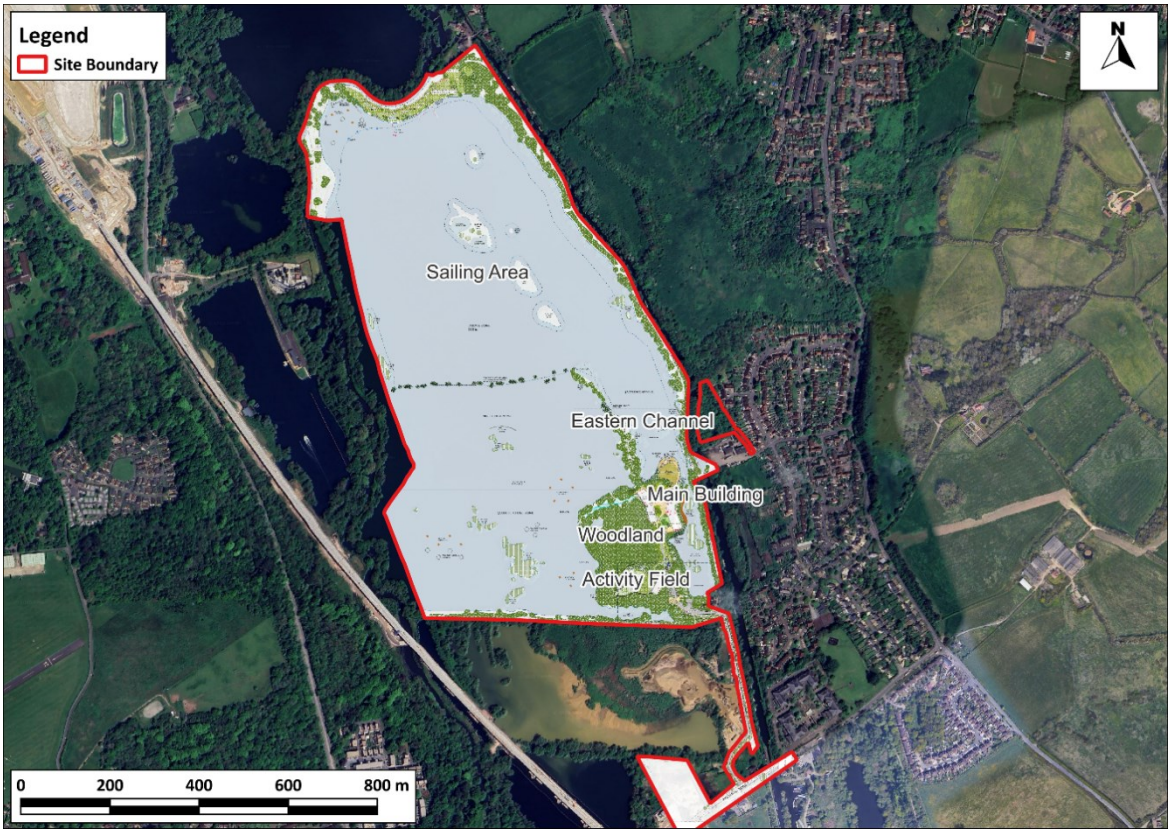


Figure 1-2: Proposed Site Location Plan

2 Assessment Approach

2.1 Baseline Noise Survey

2.1.1 To quantify existing levels of ambient noise on the site in the daytime (07:00 – 23:00) and night-time (23:00 – 07:00) periods, a series of attended noise survey were conducted over a 2-day period, between Thursday 24th and Friday 25th November 2022.

2.1.2 The measurements consisted of 15 and 30 minute daytime measurements on the Thursday and Friday, and 10 to 20 minute night-time measurements on the Friday morning.

2.1.3 **Figure 1-1** presents the sound survey locations, which are described in **Table 2-1**.

2.1.4 Photos of the noise monitoring locations are provided in **Appendix A5**. The noise monitoring locations were chosen to capture existing noise conditions on the site, including the contribution of HS2 construction noise, Harleyford aggregate plant and road traffic noise from the M25 and Moorhall Road; these noise sources are shown in **Figure 1-1**.

Table 2-1: Site Observations

Measurement Location	Date/Time	Description
ST1	10:39 24/11/2022 03:03 25/11/2022 11:17 25/11/2022	Free-field measurement at far south-west corner of site, 1.5m above ground level. The dominant noise source was construction noise from HS2, distant road traffic noise from Moorhall Rd and the M25. Air traffic noise from local airfield was audible on occasions during the day.
ST2	12:15 24/11/2022 04:28 25/11/2022 10:55 25/11/2022	Free-field measurement at most westerly accessible section to the north of the site, 1.5m above ground level. The dominant noise source was from road traffic on the M25.
ST3	10:40 24/11/2022 04:10 25/11/2022 11:19 25/11/2022	Free-field measurement on eastern boundary of the site, 1.5m above ground level. Dominant noise source is Road traffic from M25 and small aircraft.
ST4	10:00 24/11/2022 03:54 25/11/2022 04:48 25/11/2022 11:39 25/11/2022	Free-field measurement on eastern boundary of the site., 1.5m above ground level. The dominant noise source was road traffic from M25. Location considered representative of residential NSRs on St Mary's Road.
ST5	09:50 24/11/2022 03:30 25/11/2022 05:09 25/11/2022 11:49 25/11/2022	Free-field measurement at closest accessible land to centre of the site, 1.5m above ground level. Dominant noise is road traffic from M25. Construction noise from HS2 and operational noise from Harleyford aggregate plant also present. Aggregate plant not audible during the night.
ST6	09:15 24/11/2022 02:35 25/11/2022 11:19 25/11/2022	Free-field measurement at the bottom of the access road to Broadwater Sailing club, 1.5m from ground level. The dominant noise source is from the Harleyford aggregate plant. HS2 construction and some M25 road traffic noise is also present. Aggregate plant not audible during the night. Location considered representative of residential NSRs on Peerless Drive and on-site residential property.

Measurement Location	Date/Time	Description
ST7	09:09 24/11/2022 02:33 25/11/2022 05:26 25/11/2022 12:15 25/11/2022	Free-field measurement near the Harleyford Aggregate plant, 1.5m above ground level. The dominant noise source was from the aggregate plant. Some noise was also present from HS2 construction and Moorhall road. The aggregate plant was not operational during the night-time, some low level, intermittent plant noise was still present. Location considered representative of residential NSRs on Peerless Drive and on-site residential static caravans.
ST8	11:32 24/11/2022 02:15 25/11/2022 05:41 25/11/2022 10:46 25/11/2022	Free-field measurement approximately 3.5m back from Moorhall road at entrance to the site, 1.5m above ground level. Majority of noise from road traffic on Moorhall road, some HS2 construction noise also present. Small amount of noise from aggregate plant. Location considered representative of residential NSRs along Moorhall Road.

Weather Conditions

2.1.5 Weather conditions on Thursday 24th November were overcast but dry, with windspeeds less than 5 ms^{-1}. Similar conditions were present on Friday 25th November but with clear skies.

Noise Monitoring Equipment

2.1.6 Noise monitoring was undertaken using fully calibrated Class 1 instrumentation as defined in BS EN 61672-1:2013[1], calibrated to traceable standards within 2 years of the survey. Prior to and following noise measurements acoustic field-calibration of the sound level meters and microphones used in the survey was performed using an acoustic calibrator that itself had been calibrated within the preceding 12 months. No significant drift (i.e., >0.1 dB) in the field-calibrated noise level was observed. Measurement microphones were fitted with suitable windshields for the duration of the noise monitoring and were time synchronised.

2.1.7 All instrumentation was configured to report the environmental parameters L_{Aeq}, L_{A10}, L_{A90}, and L_{Amax} in 1/3 octave bands. All measurements were conducted, where possible, in accordance with BS 74451:2003 '*Description and measurement of environmental noise. Guide to quantities and procedures*' (BS 7445, 2013)

2.2 Future Baseline Noise Modelling

2.2.1 A modelling exercise has been undertaken to replicate the operational noise contours of the proposed HS2 line. A literature review has been conducted of the HS2 London-West Midlands Environmental Statement (HS2 ES) (2013[2]), available mapbooks[3] and route plan[4].

2.2.2 The above information has been used to construct a noise model representative of the future baseline scenario including elevation changes and the construction of the Colne Valley Viaduct.

[1] BS EN 61672-1:2013 Electroacoustics. Sound Level Meters Specifications (2013)
[2] HS2 London-West Midlands Environmental Statement, Volume 5: Technical Appendices, CFA7: Colne Valley Operational Assessment (SV-004-007) Sound, noise and vibration, November 2013
[3] SV-01-010 (Doc. C250-ARP-EV-MAP-000-003556), SV-01-011 (Doc. C250-ARP-EV-MAP-003557)
[4] Final Preliminary Design, Chainage 25+600 to 32+000 (Drawing No. C222-ATK-CV-DPP-020-000001-FPD)

2.2.3 Noise modelling has been undertaken in accordance with ISO 9613-2:1996 – '*Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*' (ISO 9613-2) using octave band information from Van der Toorn (2001)[5] calibrated to HS2 ES receptor levels.

2.2.4 The resulting model achieves an accuracy of +/- 3 dB when compared to the HS2 ES values, at receptors where HS2 operations will be dominant. This information and the reproduced contours have been presented in **Section 7**.

2.2.5 Based on the calibrated emissions a model has been produced to calculate propagation of the $L_{AFmax\ (night)}$ levels emitted from HS2 operations. It is assumed that peak daytime flows (07:00 – 21:00) will reach 18 trains per hour in each direction. During the night-time period the '*number of services will progressively decrease and the last service will arrive at terminal stations by 24:00*'[6]. The relevance of the number of events will be determined by the levels detailed in **Section 7** at the proposed receptors.

2.2.6 The modelling of the future baseline only includes contributions to the noise environment from HS2, not the local road network. An assessment of road traffic noise can be found in **Section 5**. It has been determined that the proposed HS2 route remains consistent with that detailed in the HS2 ES, with no additional provisions impacting this section of the line. It is understood that wayside noise barriers may have been modified but would have been designed to ensure that they do not generate any new potentially significant noise impacts compared to those advised in the ES.

2.3 Activity Noise Levels

2.3.1 An attended noise survey was undertaken at Lea River Rowing Club, Hackney, London to obtain measurements of rowing activities. Weather conditions were considered mild with no periods of rain or strong winds. During the survey, measurements on the bank of the river were supplemented by observations which confirmed that activity from the rowing club was dominant. Sources of noise included the impact of oars against paddleboards / canoes / rowing boats and the water, as well as occasional amplified instruction from the site instructors. The measured levels are described in **Table 2-2** and have been used to quantify noise emissions. Additionally, Sports England Artificial Grass Pitch (AGP)[7] Guidance, as described in **Appendix A2.3,** has been used to obtain an assumed emission for the activities field south of the woodland. This is a sound pressure level of 58 dB(A) at 10m from the edge of the equivalent halfway line of a sports field.

Table 2-2: Leisure Activity Sound Pressure Levels (L_p) at 10 Metres

Description	Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1K	2K	4K	8K	
Rowing Only at 18 metres (2 Participants)	51	50	53	57	53	47	45	39	58 $L_{Aeq,10s}$

[5] Van der Toorn, J.D, 2001, Noise and Vibration from High-Speed Trains, p65-83
[6] HS2 London-West Midlands Environmental Statement, Volume 2: Community Forum Area Report, CFA7: Colne Valley, November 2013
[7] Artificial Grass Pitch (AGP) Acoustics - Planning Implications Guidance (2015)

Description	Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1K	2K	4K	8K	
Rowing and Instruction Over Megaphone at 20 metres (4 Participants - Highest Measured Level)	53	52	54	69	60	54	44	35	67 $L_{Aeq,20s}$

2.4 Construction Noise and Vibration Assessment

Construction Noise

2.4.1 The construction noise impact assessment has been carried out for activities associated with the proposed development with regard to the methodologies set out in BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites: Part 1 - Noise*. Activity noise levels have been determined from the data tables set out in Annex C of BS 5228-1 and the predicted construction noise levels have been calculated using methods set out in Annex F of BS 5228-1.

Study Area

2.4.2 The study area identified for the construction noise assessment is 300 m from the closest construction activity boundary. Based on the prevailing noise environment, it is unlikely that outside of the 300 m study area, construction noise levels will exceed the lower cut-off values described in **Paragraph 2.4.7**. **Figure 2-1** presents the construction noise assessment study area.

Figure 2-1: Construction Noise Assessment Study Area

2.4.3 Construction activities will vary in location depending on the phase of works and most receptors will only be affected during one or two phases of the works.

Baseline Noise Levels

2.4.4 The baseline noise levels for the assessment of construction noise have been derived from the baseline noise measurements. The daytime $L_{Aeq,16hr}$, and night-time $L_{Aeq,8hr}$ noise levels are presented in **Table 3-1** in **Section 3**.

Construction Noise Receptors

2.4.5 The construction NSRs assessed are defined in **Table 2-3** and can be identified in **Figure 2-2**.

Table 2-3: Construction Noise Receptor Groups

Receptor Group	Description	Distance to Site Boundary / m
A	Existing residence off the London Loop footpath, north of Moorhall Road, Harefield, Uxbridge	23
B	Existing residences off Peerless Drive, Harefield, Uxbridge	52
C	Existing offices off Moorhall Road, Harefield, Uxbridge	54
D	Existing pub Jack's Mill and residences off Jack's Lane, Harefield, Uxbridge	96
E	Existing residences off St Mary's Close, Harefield, Uxbridge	85
F	Existing residence off Moorhall Road, Harefield, Uxbridge	46
G	Existing pub The River Garden off Moorhall Road, Harefield, Uxbridge	117
H	Existing residence south of Moorhall Road, Harefield, Uxbridge	74
I	Existing residence north of the proposed site access	On-Site
J	Existing residence west of site access road	On-Site
K	Existing caravan site west of the site access road	On-Site

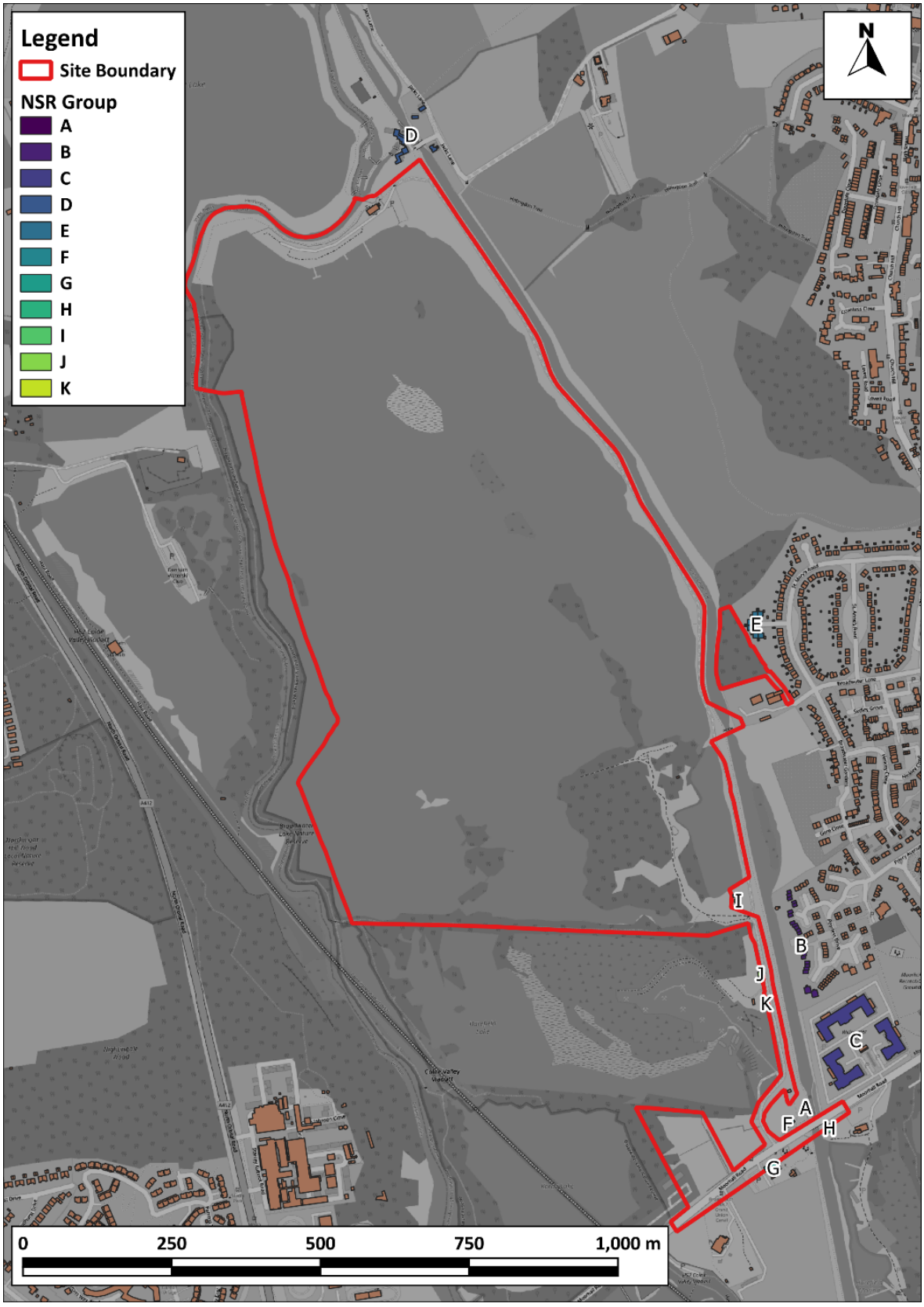


Figure 2-2: Construction Noise Receptor Groups

Assessment Criteria

2.4.6 The assessment of demolition and construction noise has regard to the BS 5228-1 5 dB(A) change method set out in **Paragraph A2.3.10**.

2.4.7 The lower cut-off values are considered to represent the LOAEL for demolition and construction noise. The lower cut-off values are construction/demolition noise levels (site noise) of 65 dB $L_{Aeq,T}$ for the daytime, 55 dB $L_{Aeq,T}$ for the evening and 45 dB $L_{Aeq,T}$ for the night-time.

2.4.8 The SOAEL is represented by the primary criterion: the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient by 5 dB or more, subject to the lower cut-off values.

2.4.9 A UAEL has been established based on the total noise exceeding the pre-construction ambient by 10 dB or more, subject to the lower cut-off values.

2.4.10 The assessment criteria are summarised in **Table 2-4**.

Table 2-4: Demolition and Construction Assessment Criteria

Assessment Period	LOAEL $L_{Aeq,T}$ (dB)	SOAEL $L_{Aeq,T}$ (dB)	UAEL $L_{Aeq,T}$ (dB)
Daytime (07:00 to 19:00)	Site Noise: 65 dB $L_{Aeq,T}$	Total noise level[8] is greater than pre-construction ambient noise level by 5 dB or more when site noise exceeds LOAEL	Total noise level[8] is greater than pre-construction ambient noise level by 10 dB or more when site noise exceeds LOAEL
Evening (19:00 to 23:00)	Site Noise: 55 dB $L_{Aeq,T}$		
Night-time (23:00 to 07:00)	Site Noise: 45 dB $L_{Aeq,T}$		

2.4.11 A significant adverse impact is indicated where the SOAEL is exceeded for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months, or if the UAEL is exceeded for any amount of time. A result between LOAEL and SOAEL should also be mitigated and minimised as far as practicable.

Construction Vibration

2.4.12 Vibration caused by demolition and construction works has the potential to cause human disturbance / annoyance. However, based on experience and the distance to nearby receptors adverse impact on residential NSRs is unlikely.

2.4.13 The construction vibration impact assessment is carried out with regard to the methodologies set out in BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites: Part 2 – Vibration*. Sources of vibration anticipated to occur include vibratory compaction during roadworks.

Study Area

2.4.14 Roadworks forming the site access off Moorhall Road will require the use of vibratory compaction which is expected to generate the highest levels of construction vibration. The study area identified for construction vibration assessment is 100m from the closest construction activity boundary. **Figure 2-3** presents the construction vibration assessment study area.

[8] Site noise level plus pre-construction ambient noise level

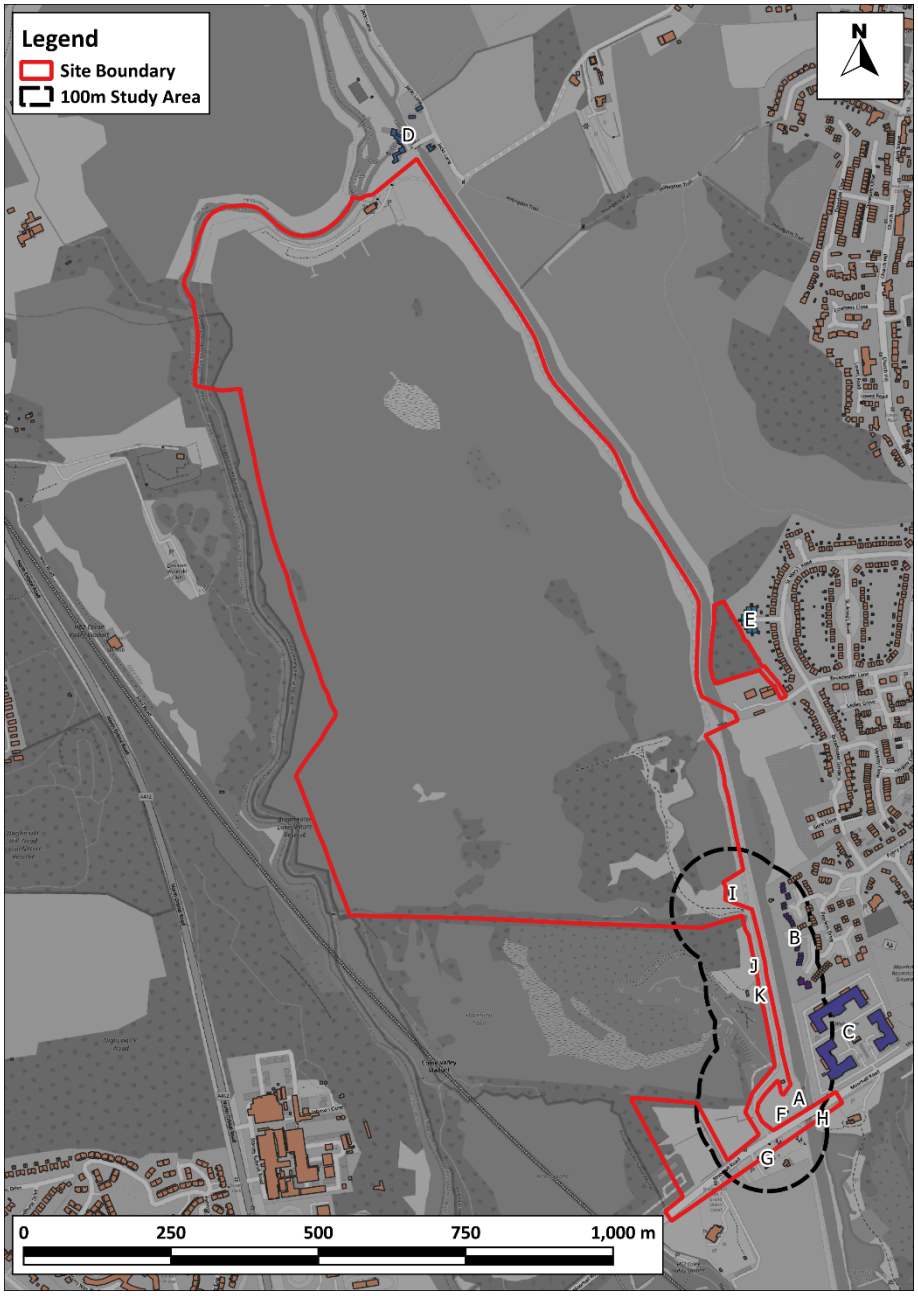


Figure 2-3: Construction Vibration Study Area

2.4.15 Construction activities will vary in location depending on the phase of works and most receptors will only be affected during one or two phases of the works, mainly those which include the use of vibratory compaction during access road construction.

Baseline Vibration Levels

2.4.16 The baseline for construction vibration assessment is assumed to be negligible in the absence of construction activity prior to the commencement of work.

Construction Vibration LOAEL and SOAEL

2.4.17 **Table 2-5** sets out the LOAEL and SOAEL for construction vibration based on the guidance in BS 5228-2.

Table 2-5: Construction Vibration LOAEL and SOAEL for all Receptors

Time Period	LOAEL	SOAEL
All time periods	0.3 mm/s PPV	1.0 mm/s PPV

Assessment Criteria

2.4.18 The magnitude of impact at the vibration sensitive receptors (VSRs) is determined using **Table 2-6**.

Table 2-6: Construction Noise Magnitude of Impact at Receptors

Magnitude of Impact	Construction Noise Level
Major	Above or equal to 10 mm/s PPV
Moderate	Above or equal to SOAEL and below 10 mm/s PPV
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

2.4.19 A significant adverse impact is determined where a major or moderate magnitude of impact will occur for 10 or more days in any 15 consecutive days or nights, or a total number of days exceeding 40 in any 6 consecutive months. This approach takes into account the transient nature of roadworks.

2.5 Construction and Operational Road Traffic Noise Assessment

Road Traffic Noise Assessment Methodology

2.5.1 The road traffic noise impact assessment is carried out with regard to the methodology set out in the Design Manual for Roads and Bridges (DMRB) LA111 Noise and Vibration.

Study Area

2.5.2 The study area for road traffic noise assessment is 50 m from the kerb line of the public roads where there is the potential for an increase in Basic Noise Level (BNL) of 1 dB(A) or more as a result of the addition of construction or operational traffic to the existing traffic flow (see **Figure 2-4**). As such, no specific residential NSRs have been identified for the assessment.

Basic Noise Level

2.5.3 BNLs are calculated using the methodology in CRTN for the peak construction year with and without construction traffic, and the opening year with and without operational traffic for all relevant road links in the study area.

2.5.4 Notably the traffic data used for the operational assessment related to a slightly larger scheme and is therefore an overestimate of the impacts likely to be experienced.

Road Traffic Noise Magnitude of Impact

2.5.5 Road traffic noise impacts are determined using the magnitude of change scale set out in **Table 2-7**.

Table 2-7: Road Traffic Noise Magnitude of Impact at Receptors

Magnitude of Impact	Change in BNL
Major	Greater than or equal to 5.0
Moderate	Greater than or equal to 3.0 and less than 5.0
Minor	Greater than or equal to 1.0 and less than 3.0
Negligible	Less than 1.0

Assessment Criteria

2.5.6 A potentially significant impact is determined where a major or moderate magnitude of impact will occur for the assessment of construction traffic noise.

2.5.7 A potentially significant impact is determined where a minor, moderate or major magnitude of impact will occur for the opening year of the development.

Traffic Data and Road Links

2.5.8 Figure 2-4 identifies the link locations.

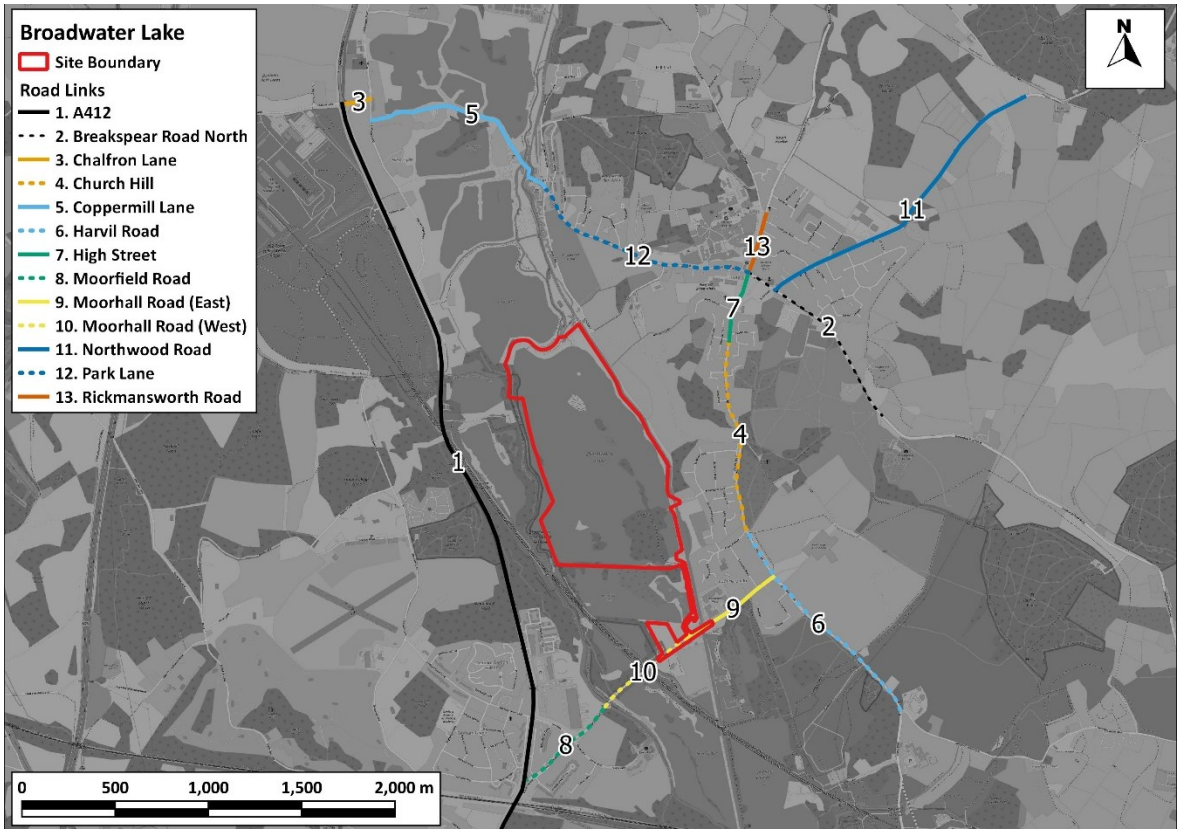


Figure 2-4: Road Traffic Links

2.5.9 The traffic data is summarised in **Appendix A7** for a larger scheme than the proposed Development, representing a worst-case assessment.

2.6 Operational Sound Assessment

Building Services and Plant Noise

2.6.1 The operational noise assessment relates to fixed building services plant (BSP) installations required as part of the proposed development. The assessment has been based on the methodology in BS 4142:2014+A1:2019 (described in **Appendix A2.3**). As the precise BSP requirements are not fully known at this stage, the assessment sets Environmental Sound Criteria (ESC) at each residential NSR which represent the combined rating level from all plant installations at the residential NSR.

2.6.2 Environmental Sound Criteria will be determined based on the background sound level, representative of the nearest measured during the baseline survey.

Leisure Activity Noise

2.6.3 Noise from the future use of Broadwater Lake for water sports activity have the potential to adversely impact existing residential NSRs on-site on the southeast peninsular and east of the development site.

2.6.4 Sports England AGP guidance (see **Appendix A2.3**) advocates an upper noise limit of 50 dB $L_{Aeq,1hr}$ for sports activities (typically on an AGP). This noise level aligns with the World Health Organization Guidelines for Community noise threshold where few people are moderately annoyed.

2.6.5 A noise limit of 50 dB $L_{Aeq,1hr}$ has been adopted for activity noise at the existing residential NSRs.

Site Suitability Assessment

2.6.6 A site suitability assessment has been included which describes the potential impact of noise and vibration upon the proposed staff accommodation at the Site. The noise model outputs based on the future baseline noise climate at the Site, described in **Section 7**, and the impacts it has upon the proposed residential development within the site have been assessed.

2.6.7 In respect of noise the sources dominant in the future baseline, these will primarily be road traffic noise from the local road network and operational HS2 noise.

2.6.8 This assessment has been prepared taking into account all relevant local and national policy, guidance and regulations provided in **Appendix A2**. The following paragraphs present the assessment criteria adopted within the site suitability assessment which has been designed to follow the approach advocated in ProPG.

Site Risk Classification

2.6.9 The ProPG site risk classification presented in **Appendix A2.3** is a sliding scale that does not define precise noise exposure limits to site risk classification. For the purposes of this report, the noise thresholds that have been adopted in order to classify site risk are defined in **Table 2-8** and are set for the daytime and night-time periods.

Table 2-8: Site Risk Noise Exposure Thresholds

ProPG Site Risk Category	Noise Exposure Threshold dB $L_{Aeq,16\text{-hour}}$	Noise Exposure Threshold dB $L_{Aeq,8\text{-hour}}$	ProPG Based Pre-Planning Application Advice
Negligible (below LOAEL)	<50	<40	Indicates development site is likely to be acceptable from a noise perspective
Low (LOAEL – SOAEL)	50 – 63	40 – 53	Indicates development site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and demonstrated
Medium (SOAEL - UAEL)	63 – 70	53 – 66	Indicates the development site is less suitable from a noise perspective. A subsequent application may be refused unless a good acoustic design process is followed and demonstrated
High (above UAEL)	>70	>66	Indicates an increased risk that the development would be refused on noise grounds. However, this risk may be reduced following a good acoustic design process.

2.6.10 With respect to the $L_{AFmax\ (night)}$, ProPG states that "the initial site noise risk assessment should include the consideration of the individual noise events when the external $L_{Amax,F}$ exceeds 60 dB. A site should not be regarded as negligible risk if the $L_{Amax,F}$ exceeds, or is likely to exceed 60 dB more than 10 times a night. A site should be regarded as high risk if the $L_{Amax,F}$ exceeds, or is likely to exceed 80 dB more than 20 times a night."

2.6.11 Therefore, taking this into account the LOAEL and UAEL thresholds for the L_{AFmax} for the purposes of this assessment:

- A 'negligible' risk is deemed to occur where the 10th highest measured $L_{AFmax,5min\ (night)}$ is less than 60 dB; and
- a 'high' risk is deemed to occur where the 20th highest measured $L_{AFmax,5min\ (night)}$ is greater than 80 dB.

2.6.12 Based on the above a 'low' risk is deemed to occur where the 10th highest measured L_{Amax} (night) is less than 70 dB.

Internal and External Noise Guidelines

2.6.13 For internal and external noise levels, the assessment references the internal noise guidelines set out in BS 8233:2014, as advocated by ProPG (**Table 2-9**). Adherence to these guidelines is considered in the design of the building envelope.

2.6.14 The assessment also considers maximum noise levels (L_{AFmax}) within bedrooms at night-time on the basis of 45 dB L_{AFmax} not normally being exceeded more than ten times a night.

2.6.15 With respect to external amenity spaces, BS 8233:2014 states that "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" and, therefore, 55 dB $L_{Aeq,T}$ has been adopted as an upper guideline value.

Table 2-9: Target Internal Noise Levels

Location	Activity	Daytime Noise Level (0700-2300hrs)	Night-time Noise Level (2300-0700hrs)
Living Room	Resting	35 dB $L_{Aeq,16hr}$	-
Dining Room	Dining	40 dB $L_{Aeq,16hr}$	-
Bedroom	Sleeping (daytime resting)	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,16hr}$ 45 dB L_{AFmax} (normally less than 10 times a night)

2.6.16 The noise insulation performance of a closed window relates to the building's façade construction and the associated elements of a room (including the sound insulation performance of glazing and ventilation components) and their respective areas. At this stage detailed design information of the proposed dwellings is not available. For the purposes of this assessment, the following conservative assumptions have therefore been adopted for the 'closed window' scenario:

- The wall and room constructions of the dwellings are of a standard nature, i.e. brick and block wall construction as per the standard assumptions made within BS 8233:2014 with a sound reduction index (SRI) summarised in **Table 2-10**.
- Standard thermal double glazing and trickle ventilators will be incorporated into the dwellings that achieve a sound reduction index (SRI) summarised in **Table 2-10**.
- It is assumed that there will be a single trickle ventilator per room.

2.6.17 Guidance on the likely reduction in façade insulation due to an open window is provided in ProPG (2017). It states that an open window typically reduces the insulation "*to no more than 10 to 15 dB(A)*". For the purposes of this assessment, it is therefore considered reasonable to assume a reduction of 13 dB(A) for an "open window" scenario.

Table 2-10: Assumed SRI for Standard Thermal Double Glazing, External Wall and Trickle Vent

Element	Sound Reduction Index (SRI) at Octave Centre Band Frequency (Hz)								R_w (C; C_{tr})
	63	125	250	500	1K	2K	4K	8K	
Double Glazing (4:12:4)	20	24	20	25	35	38	35	35	32 (-2; -5)
Brick and Block External Wall	40	40	44	45	51	56	56	56	52 (-2; -5)
Standard In/over-frame Trickle Vent	20	23	26	29	30	33	33	35	33 (-2; -4)

3 Baseline Conditions Assessment

3.1 Noise Measurement Results

3.1.1 A summary of the noise measurement results is presented in **Table 3-1**.

3.1.2 The results of the attended daytime and night-time noise measurements are rounded to the nearest decimal. For L_{Aeq} noise levels, the values presented in the table are the logarithmic average of measured data. For L_{A90} the arithmetic mean is presented. For the L_{AFmax} values at night, the range of 5-minute values are presented.

Table 3-1: Noise Measurement Results

Measurement Location	Period	$L_{Aeq,T}$ (dB)	L_{AFmax} (dB) (range 5-minute)	$L_{A90,T}$ (dB)
ST1	Daytime (07:00 – 23:00hrs)	51.6	-	47.8
	Night-time (23:00 – 07:00hrs)	44.0	45.3 – 51.0	42.9
ST2	Daytime (07:00 – 23:00hrs)	53.0	-	48.0
	Night-time (23:00 – 07:00hrs)	44.6	46.1 - 48.5	43.5
ST3	Daytime (07:00 – 23:00hrs)	50.0	-	46.9
	Night-time (23:00 – 07:00hrs)	42.9	43.7 - 47.9	41.5
ST4	Daytime (07:00 – 23:00hrs)	49.4	-	48.3
	Night-time (23:00 – 07:00hrs)	45.3	46.1 - 55.2	43.4
ST5	Daytime (07:00 – 23:00hrs)	48.7	-	47.5
	Night-time (23:00 – 07:00hrs)	44.1	45.9 - 52.4	42.8
ST6	Daytime (07:00 – 23:00hrs)	49.5	-	48.0
	Night-time (23:00 – 07:00hrs)	40.3	48.8 - 56.3	38.4
ST7	Daytime (07:00 – 23:00hrs)	62.2	-	61.1
	Night-time (23:00 – 07:00hrs)	46.3	47.8 - 57.7	43.8
ST8	Daytime (07:00 – 23:00hrs)	71.7	-	51.2
	Night-time (23:00 – 07:00hrs)	66.3	48.5 - 89.3	44.9

3.2 Future Baseline Assessment

3.2.1 In order to determine the noise exposure of the proposed development to future operational noise from HS2, a comprehensive noise model has been developed and calibrated as described in **Paragraph 2.2.3.** The model has been developed using LimA® computational sound modelling software (v2020) and has been configured to calculate daytime and night-time levels of noise in accordance with ISO 9613 -2.

3.2.2 The model has been developed using OpenStreetMap digital mapping data and digital drawings of the proposed development provided in the supplementary documents of the 2013 ES. Existing terrain and building height information was obtained from the UK Environment Agency Digital Terrain Model (DTM) 2022 and Digital Surface Model (DSM) 2022 datasets (public sector information licenced under the Open Government Licence v3.0).

3.2.3 Noise contours have been presented in **Section 7** as part of the Site Suitability assessment.

Table 3-2: Future Baseline Results Summary

Location	Period	$L_{Aeq,T}$ (dB)			L_{AFmax} (dB) (range 5-minute)		
		Measured Baseline	HS2 Predicted	Cumulative	Measured (single highest)	HS2 Predicted*	Difference
ST1	Daytime	51.6	59.3	59.9	74.0	79.5	5.5
	Night-time	44.0	49.8	50.8	51.0		28.5
ST2	Daytime	53.0	47.0	54.0	76.3	53.6	-27.7
	Night-time	44.6	37.5	45.4	48.5		5.1
ST3	Daytime	50.0	47.5	51.9	73.4	52.6	20.8
	Night-time	42.9	38.0	44.1	47.9		4.7
ST4	Daytime	49.4	48.2	51.9	59.1	53.2	-5.9
	Night-time	45.3	38.7	46.2	55.2		-2.0
ST5	Daytime	48.7	51.4	53.2	56.0	58.0	2.0
	Night-time	44.1	41.9	46.1	52.4		5.6
ST6	Daytime	49.5	51.7	53.8	62.2	58.7	-3.5
	Night-time	40.3	42.2	44.4	56.3		2.4
ST7	Daytime	62.2	52.3	62.6	74.9	60.3	-14.6
	Night-time	46.3	42.8	47.9	57.7		2.6
ST8	Daytime	71.7	56.2	71.8	86.2	69.4	-16.8
	Night-time	66.3	46.7	66.3	89.3		-19.9
*Notably road traffic L_{AFmax} noise levels are not included in NCL's modelling of HS2							

4 Construction Noise and Vibration Assessment

4.1 Construction Noise Assessment

4.1.1 The construction noise impact assessment has been carried out with regard to the methodologies set out in BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites: Part 1 - Noise*. Activity noise levels have been determined from the data tables set out in Annex C of BS 5228-1 and the predicted construction noise levels have been calculated using the calculation methodologies in Annex F of BS 5228-1 .

Construction Phases

4.1.2 The construction phases are summarised in Table A6-4. An assumed programme is presented in Figure A6-1.

4.1.3 This spans a total of 95 weeks, of which seven 1-month periods have been selected for use in this assessment. Each works item has been captured at least once in the seven chosen time-slices.

4.1.4 The assessment phases and associated sub-activities are summarised in **Table 4-1** and **Table A6-1** respectively. Please note that though some sub-activities are repeated across phases, the plant in use and associated operating conditions may vary. See **Table A6-3** for more detail.

Table 4-1: Construction Phase Item of Works

Phase No.	Item of Works
1	Establish site compound and install noise barriers
2	Dredging of Lake / remove islands
3	Reclamation of Land southeast
4	Creating of Islands
5	Creating of reed beds
6	Demolition of obsolete infrastructure
7	Utilities
8	Road building, resurfacing (including car parks)
9	Construction - Main Buildings
10	Construction of outdoor activities incl. zipwire etc
11	Demolition of existing sailing Club
12	Landscaping

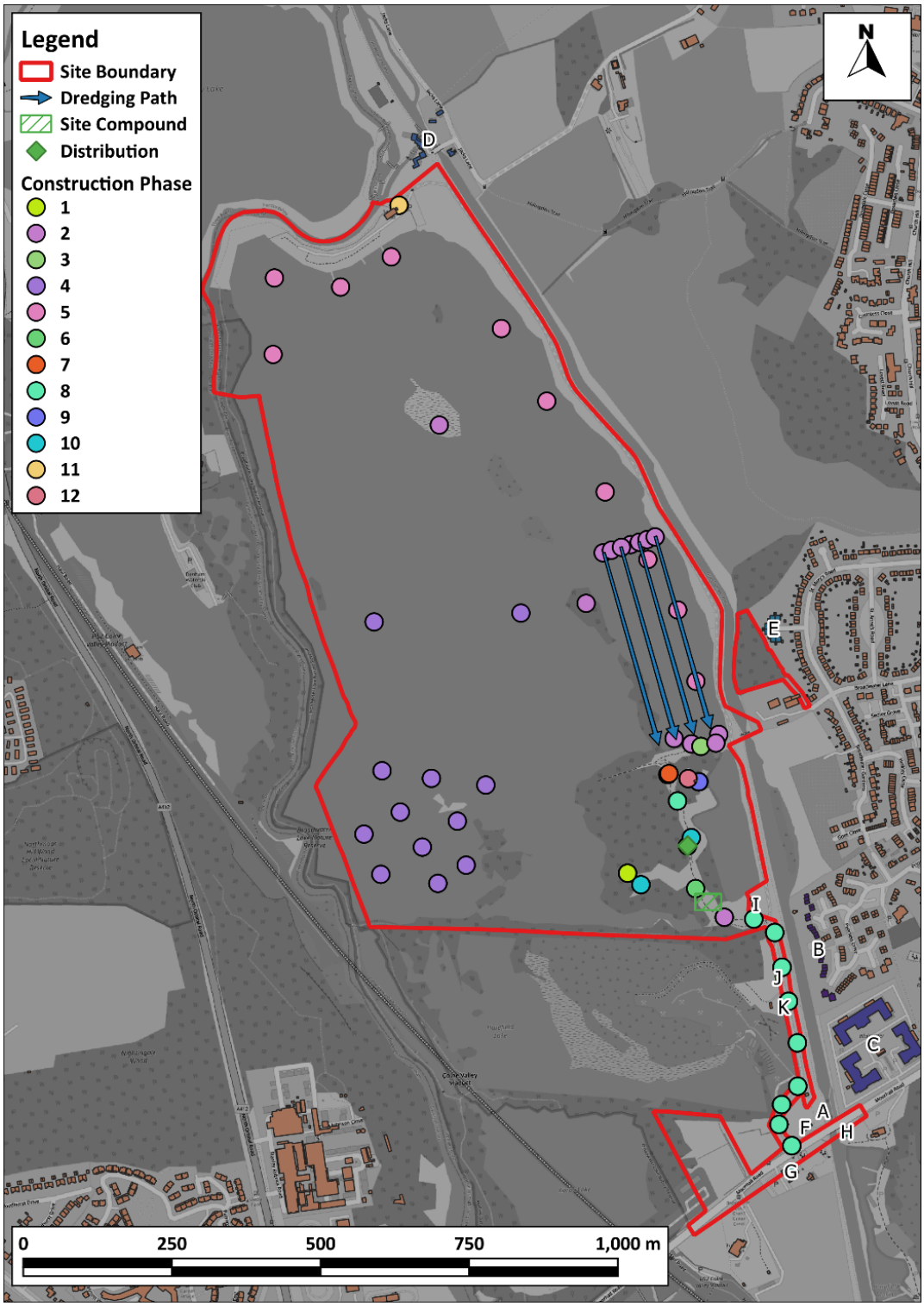
Model Assumptions

4.1.5 Levels of construction noise have been calculated using a noise model in accordance with Annex F of BS 5228-1 accounting for distance attenuation, air absorption, topography, ground cover and screening and reflections caused by buildings and other features. To account for propagation to specific receptor points from sources across the lake, the ground type has been set to hard (G = 0)

as water is acoustically reflective: this represents a worst-case assessment for all source and receptor locations.

4.1.6 The prediction methodology has assumed some indicative locations for the proposed works activities shown in **Figure 4-1**. More detail on the assumed plant for each construction phase is presented in **Table A6-3**.

Figure 4-1: Construction Phase Source Locations



Plant List

4.1.7 The associated sound power level information as required for the noise predictions has been taken from those detailed in BS 5228-1, and the assumptions are summarised in **Table A6-2**. The equipment on-times and phasing are described in more detail in **Table A6-3**.

Assessment Scenarios

4.1.8 As stated in **Paragraph 4.1.2**, seven assessment scenarios have been included, **Table 4-2** below details works items undertaken in each one-month period.

Table 4-2: Construction Assessment Scenarios

	Construction Assessment Scenarios						
Phase No.	Sept 2026	Oct 2026	March 2027	July 2027	Sept 2027	Dec 2027	Feb 2028
1	✓						
2	✓						
3	✓						
4	✓						
5	✓						
6	✓						
7	✓	✓	✓	✓	✓		
8	✓	✓			✓	✓	✓
9		✓	✓	✓			
10			✓				
11					✓		
12			✓		✓	✓	

Detailed Results

4.1.9 The resulting construction noise levels at the noise sensitive receptors based on the above assumptions are given in **Table 4-3**. The cumulative construction noise and ambient levels are given as façade levels in **Table 4-4**.

Table 4-3: Site Noise Levels (Façade)

Residential NSR Group	Floor	Sept 2026	Oct 2026	March 2027	July 2027	Sept 2027	Dec 2027	Feb 2028
		Construction (Site) Noise Level Only $L_{Aeq,T}$ dB						
A	Gf	66	65	55	54	65	65	65
	1f	67	66	55	54	65	65	65
B North	Gf	71	66	60	53	66	66	66
	1f	71	66	60	55	66	66	66
B South	Gf	70	67	59	57	66	66	66
	1f	70	67	60	57	66	66	66
C	Gf	66	64	56	52	63	63	63
	1f	66	64	56	53	63	63	63
	2f	66	64	57	54	63	63	63
	3f	67	64	58	55	64	63	63
D	Gf	55	48	50	48	73	42	40
E	Gf	65	59	60	58	57	53	51
	1f	65	59	60	58	57	53	51
F	Gf	69	68	54	52	68	68	68
	1f	69	68	54	52	68	68	68
	2f	70	69	55	52	68	68	68
G	Gf	69	68	52	49	67	67	67

Residential NSR Group	Floor	Sept 2026	Oct 2026	March 2027	July 2027	Sept 2027	Dec 2027	Feb 2028
		Construction (Site) Noise Level Only $L_{Aeq,T}$ dB						
	1f	69	68	55	52	68	67	67
H	Gf	57	55	48	47	54	54	54
I	Gf	78	71	66	63	70	70	69
J	Gf	74	74	56	54	73	73	73
K	Gf	75	75	53	53	74	74	74
	Site noise level ≥ LOAEL of 65 dB							

Table 4-4: Residential NSRs Cumulative Construction Noise Levels (Façade)

Residential NSR Group	Floor	Representative Baseline Location	Daytime Pre-Construction Ambient $L_{Aeq,T}$ dB	Sept 2026	Oct 2026	March 2027	July 2027	Sept 2027	Dec 2027	Feb 2028
				Cumulative Level, $L_{Aeq,T}$ dB (Construction Site Noise plus Pre-Construction Ambient)						
A	Gf	ST8	75	76	75	75	75	75	75	75
	1f			76	76	75	75	75	75	75
B North	Gf	ST7	65	72	69	66	65	69	69	69
	1f			72	69	66	65	69	69	69
B South	Gf			71	69	66	66	69	69	69
	1f			71	69	66	66	69	69	69
C	Gf			69	68	66	65	67	67	67
	1f			69	68	66	65	67	67	67

Residential NSR Group	Floor	Representative Baseline Location	Daytime Pre-Construction Ambient $L_{Aeq,T}$ dB	Sept 2026	Oct 2026	March 2027	July 2027	Sept 2027	Dec 2027	Feb 2028
				Cumulative Level, $L_{Aeq,T}$ dB (Construction Site Noise plus Pre-Construction Ambient)						
	2f			69	68	66	65	67	67	67
	3f			69	68	66	65	68	67	67
D	Gf	ST2	56	59	57	57	57	73	56	56
E	Gf	ST4	52	65	60	61	59	58	56	55
	1f			65	60	61	59	58	56	55
F	Gf	ST8	75	76	76	75	75	76	76	76
	1f			76	76	75	75	76	76	76
	2f			76	76	75	75	76	76	76
G	Gf			76	76	75	75	76	76	76
	1f			76	76	75	75	76	76	76
H	Gf			75	75	75	75	75	75	75
I	Gf	ST6	53	78	71	66	63	70	70	69
J	Gf	ST7	65	75	75	66	65	74	74	74
K	Gf			75	75	65	65	75	75	75
	Site noise level ≥ LOAEL of 65 dB									
	Site noise level > LOAEL and Total noise level exceeds the pre-construction ambient by 5 dB or more (SOAEL)									
	Site noise level > LOAEL and Total noise level exceeds the pre-construction ambient by 10 dB or more (UAEL)									

4.1.10 As shown in **Table 4-4**, noise levels associated with a majority of the construction phases at the considered receptors fall into or below the LOAEL criteria, and therefore potential significant noise impacts at residential NSR group C, D, E and H are unlikely to occur during most phases assuming that contractors adopt best practicable means (BPM).

4.1.11 The construction phases that are likely to produce the greatest noise levels at residential NSRs include road construction, and demolition of the old sailing club.

4.1.12 The highest noise levels occur as a result of road construction between September 2026 and March 2027, and September 2027 and February 2028. The most affected receptors are on-site residential NSR groups I – K where the UAEL criteria is exceeded due to the close proximity of the works to the receptors. Additionally, the SOAEL criteria is exceeded at group B during the earliest stages of construction only. It should be noted that road works will progressively move along the road, and the model results present works at a worst-case location. Importantly, these levels will only be experienced for short periods of time when the road construction activities are occurring close to the dwellings along the access road.

4.1.13 Additionally, at the off-site NSRs the UAEL criteria is exceeded at group D during the demolition phase.

Additional Mitigation

4.1.14 In order to minimise the impacts of construction noise, a Construction Environmental Management Plan (CEMP) will also be produced by the contractor (Appendix 6.1 of the Environmental Statement), which includes specific mitigation measures according to best practicable means (BPM) that the contractor will take to control noise impacts. Since significant adverse impacts are only experienced during specific phases, described above, the CEMP will focus on reducing noise impacts during these activities (i.e. road construction, dredging of the lake, and demolition of the BSC building). In particular, the following BPM measures would be appropriate:

- **Substitution** – where practicable, one or more of the proposed construction plant items are substituted for a quieter or lower vibration option, e.g., use of rotary bored piling over driven piles.
- **Equipment siting** – when and where practicable, operational construction plant items will be located away from noise sensitive areas.
- **Screening** – site hoarding, site cabins and material stores will provide noise screening to low level sources of noise. Specific sources of noise will be enclosed or screened, where practicable, to further reduce noise. Inherent screening will also be achieved as buildings increase in height and the building envelope is completed.
- **Working methods** – where practicable, adjust working methods so that the number of concurrent noisy construction activities being undertaken is reduced. Completing activities close to the Site boundary quickly and efficiently. Shutting down noisy equipment when not in use. Starting up/shutting down vibratory compaction equipment away from vibration sensitive areas.
- **Hours of work** – working hours on Site will be agreed with the Council, with the standard hours of work adhered to as far as practicable. Any work outside of the agreed hours will be subject to prior agreement of, and/or reasonable notice to the Council, as appropriate.
- **Risk assessments and method statements** – incorporating noise and vibration control into the method statements at an early stage to capture the provision of appropriate mitigation measures. Preparation of risk assessments to inform relevant structural surveys in relation to construction vibration, if applicable. Toolbox talks to ensure workers are fully briefed on any adjustments to working practices in the interests of noise and vibration.

- **Community liaison** – Proactive links between noise management activities and community relations activities to keep local residents informed of periods of likely intensive construction activities, including changes to hours of work. Appointment of a Site contact to whom complaints/queries about noise and vibration can be directed, investigated and acted upon.

- **Noise and vibration monitoring** – application of a noise and vibration monitoring protocol to ensure compliance with any acoustic commitments and consents and to enable action upon potential breaches quickly and efficiently.

4.1.15 Notably, as advocated in BS 5228-1, if there is a barrier or topographic feature between the source and receptor, a 5 dB attenuation can be assumed if the plant is 'just visible' at the receiver, and 10 dB attenuation when the noise source is completely screened. As such, where feasible to do so, site hoardings or noise screening barriers should be erected to reduce noise levels at the nearest receptors.

4.2 Construction Vibration Assessment

4.2.1 The construction vibration impact assessment is carried out with regard to the methodologies set out in BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites: Part 2 – Vibration*.

Construction Activities

4.2.2 Roadworks will require the use of vibratory compaction. It is assumed that vibratory compaction will only occur during daytime construction hours (i.e. 0800 hrs to 1800 hrs).

4.2.3 For the purpose of this assessment, an 18 tonne Bomag BW 216 PD-5 single drum vibratory compactor has been considered to be representative of a standard plant used for these activities. The Bomag plant has two vibration settings, with the lower setting being assessed in this scenario.

4.2.4 The calculation of vibration has been carried out using the equations from BS 5228-2 Table E.1 for vibratory compaction in a steady state. The assessment includes scenarios where there is a 5% probability that predicted values could be exceeded. It is noted that higher levels of vibration can occur during the start-up and run down of the plant, however this is transient in duration and by way of mitigation could readily be conducted at distances further away from receptors.

4.2.5 A worst-case assessment assuming one vibratory compactor at the closest location to a receptor has been carried out.

Predicted Construction Vibration Levels

4.2.6 **Table 4-5** sets out the predicted distances within which construction vibration is likely to exceed the LOAEL (0.3 mm/s PPV), SOAEL (1 mm/s PPV) and 10 mm/s PPV for steady state activities at low amplitude settings. The probability of these levels being exceeded is 5%.

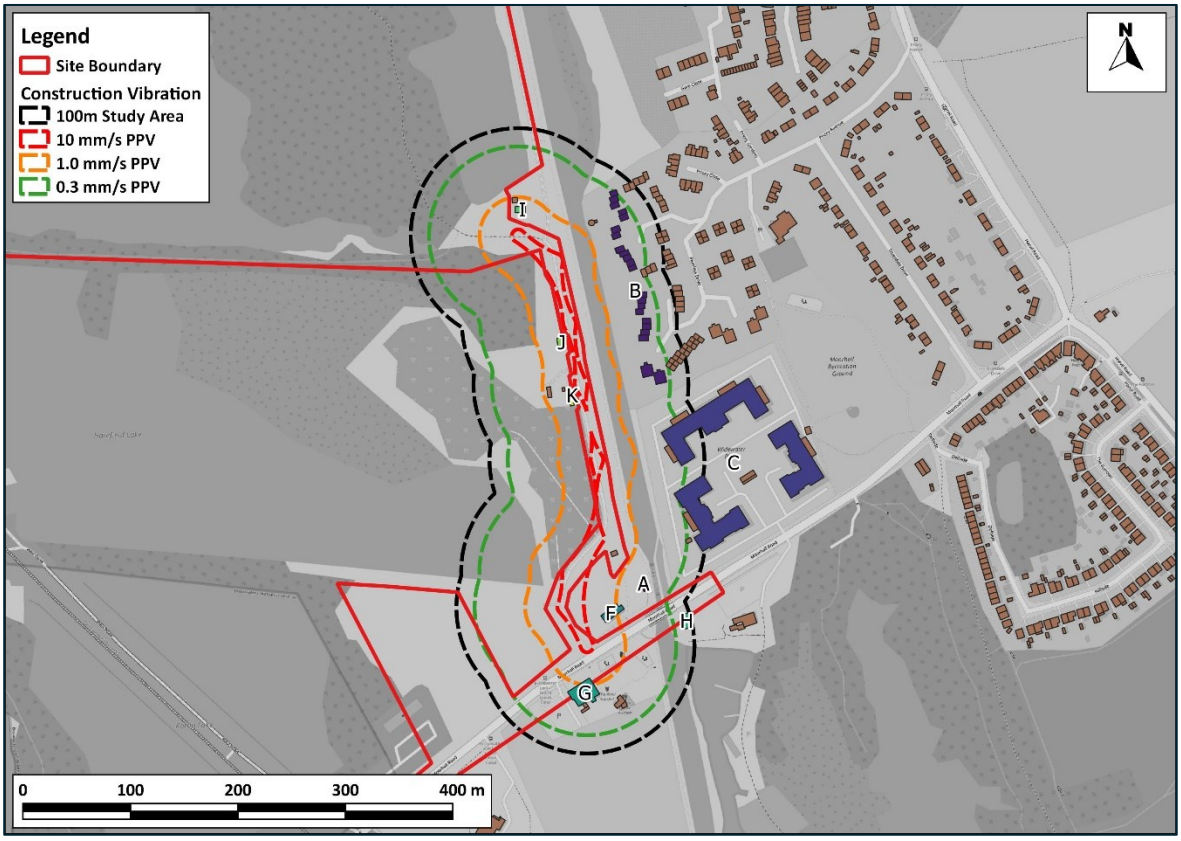
Table 4-5: Predicted Distances for Construction Vibration Levels

Type of Activity	Amplitude Setting	Distance from Scheme Boundary	Comment
Steady State	Low (0.9 mm)	83 m	Distance at which vibration levels predicted to reduce below LOAEL (0.3 mm/s PPV)

Type of Activity	Amplitude Setting	Distance from Scheme Boundary	Comment
		36 m	Distance at which vibration levels predicted to reduce below SOAEL (1.0 mm/s PPV)
		6 m	Distance at which vibration levels predicted to reduce below 10 mm/s PPV
Start-Up/Run Down[9]		117 m	Distance at which vibration levels predicted to reduce below LOAEL (0.3 mm/s PPV)
		46 m	Distance at which vibration levels predicted to reduce below SOAEL (1.0 mm/s PPV)
		6 m	Distance at which vibration levels predicted to reduce below 10 mm/s PPV

4.2.7 **Figure 4-2** presents the residential NSRs which are located within 6 m, 36 m, and 83 m of the new or altered access roads for the development where vibratory compaction may be required.

Figure 4-2: Construction Vibration Impacts - South



[9] Start up and run down operations should not be carried out within 100 m of a residential NSR.

Assessment of Impacts

4.2.8 NSR group C comprises office blocks exposed to vibration levels below the LOAEL which is likely a negligible impact. Therefore, **Table 4-6** sets out the number of residential receptors located within each area around the new and altered roads which may perceive vibration at levels:

- Below LOAEL (<0.3 mm/s PPV) which is a Negligible Impact
- Between LOAEL (0.3 mm/s PPV) and SOAEL (1.0 mm/s PPV) which is a Minor Impact
- Between SOAEL (1.0 mm/s PPV) and 10 mm/s PPV which is a Moderate Impact
- Above 10 mm/s PPV which is a Major Impact.

Table 4-6: Number of Residential Properties within Adopted Vibration Significance Criteria

Below LOAEL (<0.3 mm/s PPV)	Between LOAEL (0.3 mm/s PPV) and SOAEL (1.0 mm/s PPV)	Between SOAEL (1.0 mm/s PPV) and 10mm/s PPV	Above 10mm/s PPV
Negligible	Minor	Moderate	Major
1	6	4	0

4.2.9 With regards to the magnitude of vibration, potentially significant impacts are predicted for residences on the southeast peninsula. The number of properties potentially affected is very small and importantly none of the works are expected to exceed the temporal thresholds adopted.

Additional Mitigation

4.2.10 Vibration generated during the start-up/run down the vibratory compactor is likely to be higher than during steady state activities. The start up and run down of vibratory compactors should therefore be undertaken at least 100 m from residential NSRs, where possible, to avoid unnecessarily high levels of vibration.

4.2.11 Where residential NSRs are located within 100 m of the construction activities, the low amplitude vibration setting should be used where possible. Ideally, a non-vibratory solution should be utilised, if available.

4.2.12 Engaging with the local community, particularly anyone living or working within 36 m of the vibratory works, to inform them of when the vibratory works will take place and how long they are likely to last, as well as any measures being taken to minimise vibration.

4.2.13 Consideration of vibration monitoring at key receptors is recommended if the duration of works is likely to last for extended periods of time or in very close proximity to receptors.

5 Road Traffic Noise Assessments

5.1 Construction Traffic Noise Assessment

Predicted Construction Traffic Noise Levels

5.1.1 **Table 5-1** sets out predicted road traffic noise levels on expected construction traffic routes (see **Figure 2-4**) for both the Baseline (peak construction traffic year without construction traffic) and the peak construction traffic year scenarios. The noise levels are presented as a Basic Noise Level (BNL) as described in CRTN.

Table 5-1: Predicted Construction Traffic Noise Levels

Link Ref	Name	Baseline BNL (dB)	With Construction Traffic BNL (dB)	Change in BNL (dB)
1	A412	72.2	72.2	0.0
2	Breakspear Road North	61.0	61.0	0.0
3	Chalfron Lane	65.6	65.6	0.0
4	Church Hill	68.2	68.2	0.0
5	Coppermill Lane	67.4	67.4	0.0
6	Harvil Road	67.4	67.4	0.0
7	High Street	67.4	67.4	0.0
8	Moorfield Road	64.0	64.1	+0.1
9	Moorhall Road (East)	63.7	63.7	0.0
10	Moorhall Road (West)	63.7	63.7	+0.1
11	Northwood Road	62.8	62.8	0.0
12	Park Lane	63.2	63.2	0.0
13	Rickmansworth Road	63.7	63.7	0.0

5.1.2 **Table 5-1** shows that no links experience construction traffic that would lead to an increase in road traffic noise of more than 1dB. Consequently, the magnitude of impact would be classed as negligible.

5.2 Operational Road Traffic Noise Assessment

Predicted Road Traffic Noise Levels

5.2.1 **Table 5-2** presents the predicted short-term change in noise levels for the opening year without Development traffic (future baseline) scenario and the future year scenario with Development.

Table 5-2: Change in Noise Levels

Link Ref	Name	Future Baseline BNL (dB)	Opening Year With Development BNL (dB)	Change in Noise Level (dB)
1	A412	72.2	72.2	0.0
2	Breakspear Road North	61.1	61.1	0.0
3	Chalfron Lane	65.6	65.6	0.0
4	Church Hill	68.3	68.3	0.0
5	Coppermill Lane	67.5	67.5	0.0
6	Harvil Road	67.4	67.4	0.0
7	High Street	67.4	67.4	0.0
8	Moorfield Road	64.1	64.2	+0.1
9	Moorhall Road (East)	63.7	63.8	+0.1
10	Moorhall Road (West)	63.7	63.8	+0.1
11	Northwood Road	62.8	62.8	0.0
12	Park Lane	63.2	63.2	0.0
13	Rickmansworth Road	63.8	63.8	0.0

5.2.2 **Table 5-2** shows that no links experience operational traffic volumes that would lead to an increase in road traffic noise of more than 1dB. Consequently, the magnitude of impact would be classed as negligible.

6 Operational Sound Assessments

6.1 Building Services and Plant Noise

6.1.1 The precise details of any building services plant required as part of the development are currently unknown. It is anticipated that building services plant will be required at the main building. This may include air source heat pumps (ASHPs) for the residential units and other building services plant that may be required for the activity spaces.

Background Sound Level

6.1.2 From the baseline survey, on-site noise monitoring position ST6 (adjacent receptor I) has been selected as the representative background sound level for use in the assessment of building services plant on residential NSRs nearest to the proposed main building. The mean $L_{A90,15min}$ measured at ST6 during the daytime (07:00 – 19:00) and night-time (23:00 – 07:00) periods over a typical weekday are considered worst case for dwellings surrounding the southeast peninsula. The adopted background sound levels applied to the assessment are summarised in **Table 6-1**.

Table 6-1: Background Sound Levels Adopted for the Assessment

Location	Period	Time Period	dB $L_{A90,15min}$
ST6	Weekday	Day (07:00 – 19:00hrs)	48
		Night (23:00 – 07:00hrs)	38

Environmental Sound Criteria (ESC)

6.1.3 Indicative Environmental Sound Criteria (ESC) have been set, in **Table 6-2**, for the proposed development in accordance with BS 4142. In relation to continuous mechanical and electrical equipment noise (i.e. plant room, energy centre and water source heat pump (WSHP)), the criteria are based on the sound rating level ($L_{Ar,Tr}$) not exceeding the existing background sound level during the daytime and night-time. According to BS 4142, "*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*".

Table 6-2: BS 4142:2014+A1:2019 Environmental Sound Criteria

Residential NSR	Time Period	ESC, dB $L_{Ar,Tr}$ (Mechanical and electrical equipment noise)
Closest off-site residential NSRs: I - K,	Day (07:00 – 19:00)	48
	Night (23:00 – 07:00)	38

6.2 Leisure Activity Noise

6.2.1 A modelling exercise has been undertaken to establish the impact of the proposed leisure activities over a 1h and 16h period. It is assumed that operating hours will be limited to daylight hours (10:00 – 15:00 during the weekday and 10:00 – 13:00 on weekends) except for camping activities. This results in a 5h operational period during a typical 16h day. Activities considered in the assessment are:

- The Sailing Area accessed via the Eastern Channel;
- Other waterborne activities within the Eastern Channel; and
- Generic land-based activities on the southern peninsula

6.2.2 A cumulative future noise level has been presented in **Table 6-3** alongside the peak leisure activity $L_{Aeq,1h}$ for the following scenario:

- Sailing use - Up to 12 children in six dinghies plus two adults in a 'silent' electric safety boat;
- Other water-based activities - 48 children plus six adults and HWSFAC staff; and
- Land based activities – Up to 60 children plus six adults and Hillingdon Water Sports Facility and Activity Centre (HWSFAC) staff at any one time split across different activities on the peninsula. Noise modelling assumes that the majority of activity will occur within the Activity Field.

Table 6-3: Residential NSRs External Amenity Leisure Activity Noise Levels (Worst Case 1-Hour)

Residential NSR Group	Leisure Activity (A) $L_{Aeq,1h}$ dB	Future Baseline (measured ambient plus HS2) (B) $L_{Aeq,16h}$ (dB)	Cumulative Future Noise Level (Log Sum A+B = C) $L_{Aeq,1h}$ dB	Change dB (C-B)
A	36	72	72.0	0.0
B North	42	63	63.0	0.0
B South	39		63.0	0.0
C	31		63.0	0.0
D	43	54	54.3	+0.3
E	54	52	55.9	+3.9
F	35	72	72.0	0.0
G	34		72.0	0.0
H	33		72.0	0.0
I	42	54	54.3	+0.3
J	40	63	63.0	0.0
K	37		63.0	0.0

6.2.3 This assessment has assumed that activities will occur in the areas outlined in the development plan (shown in **Figure 1-2**) only during daylight hours and will not extend into the evening. Based on measured source levels and the separation distance between the activities and existing residential receptors, it is anticipated that at the majority of NSR Groups, levels from leisure activities will be below 50dB $L_{Aeq,1h}$. This achieves guidelines outlined in AGP for residential external amenity in which case it is anticipated that the impact on these receptors negligible.

6.2.4 Noise levels during periods of peak leisure activity are dominated by use of the Eastern Channel and reach 54 dB $L_{Aeq,1h}$ at Group E. This is a marginal exceedance of guidelines outlined in AGP. It should

be noted however, instances of peak activity are anticipated to be limited to school term time, within school hours, and when considering noise levels across a 16h day noise levels would be less than 50 dB $L_{Aeq,16h}$ and meet BS 8233:2014 desirable criteria for noise levels in external residential amenity.

7 Site Suitability Assessment

7.1 Guidance

7.1.1 The suitability of the site for residential development, in terms of achieving appropriate internal and external noise levels has been assessed with reference to the following British Standards and Guidance which are described in more detail in **Appendix A2.3**.

- Professional Practice Guidance on Planning & Noise: New Residential Development (ProPG)
- British Standard 8233: 2014 Guidance on sound insulation and noise reduction for buildings (BS 8233)
- Building Regulations Approved Document O – Overheating (ADO)

7.2 Stage 1 – Initial Assessment

7.2.1 Daytime and night-time HS2 noise exposure has been predicted across the open site (in the absence of any development), this future baseline and the results of the initial baseline survey have been used as a basis for the initial site noise risk assessment. The results are shown in **Figure 7-1** to **Figure 7-3** with the cumulative levels described in **Table 3-2**.

7.2.2 With reference to the assessment criteria and the advice provided in ProPG Stage 1, the results of the noise modelling shown in **Figure 7-1** to **Figure 7-3** that the site is of a '**low**' noise risk in both the day and night in the area of the proposed accommodation building.

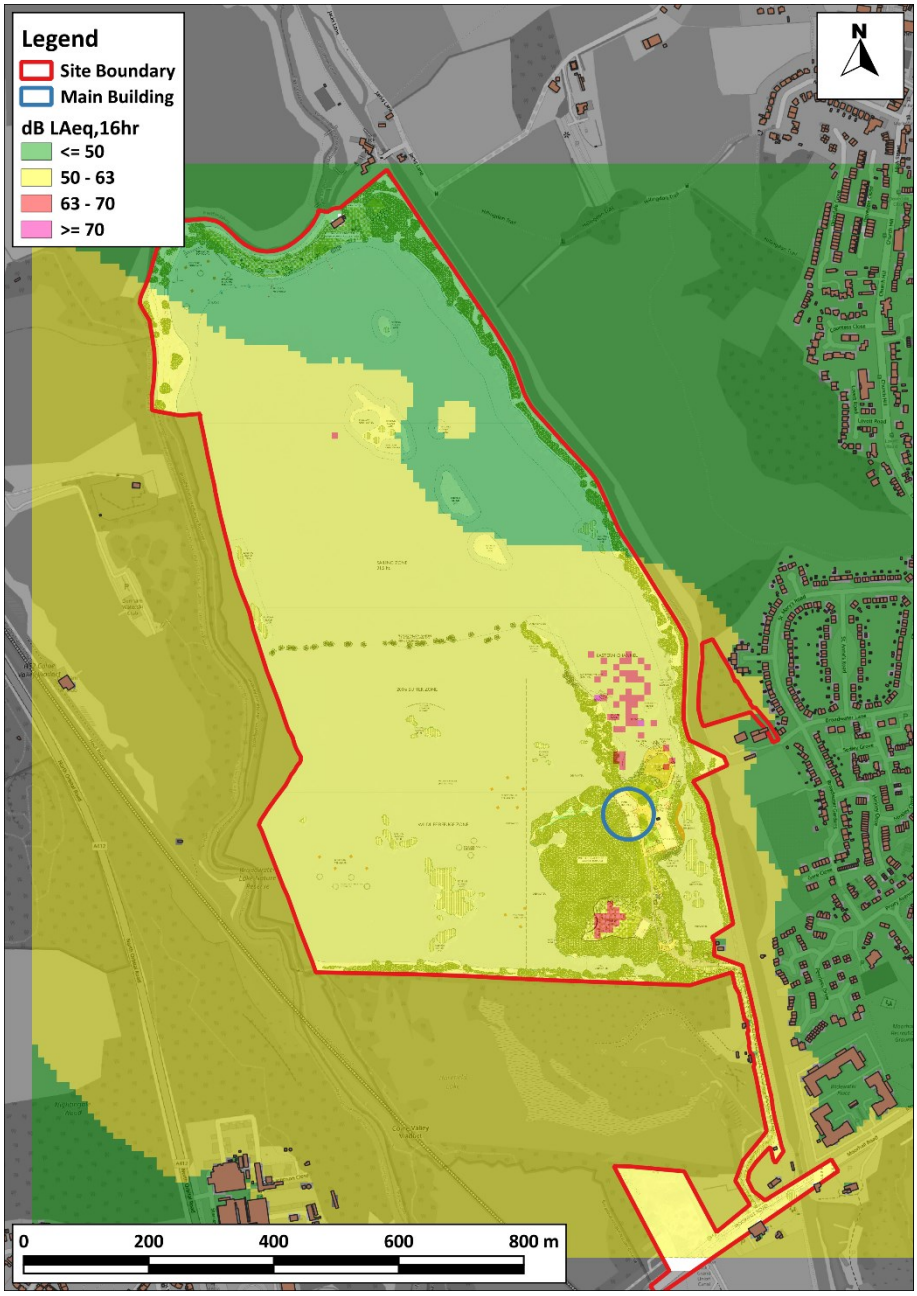


Figure 7-1: HS2 and Leisure Activity Future Baseline – Daytime $L_{Aeq,16hr}$

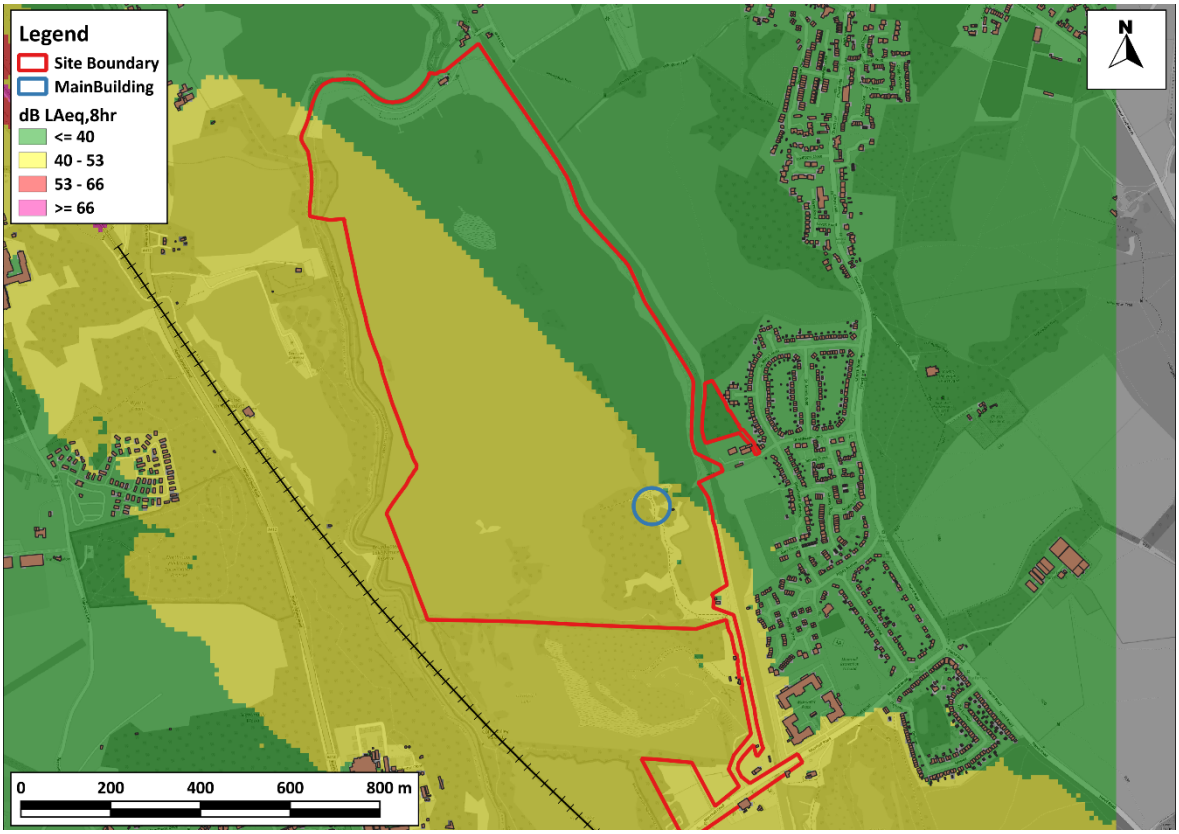


Figure 7-2: HS2 Future Baseline – Night-time $L_{Aeq,8hr}$

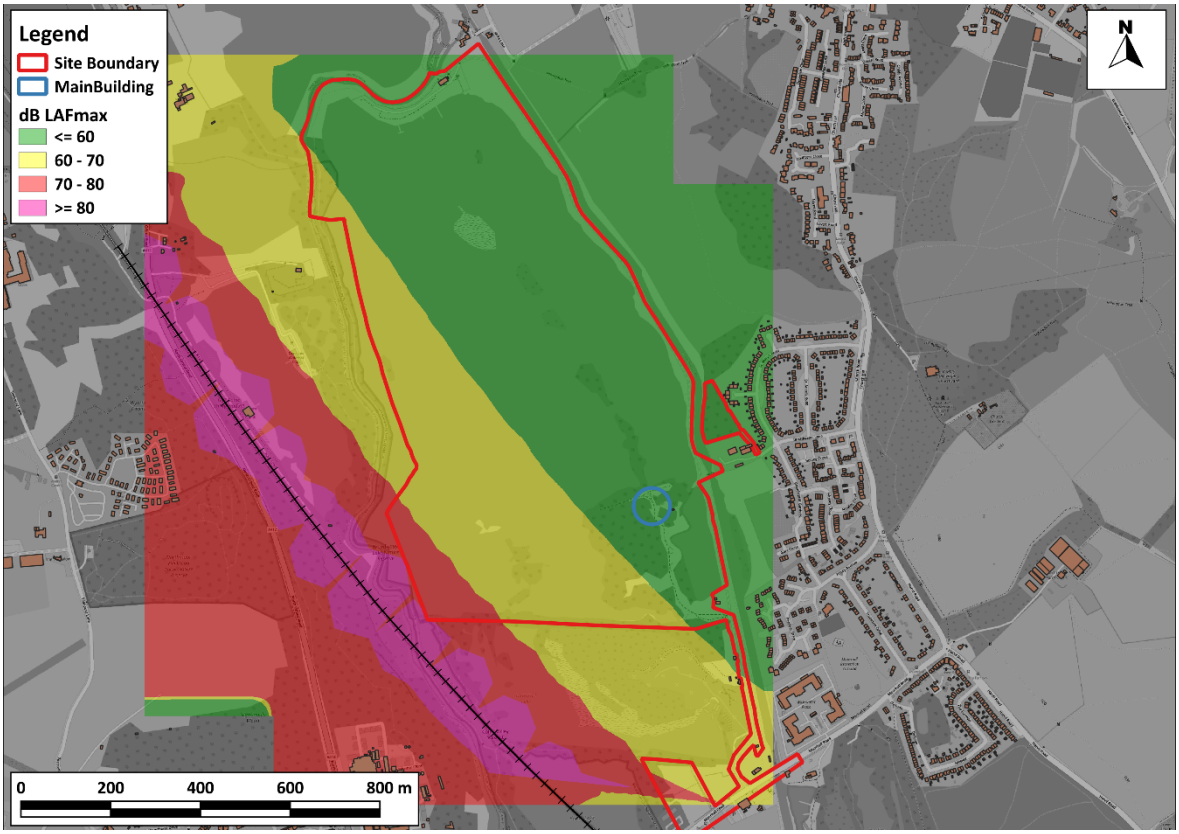


Figure 7-3: HS2 Future Baseline – Night-time L_{AFmax}

7.2.3 A Stage 2 full assessment supported by an Acoustic Design Statement (ADS) is necessary to demonstrate a good acoustic design process can be followed in order to ensure acceptable residential amenity can be incorporated into the final design and layout of the Development.

7.3 ProPG Stage 2: Full Assessment

7.3.1 Where the ProPG Stage 1 assessment indicates that the site is at low, medium or high risk of adverse noise effects, a ProPG Stage 2 assessment should be carried out. The following subsections outline the relevant internal and external noise guidelines considered in the assessment.

7.3.2 The target noise levels outlined in **Table 2-9** are to be achieved with closed windows and an appropriate means of ventilation with respect to the Building Regulations Approved Document F (ADF).

7.3.3 When windows are closed the sound insulation performance is determined by the building envelope construction including the performance of glazing and ventilation components and their respective areas.

7.3.4 The combination of external noise levels measured at ST5 and predicted HS2 noise levels presented in **Table 3-2** are deemed representative of the external levels at the proposed staff accommodation. The future baseline levels have been assessed below.

7.3.5 Internal noise levels have been calculated assuming standard thermal double-glazed windows with trickle vents using the methodology outlined in BS 8233:2014 and ProPG (2017). **Table 7-1** presents the calculated internal noise (based on the assumptions detailed in **paragraph 2.6.16** and **2.6.17**).

Table 7-1: BS 8233:2014 Internal Noise Assessment Assuming a Standard Building Envelope

Location	Window Condition	Living Areas	Bedrooms		Comment
		$L_{Aeq, 16hr}$	$L_{Aeq, 8hr}$	L_{Amax} (night)	
Residential NSR1 (Future Baseline)	Partially Open	40	33	<45	Achieves BS 8233:2014 guidelines with closed windows for living areas and bedrooms. 45 dB L_{Amax} criterion achieved for both scenarios.
	Closed	28	21	<45	
Key					
BS 8233:2014 Internal Noise Levels				Action	
Achieve BS 8233:2014 Guidelines or < 45 dB L_{Amax} in bedrooms				No Action	
Within +5 dB of BS 8233:2014 'Guidelines				Mitigate and reduce if sustainable	
Exceeds BS 8233:2014 Guidelines and/or > 45 dB L_{Amax} in bedrooms				Avoid – sound attenuated measures required	

7.3.6 Table 7-1 shows that at the proposed staff accommodation:

- Ambient ($L_{Aeq,T}$) noise levels for living areas comply with the BS 8233:2014 guidelines with windows closed during both the day and night
- Whilst internal levels are elevated when windows are partially open, sound levels are not unreasonable; and
- The night-time L_{Amax} noise levels for bedrooms are in compliance with the BS 8233:2014.

Control of Overheating

7.3.7 The Building Regulations Approved Document O – Overheating (ADO) requires that the '*simplified method*' of assessing overheating in dwellings is not used because windows are likely to be closed where the internal noise levels will exceed:

- 40 dB $L_{Aeq,8hr}$ (2300 hrs to 0700 hrs); and
- 55 dB L_{AFmax} more than 10 times a night (between 2300 hrs and 0700 hrs).

7.3.8 The *ADO Noise Guide*[10] calculates that in a moderate risk area[11] the minimum free areas required to achieve the requirements of ADO provide an external to internal sound level difference of 10 dB(A). This results in equivalent external noise levels of 50 dB $L_{Aeq,8hr}$ and 65 dB L_{AFmax} as a guide to whether windows are likely to be closed during the night-time.

7.3.9 **Table 7-2** presents a comparison of the future baseline noise levels against the equivalent external noise levels.

Table 7-2: Noise Level Assessment for Overheating

Location	Night-time $L_{Aeq,8hr}$ (dB)	Night-time L_{Amax} (dB)	ADO Noise Assessment
Residential NSR1 (Future Baseline)	46	58	Calculated noise levels are below the equivalent external noise levels. Therefore, internal noise levels are predicted to meet the ADO thresholds, and indicates that the 'simplified method' may be sufficient to demonstrate compliance with ADO

[10] Association of Noise Consultants (ANC) and Institute of Acoustics (IoA)
[11] A moderate risk location is defined in ADO as all of "*England, excluding high risk parts of London*".

8 Conclusions

8.1.1 This report describes the potential impacts associated with the proposed recreational development (the 'development') at Hillingdon Water Sports Facility and Activity Centre (HWSFAC), Broadwater Lake, Moorhall Road, Harefield, Uxbridge UB9 6PE (the 'site'). The proposed development is described as (hereafter referred to as the 'Development'):

"Redevelopment of the site to create the Hillingdon Watersports Facility and Activity Centre including demolition of existing Broadwater Lake Sailing Club (BSC) clubhouse at the north of the lake and erection of a building including changing facilities, meeting rooms, storage, Workshop and seasonal worker accommodation (sui generis), activity shelters; installation of pontoons and concrete slipways; boat shed; equipment storage huts; boat parking and racking areas; camping area; outdoor activity areas; ecological enhancement throughout the site; new pedestrian routes through the peninsula; landscaping including new woodland, dense vegetation screens and boundary treatment; new access and access road; localised dredging and land reclamation; relocation of existing sailing area and creation of floating reedbeds within the lake; coach drop off and turning area; vehicle parking; cycle parking; and associated works."

8.1.2 The preceding sections present the findings of the assessments of construction and operational noise impacts on existing noise sensitive receptors and the potential impact of operational HS2 on the residential aspects of the 'development'.

8.2 Summary of Impacts

Construction Noise and Vibration

8.2.1 Noise levels associated with a majority of the construction phases at the existing residential NSRs fall below the LOAEL threshold or between LOAL and SOAEL. Activities that produce the greatest noise levels include road construction, dredging of the lake, and demolition of the old sailing club. A worst-case assessment has been undertaken with activities such as road construction assessed at locations nearest to the on-site residential NSRs.

8.2.2 Dwellings within on-site residential NSR groups I – K and off-site residential NSR group B are expected to be impacted by site noise levels causing an exceedance of the UAEL and SOAEL respectively. This assessment outcome indicates that these residential NSR groups will experience likely significant adverse impacts during the road construction phases of the programme. The intensity of these works is dependent on proximity to the residential NSRs and predictions present a worst-case level.

8.2.3 In order to minimise the impact of construction noise specific mitigation measures according to best practicable means (BPM) must be included in the CEMP focusing on activities associated with road construction. In particular the following BPM measures would be appropriate:

- Limiting the noisiest activity to less-sensitive times of day; and / or
- Using quieter equipment and methods of construction where feasible; and / or
- A noise screening barrier of a surface mass of at least 10kg/m^2.

8.2.4 With regards to the magnitude of vibration, potential significant impacts are predicted for residences on the southeast peninsula. The number of properties potentially affected are very small and importantly none of the works are expected to exceed the temporal thresholds adopted.

Road Traffic Noise

Construction Road Traffic

8.2.5 The magnitude of impact of construction traffic along the designated routes (see **Figure 2-4**) has been classed as negligible.

Operational Road Traffic

8.2.6 On the basis of the short-term noise assessment, the magnitude of impact of operational traffic along the designated routes (see **Figure 2-4**) has been classed as negligible.

Operational Noise

Building Services and Plant Noise

8.2.7 Initial Environmental Sound Criteria (ESC) have been set for the proposed staff accommodation and quiet SEN areas, as well as nearest existing residential NSRs. The design of any plant installations, for future use at Broadwater Lake should have regard to the ESC and cumulative emissions which do not exceed the ESC would have a negligible impact on residential receptors.

Leisure Activity Noise

8.2.8 A quantitative assessment of the potential impact upon residential NSRs from leisure activity on the lake and at the associated facilities has been undertaken. It has been determined that noise from peak Eastern Channel activity is likely to marginally exceed AGP criteria for residential external amenity at one NSR group. However, across an entire daytime, leisure activity noise levels meet BS 8233:2014 desirable criteria and as such the impact is negligible.

Site Suitability (Staff Accommodation)

8.2.9 The report describes the future baseline acoustic environment across the site based on baseline monitoring, and noise modelling.

8.2.10 An initial Stage 1 ProPG site risk assessment has been undertaken demonstrating that there is a likely **low risk of adverse effects** from noise on an open site basis and in the absence of specific mitigation measures.

8.2.11 A Stage 2 assessment indicates that with windows open, predicted levels at the façade of the staff accommodation facing HS2 are expected to exceed the adopted internal noise criteria although this is commonly the case for many developments with the exception of those very few located in remote rural locations.

8.2.12 Internal noise levels with windows open are within 5 dB of the adopted internal noise criteria and are not considered to be unreasonable. Furthermore, the ADO night-time noise limits for overheating assessment in bedrooms will not be exceeded with open windows.

8.2.13 With windows closed, the adopted internal noise criteria can be achieved without acoustic glazing or ventilation, supporting the ProPG Stage 1 assessment outcome ('low' risk).

8.2.14 On the basis of this assessment, the development is not considered likely to give rise to a significant adverse impact on health and quality of life in relation to noise in accordance with paragraph 187 and 198 of the NPPF or be in conflict with Para 200 (agent of change).

9 Appendices

A1 Glossary

A-weighting	Frequency weighting applied to measured sound in order to account for the relative loudness perceived by the human ear.
Ambient Noise	The A-weighted equivalent continuous sound level of the totally encompassing sound for a given situation and time interval, T.
Basic Noise Level, BNL	The basic noise level (BNL) is a measure of source noise. For road traffic noise, this is calculated using the traffic flow volume, speed and heavy goods vehicle (HGV) percentage to determine a reference noise emission at a distance of 10 metres from the kerb for an individual road link.
Decibel, dB	The logarithmically scaled measurement unit of sound which is used to describe the magnitude of sound.
Façade Sound Level	Sound level that is determined 1 metre in front of a window or door in a façade, including reflections from the facade.
Free-field Sound Level	A sound level which is measured or calculated in the open without any reflections from nearby surfaces except the ground. Measurements are typically carried out at 1.2 m to 1.5 m above ground level and at least 3.5 m from other reflective surfaces such as buildings which is in accordance with British Standard 7445-2: 1991 *Description and measurement of environmental noise - Part 2: Guide to the acquisition of data pertinent to land use*.
$L_{Aeq,T}$	A-weighted equivalent continuous sound level over a given time period. It is the sound level of a steady sound that has the same energy as a fluctuating sound over the same time period.
$L_{A10,T}$	The A-weighted sound level exceeded for 10% of the measurement period. In the UK, it is widely used as a descriptor of road traffic noise, often over an 18-hour period between 0600 hrs and 0000 hrs ($L_{A10,18hr}$).
$L_{A90,T}$	The A-weighted sound level exceeded for 90% of the measurement period. Often referred to as the background sound level.
L_{Amax}	The A-weighted maximum recorded noise level during a measurement period. It is normally associated with a time weighting: F (fast) or S (slow).
Lowest Observed Adverse Effect Level, LOAEL	The level above which adverse effects on health and quality of life can be detected.
Noise	In basic terms, unwanted sound.
Noise Mapping	Computer generated maps showing the variation of predicted noise levels across an area.
Noise Modelling	The use of computer software to predict noise levels.
Noise Monitoring	The measurement of sound levels at a specific location.
Noise Sensitive Receptor, NSR	Receptors which are particularly sensitive to noise. Examples include residential dwellings, hospitals, healthcare facilities, education facilities, community facilities, quiet areas designated

A-weighting	Frequency weighting applied to measured sound in order to account for the relative loudness perceived by the human ear.
	under the European Noise Directive (END), international and national or statutorily designated sites, public rights of way and cultural heritage assets.
Peak Particle Velocity, PPV	Peak Particle Velocity (PPV) is the instantaneous maximum velocity reached by any vibrating element as it oscillates about its resting position. PPV is the simplest indicator of both perceptibility and the risk of damage to structures. It is commonly used to assess and monitor construction vibration and is measured in mm/s.
Rating level, $L_{Ar,Tr}$	The specific sound level plus any adjustment for the characteristic features of the sound.
Residual sound level	The A-weighted equivalent continuous ambient sound level remaining when the specific sound level has decreased to a degree in which it does not contribute to the ambient sound level.
Significant Observed Adverse Effect Level, SOAEL	The level above which significant adverse effects on health and quality of life occur.
Sound	The physical vibration in the air, propagating away from a source, whether heard or not.
Sound power level	The sound power level (L_W) of a source is a measure of the acoustic energy radiated by a source per second. The sound power level is an inherent characteristic of a sound source.
Specific sound level, $L_s = L_{Aeq,Tr}$	The A-weighted equivalent continuous sound pressure level produced by the specific sound source at the reference location over a reference time interval, T.
Vibration	Vibration may be expressed in terms of displacement, velocity and acceleration. Velocity and acceleration are most commonly used when assessing the risk of building damage, human comfort or structureborne noise issues.
Vibration Dose Value	Vibration Dose Value (VDV) is a parameter which combines the magnitude of vibration and the time for which it occurs. It provides a cumulative measurement of the vibration level received at a receptor over a specific time period. Typically used to describe human response to vibration in buildings from intermittent/transient vibration. The VDV is the fourth root of the time integral of the fourth power of the weighted acceleration. VDV are measured in units of $mm/s^{1.75}$. The frequency weightings are defined in BS 64772-1:2008.

A2 Legislation, Policy and Guidance

A2.1 National Planning Policy and Guidance

National Planning Policy Framework 2024

A2.1.1 The National Planning Policy Framework (NPPF, 2024) sets out the Government's planning policies for England and how these should be applied. The NPPF provides a framework within which locally prepared plans for housing and other development can be produced.

A2.1.2 In relation to noise, it states:

"187. Planning policies and decisions should contribute to and enhance the natural local environment by: …

- preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and…"

A2.1.3 The NPPF includes policy which makes reference to 'significant adverse impacts on health and quality of life', as per the NPSE. NPPF policy states:

"198. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

- identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and…"

A2.1.4 NPPF has also recently introduced the agent of change principle as follows:

"200. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

Noise Policy Statement for England, 2010

A2.1.5 The Noise Policy Statement for England (NPSE, 2010) sets out the Government's Noise Policy Vision to:

"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development".

A2.1.6 This long-term vision is supported by three Noise Policy Aims that can be delivered through effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development. These aims are to:

1) avoid significant adverse impacts on health and quality of life;

2) mitigate and minimise adverse impacts on health and quality of life; and

3) where possible, contribute to the improvement of health and quality of life.

A2.1.7 The explanatory note to the NPSE sets out 'effect levels' which are aligned to the Policy Aims. Drawing upon established concepts from toxicology, the NPSE defines the following noise effect levels:

- NOEL - 'No Observed Effect Level';
- LOAEL - 'Lowest Observed Adverse Effect Level'; and
- SOAEL - 'Significant Observed Adverse Effect Level'.

A2.1.8 The explanatory note describes SOAEL as the effect level above which significant adverse effects on health and quality of life occur, aligning this level with the first policy aim.

A2.1.9 LOAEL is described as the level at which adverse effects begin and the second aim of the NPSE refers to a situation where the effect lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8 of the NPSE) however this does not mean that such adverse effects cannot occur.

A2.1.10 NOEL is described as a level of noise exposure below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life.

A2.1.11 The third aim seeks, where possible, to positively improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society.

A2.1.12 The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.

A2.1.13 NPSE states that it is not possible have a single, numerical definition of the SOAEL that is applicable to all sources of noise in all situations, since the SOAEL is likely to be different for different noise sources, for different receptors and at different times.

Planning Practice Guidance Noise PPG(N) 2019

A2.1.14 The Planning Practice Guidance (PPG(N), 2019) provides further detail about how the effects of noise can be described in terms of perception and outcomes. It aligns this to increasing effect levels as defined in the NPSE. In addition, the PPG(N) adds a fourth term and corresponding effect level:

- UAEL – 'Unacceptable Adverse Effect Level'.

A2.1.15 This effect level is higher than the significant adverse effect on health and quality of life (SOAEL) and requires that unacceptable adverse effects are to be prevented. In PPG(N), prevention is not in the context of Government policy on sustainable development. **Table A2-1** presents the noise exposure hierarchy described in PPG(N).

Table A2-1: Planning Practice Guidance – Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

A2.1.16 This noise exposure hierarchy is based on the principle that once noise or vibration becomes perceptible, the effect on people and other receptors increases as the level increases. PPG(N) presents example outcomes to help characterise these effects using non-technical language. In general terms, an observed adverse effect is characterised as a perceived change in quality of life for occupants of a building or a perceived change in the acoustic character of an area, whereas a significant observed adverse effect disrupts activities.

A2.1.17 PPG(N) also provides guidance in terms of what factors may influence whether noise could become a concern, and how adverse effects of noise can be mitigated. Examples of mitigation provided include:

- "engineering: reducing the noise generated at source and/or containing the noise generated;
- layout: where possible, optimising the distance between the source and noise-sensitive receptors and/or incorporating good design to minimise noise transmission through the use of screening by natural or purpose built barriers, or other buildings;
- using planning conditions/obligations to restrict activities allowed on the site at certain times and/or specifying permissible noise levels differentiating as appropriate between different times of day, such as evenings and late at night, and;
- mitigating the impact on areas likely to be affected by noise including through noise insulation when the impact is on a building".

A2.2 Local and Regional Policy

A2.2.1 The site is located within the administrative area of the London Borough of Hillingdon (LBH). The local policies from LBH that are relevant to noise and vibration are presented below.

Hillingdon Local Plan Part 1: 2012 – 2026

A2.2.2 Hillingdon council makes reference to noise in Policy EM8 of the current Local Plan:

"The Council will seek to ensure that noise sensitive development and noise generating development are only permitted if noise impacts can be adequately controlled and mitigated."

A2.2.3 It therefore broadly aligns with national policy.

A2.3 Noise Guidance

ISO 9613 Acoustics – Attenuation of Sound During Propagation Outdoors

A2.3.1 ISO 9613 defines a method for predicting the propagation of noise outdoors. It accounts for distance attenuation, air absorption, topography, ground cover and screening and reflections caused by buildings and other features.

Calculation of Road Traffic Noise (CRTN) 1988

A2.3.2 The Calculation of Road Traffic Noise (CRTN, 1988) provides a methodology for the measurement and prediction of road traffic noise. CRTN was prepared to determine entitlement under the Noise Insulation Regulations 1975, but it is stated in the document that the guidance is equally appropriate to the calculation of traffic noise for land use planning purposes.

A2.3.3 In the UK, operational road traffic noise is predicted using the Calculation Road Traffic Noise (CRTN). CRTN provides methodologies for the calculation of road noise emissions, based on the traffic data,

through the calculation of a Basic Noise Level (BNL) which is the noise level at 10m from the kerb. THE BNL calculation methodology utilises detailed information on two-way traffic flows, percentage of HGV movements, vehicle speed, road slope gradient, ground conditions and screening to calculate the propagation of noise from roads. The use of BNL enables a direct comparison to be made of the change in noise level associated with particular sections of road.

Design Manual for Roads and Bridges: Sustainability & Environmental Appraisal LA 111 Noise and Vibration (LA111) 2020

A2.3.4 LA111 'Noise and vibration' of the Design Manual for Roads and Bridges provides guidance on undertaking noise and vibration assessments on the impact of road projects. This includes assessing changes in traffic on existing roads, where it outlines the magnitude of impact in the short term and long term.

A2.3.5 The construction traffic assessment considers the change in noise level with the addition of construction traffic on the primary traffic routes. Consideration is also given to the impact of traffic diversion routes, particularly at night-time, where carriageway closures are required to complete construction works.

A2.3.6 The operational assessment generally considers the change in noise level with and without the scheme in the short-term (opening year) and in the long-term (opening year and future year). The assessment of significance can be influenced by other relevant factors including a comparison of the absolute noise levels against the LOAEL and SOAEL criteria, acoustic context, and perceptibility of change (i.e. if there is a change to the landscape).

BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites: Part 1 – Noise

A2.3.7 Part 1 of BS 5228 sets out methodologies for predicting noise levels from construction and related activities. It also sets out methodologies for determining the potential effects on existing noise sensitive human receptors as a result of noise arising from construction activities. This includes construction vehicles travelling on haulage routes to and from the construction site.

A2.3.8 Data on sound levels is provided within the standard for a wide variety of site activities and mobile equipment used on construction and open sites. In addition, calculation procedures and methodology are provided to calculate construction noise levels at receptors.

A2.3.9 The ABC method is generally the preferred method to determine values which indicate the threshold above which a significant adverse effect occurs. The threshold values are generally easier to control during construction works than setting individual noise limits for each receptor such as would occur using the 5 dB(A) change method. However, the ABC method is only applicable to residential receptors. Therefore, due to the variety of noise sensitive receptors (NSRs) around the site, the proposed demolition and construction noise assessment methodology has been based on the 5 dB(A) change method described below:

"Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq,T}$ from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month of more, unless works of a shorter duration are likely to result in significant effect."

A2.3.10 The 5 dB(A) change method generally applies to:

- Residential buildings

- Hotels and hostels
- Buildings in religious use
- Buildings in educational use
- Buildings in health and/or community use.

A2.3.11 In respect of public open space, the additional consideration of the extent of the area impacted relative to the total available area needs to also be taken into consideration when determining whether the impact causes a significant effect.

A2.3.12 Ultimately, BS 5228-1 sets out a best practicable means approach to construction noise mitigation identifying measures that can be readily employed on a construction site to minimise adverse noise effects.

BS 4142:2014+A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound

A2.3.13 BS 4142:2014+A1:2019 is used to rate and assess sound of an industrial nature including but not limited to assessing sound from proposed, new, modified, or additional sources of industrial sound. It contains guidance on the monitoring and assessment of industrial and commercial sound sources (including fixed installations comprising mechanical and electrical plant and equipment) affecting sensitive receptors.

A2.3.14 The methodology relies on comparing the operational rating level, $L_{Ar,Tr}$, with the background sound level, $L_{A90,T}$ (i.e. the level that would be present without the development) over a representative time period. BS 4142:2014+A1:2019 provides guidance on the measurement of background sound, the determination of specific sound and calculation of the rating level.

A2.3.15 Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. A character correction should be added to the specific sound level to obtain the rating level, where such features are present at the assessment location. It states that the specific sound level should be corrected if a tone, impulse or other characteristic occurs, or is expected to be present for new sound sources.

A2.3.16 Where there are certain acoustic features of the specific sound level, L_s that would likely increase the significance of impact, then an appropriate character correction is added to the specific sound level, L_s. This is referred to as the rating level $L_{Ar,Tr}$.

Character Correction Considerations

Tonality

A2.3.17 A tonal correction between 0 and +6 dB can be applied for sounds that range from not tonal to prominently tonal. Several methodologies are presented in BS 4142 in order to determine the appropriate correction to be applied. Table A2-2 presents the subjective assessment method corrections for tonal sounds.

Table A2-2: Subjective Method – Rating Level Corrections for Tonal Sounds

Subjective Assessment of Sound at the Receptor	Correction
The tone is just perceptible at the receptor	+2 dB
The tone is clearly perceptible at the receptor	+4 dB

Subjective Assessment of Sound at the Receptor	Correction
The tone is highly perceptible at the receptor	+6 dB

Impulsivity

A2.3.18 An impulsivity correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. **Table A2-3** presents the subjective method corrections for impulsive sounds.

Table A2-3: Subjective Method – Rating Level Corrections for Impulsive Sounds

Subjective Assessment of Sound at the Receptor	Correction
Impulsivity is just perceptible at the receptor	+3 dB
Impulsivity is clearly perceptible at the receptor	+6 dB
Impulsivity is highly perceptible at the receptor	+9 dB

Intermittency

A2.3.19 A 3 dB penalty can be applied where the specific sound has identifiable on/off conditions (intermittent operation) which are readily distinctive against the residual acoustic environment.

Other Sound Characteristics

A2.3.20 Where the specific sound has characteristics that do not fall into the tonal, impulsive or intermittent categories but are otherwise readily distinguishable against the residual acoustic environment, a penalty of 3 dB can be applied.

Initial Indication of impact

A2.3.21 BS 4142:2014+A1:2019 assessment methodology also states that:

- "Typically, the higher the rating level is above the background sound level 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 source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."

A2.3.22 In order to determine the impact threshold levels for the assessment of operational industrial sound, the difference between the rating level and background sound level is considered, as advocated by the methodology within BS 4142:2014+A1:2019.

Reference Time Periods

A2.3.23 The appropriate reference time interval for assessing a sound source is dependent upon when it operates i.e. during the daytime or night-time. BS 4142 determines the reference time interval as 1 hour during the daytime (07:00-23:00) and 15 minutes at night (23:00-07:00).

Sport England Guidelines – Design Guidance Note: Artificial Grass Pitch (AGP) Acoustics – Planning Implications, 2015.

A2.3.24 Sport England have produced a guidance document on noise from AGPs with the aim of:

- Increasing awareness of good design in sports facilities;
- Helping key building professions, clients, user representatives and other stakeholders to follow best practice; and,
- Encouraging well-designed sports facilities that meet the needs of sports and are a pleasure to use.

A2.3.25 The guidance discusses the use of other guidance such as the WHO GCN but states: "Exceedance of the WHO [GCN] guideline values does not necessarily imply significant noise impact and indeed it may be that significant impacts do not occur until much higher levels of noise exposure are reached".

A2.3.26 The guidance then discusses the comparison of the AGP noise against the existing noise climate and states: "*A 'slight' impact is considered for an increase less than 3 decibels*".

A2.3.27 This increase is generally in line with acoustic principles that a 3 dB(A) increase is the minimum perceptible under normal conditions. As part of drafting the guidance, measurements were taken of noise levels during nine sports sessions on three separate AGP's with sports including; football, hockey and rugby, in order to obtain a 'typical' noise level generated from a 'typical' AGP sports session.

A2.3.28 Noise level measurements were taken at a distance of 10 metres behind the mid-way points along goal lines and sidelines. They were found to be highest behind the sideline halfway line. The document states that;

A2.3.29 "The most significant noise levels were found to be generally derived from the voices of players, with the exception of hockey where impact noises of balls hitting perimeter strike boards and goal back boards were more noticeable. Such impact noises can be mitigated by incorporating shock absorbing noise reduction measures. Assuming such mitigation measures, the most significant noise source from typical AGP sports sessions is therefore voice and as such, a typical noise level can be determined."

A2.3.30 The document provides a 'typical' free-field noise level (with impact mitigation measures) of 58 dB $L_{Aeq,1hr}$ at a distance of 10m perpendicular from the sideline halfway line. The guidance recommends;

- predicting the impact of the use of an AGP based on the data provided within the guidance and topographical information about the site, along with the buildings and site layout;
- the noise criterion for AGP's in close proximity to residential properties in the daytime and evenings, in line with WHO guidelines, is 50 dB LAeq(1 hour) upper noise limit, external to residential properties with external living areas, to avoid moderate annoyance.

A2.3.31 The guidance suggests that on level ground a (single) sports pitch should be located a minimum of 40m distant (measured from the sideline) from the nearest ground-level noise-sensitive receptor in order to achieve WHO guideline noise levels at the receptor and to avoid moderate annoyance.

A2.4 Site Suitability Assessment Guidance

ProPG Planninga & Noise – Professional Practice Guidance on Planning & Noise, 2017

A2.4.1 Professional Practice Guidance: Planning & Noise - New Residential Development (ProPG, 2017) is a joint publication by the Chartered Institute of Environmental Health (CIEH), the Association of Noise Consultants (ANC) and the Institute of Acoustics (IoA).

A2.4.2 The primary goal of ProPG is "to assist the delivery of sustainable development by promoting good health and wellbeing through the effective management of noise".

A2.4.3 The guidance has been produced to assist practitioners in matters relating to noise and new residential development. It focusses on existing transportation noise sources and has been developed to consider the Government's overarching noise policy, planning policy and policy guidance. It has also been developed to take into account other authoritative sources of guidance such as British Standard 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' (BS 8233:2014).

A2.4.4 The guidance provides advice for Local Planning Authorities (LPAs) and developers, and practitioners. ProPG aims to:

- Advocate the full consideration of the acoustic environment from the earliest possible stage of the development control process;
- Promote and encourage the process of good acoustic design in and around new residential developments;
- Set out the considerations which should be taken into account in deciding planning applications for new noise-sensitive developments;
- Promoting the use of appropriate noise exposure standards and policies in assessment; and
- Provide assistance in the delivery of sustainable development.

A2.4.5 ProPG advocates a two-stage assessment approach:

- **Stage 1** – an initial noise risk assessment of the proposed development site; and
- **Stage 2** – a systematic assessment considering four key elements.

A2.4.6 ProPG is underpinned by the preparation and delivery of an Acoustic Design Statement (ADS).

Stage 1 – Initial Risk Assessment

A2.4.7 Stage 1 of ProPG provides guidance to practitioners as to whether the site poses a risk in terms of noise for any future site occupants. To identify this, ProPG sets out a number of considerations for inclusion within an 'initial risk assessment'. **Table A2-4** reproduces Figure 1 from ProPG which describes the initial site risk assessment.

A2.4.8 ProPG is clear that an ADS should be included as part of a planning application where the risk is above 'negligible'.

Table A2-4: ProPG – Stage 1 Initial Site Noise Risk Assessment

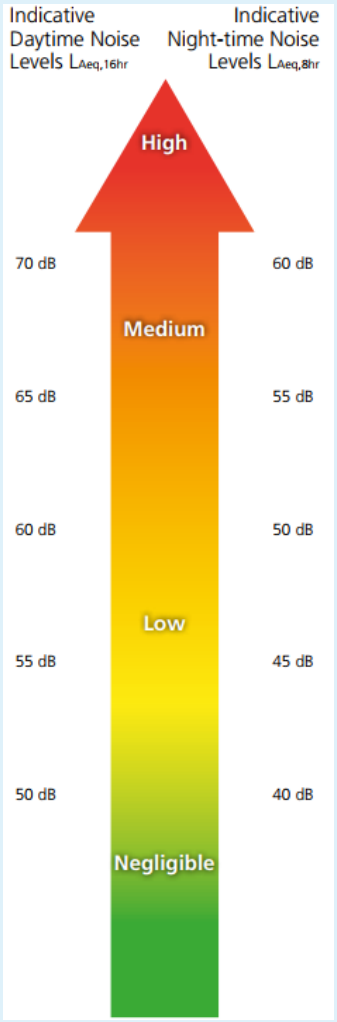
Noise Risk Assessment	Potential Effect Without Noise Mitigation	Pre-Planning Application Advice
	Increasing risk of adverse effect	High noise levels indicate that there is an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice. As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development. At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.
	No adverse effect	These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.

Figure 1 Notes:
a. Indicative noise levels should be assessed without inclusion of the acoustic effect of any scheme specific noise mitigation measures.
b. Indicative noise levels are the combined free-field noise level from all sources of transport noise and may also include industrial/commercial noise where this is present but is "not dominant".
c. $L_{Aeq,16hr}$ is for daytime 07:00 – 23:00, $L_{Aeq,8hr}$ is for night-time 23:00 – 07:00.
d. An indication that there may be more than 10 noise events at night (23:00 – 07:00) with $L_{Amax,F}$ > 60 dB means the site should not be regarded as negligible risk.

Stage 2 – Full Assessment

A2.4.9 Stage 2 of ProPG describes four elements required for a full assessment. These are:

- **Element 1** – demonstrating a "Good Acoustic Design Process"
- **Element 2** – observing internal "Noise Level Guidelines"

- **Element 3** – undertaking an "External Amenity Area Noise Assessment"; and
- **Element 4** – the consideration of "Other Relevant Issues".

A2.4.10 A summary of the considerations required in each of the four elements is provided in **Table A2-5**.

Table A2-5: Professional Practice Guidance – Full Assessment Key Elements

Element	Considerations
Element 1 Good Acoustic Design Process	Considerations include: • Good acoustic design is not just compliance with recommended internal and external noise exposure standards. Good acoustic design should provide an integrated solution whereby the optimum acoustic outcome is achieved, without design compromises that will adversely affect living conditions and the quality of life of the inhabitants or other sustainable design objectives and requirements. • Using fixed unopenable glazing for sound insulation purposes is generally unsatisfactory and should be avoided. Any reliance upon building envelope insulation with closed windows should be justified in supporting documents The Planning Application MUST: • Check the feasibility of relocating, or reducing noise levels from relevant sources. • Consider options for planning the site or building layout. • Consider the orientation of proposed building(s). • Select construction types and methods for meeting building performance requirements. • Examine the effects of noise control measures on ventilation, fire regulation, • health and safety, cost, CDM (construction, design and management) etc. • Assess the viability of alternative solutions. • Assess external amenity area noise.
Element 2 Internal Noise Level Guidelines	Considerations include: • Reference to BS 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' for internal noise level guidelines • Most residents value the ability to open windows at will, for a variety of reasons, and LPAs should therefore normally request that designers principally aim, through the use of good acoustic design, to achieve the internal noise level guidelines in noise-sensitive rooms with windows open. Where internal noise levels are assessed with windows closed the justification for this should be included in the ADS. • In the case of sites exposed to industrial and/or commercial noise: • Where industrial and/or commercial noise is present on the site and is considered to be "dominant" (i.e. where the impact would be rated as adverse or greater (subject to context)) then this is outside the scope of this ProPG and regard should be had to the guidance in BS 4142:2014. In the special case where industrial and/or commercial noise is present on the site but is "not dominant" (i.e. where the impact would be rated as lower than adverse (subject to context) if a BS 4142:2014 assessment was to be carried out), its contribution may be included in the noise level used to establish the degree of risk in Stage 1 and may also be included in the consideration of Stage 2 Element 2 Internal Noise Level Guidelines (and if included, this should be clearly stated).
Element 3	The assessment must provide and demonstrate: • Full details of the external amenity area noise assessment should be included in an Acoustic Design Statement.

Element	Considerations
External Amenity Area Noise Assessment	• The term "assessment" is deliberately used because this element concerns more than just the level of noise outside. • ProPG external amenity area noise assessment reflects and extends the advice contained in BS 8233:2014 and the current Government guidance in PPG-Noise • Where external amenity areas are exposed to "dominant" industrial and/or commercial noise, the impact of the noise should be assessed in accordance with BS 4142:2014 over the time period that the amenity area is likely to be used. In the special case where industrial and/or commercial noise is present on the site but is "not dominant", its contribution may be included in the noise level used to establish the degree of risk in Stage 1 and may also be included in the consideration of Stage 2 Element 3 External Amenity Area Noise Assessment (and if included, this should be clearly stated).
Element 4 Assessment of Other Relevant Issues	Consideration should be given to: • Compliance with relevant national and local policy: ie, NPSE, PPG-Noise and The Environmental Noise Regulations. • Magnitude and extent of compliance with ProPG • Likely occupants of the development • Acoustic design vs unintended adverse consequences: Examples include sealed up balconies that result in a lack of connection with the external environment, roadside barriers that remove views or prevent crossing roads, sealed facades that affect personal control over the internal environment etc. Wherever possible, such unintended adverse consequences should be obviated by good acoustic design. • Acoustic design vs wider planning objectives

A2.4.11 Of note, guidance on suitable noise levels for individual events is provided in ProPG, which states:

"In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45 dB $L_{Amax,\ F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as source, number, distribution, predictability and regularity of noise events."

A2.4.12 Additionally, ProPG provides guidance which has been utilised to establish UAELs. ProPG states:

"Once internal L_{Aeq} noise levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally."

Acoustic Design Statement (ADS)

A2.4.13 ProPG requires that the ADS provide sufficient evidence that the ProPG Stage 1 and Stage 2 Elements 1 – 4 have been followed. It also advises that the ADS should be proportionate to the scale of the development and the degree of noise risk at the proposed development site. In this context, ProPG states that the level of detail to be provided within the ADS should increase with the increasing level of risk.

Supporting Decision-Makers

A2.4.14 ProPG also provides advice and support to decision-makers when taking into account noise and new residential development. These recommendations are aligned to the outcomes of Stage 1 and Stage

2 of the assessment along with the considerations made within the Acoustic Design Statement. Section 3 of ProPG details the recommendations to decision-makers.

Sites Exposed to Industrial and/or Commercial Noise

A2.4.15 In the case of sites exposed to industrial and/or commercial noise, ProPG states that if the industrial and/or commercial noise is present but not dominant, then its contribution may be included in the noise level used to establish the degree of risk.

A2.4.16 If the industrial and/or commercial noise is considered to be dominant, then the risk assessment should not be applied to the industrial or commercial noise and instead the assessment should follow the methodology and guidance provided in British Standard 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound' (BS 4142:2014+A1:2019).

A2.4.17 ProPG states that "[t]he judgement on whether or not to undertake a BS 4142:2014 assessment to determine dominance should be proportionate to the level of risk. In low risk cases a subjective judgement of dominance, based on audibility, would normally be sufficient."

British Standard 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings'

A2.4.18 BS 8233:2014 provides guidance for the control of noise in and around buildings. It is a not to exceed during daytime and night-time periods within habitable rooms. These guideline values are reproduced in **Table A2-6**.

Table A2-6: Indoor Ambient Noise Levels for Residential Dwellings

Activity	Location	Daytime Guideline (07:00-23:00hrs)	Night-time Guideline (23:00-07:00hrs)
Resting	Living Room	35 dB $L_{Aeq, 16hr}$	-
Dining	Dining Room / Area	40 dB $L_{Aeq, 16hr}$	-
Sleeping (Daytime Resting)	Bedroom	35 dB $L_{Aeq, 16hr}$	30 dB $L_{Aeq, 8hr}$

A2.4.19 The internal noise requirements are not intended to be met with open windows, although BS 8223:2014 states that the internal noise levels should take account of the proposed ventilation strategy. Guidance on the likely reduction in façade insulation due to an open window is provided in ProPG (2017). It states that an open window typically reduces the insulation "to no more than 10 to 15 dB(A)". For the purposes of this assessment, it is therefore considered reasonable to assume a reduction of 13 dB(A) for an "open window" scenario.

A2.4.20 BS 8233:2014 also notes that: "Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved".

A2.4.21 BS 8233:2014 does not provide specific guidance on noise levels for regular individual noise events, such as passing trains, which can cause sleep disturbance. Guidance on suitable noise levels for individual events is provided in ProPG, which states:

"In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45 dB $L_{Amax, F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement

of acceptability will depend not only on the maximum noise levels but also on factors such as source, number, distribution, predictability and regularity of noise events".

A2.4.22 On this basis, it is usually considered appropriate to adopt the 10th highest $L_{Amax,F}$ noise event occurring in the night-time period when performing noise ingress calculations.

A2.4.23 With respect to external amenity spaces, BS 8233:2014 states that "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."

A2.4.24 BS 8233:2014 also states that it will not always be possible to achieve these guideline values for all circumstances where development may be desirable, and that development in higher noise areas, such as urban areas adjoining the strategic transport network or city centres, may warrant a compromise between elevated noise levels and other factors (for example the convenience of living in these locations). In these situations, BS 8233:2014 states that "*development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.*" This approach is also advocated in PPG-Noise.

World Health Organization Community Noise Guidelines, 1999

A2.4.25 The World Health Organization (WHO) Community Noise Guidelines (CNG, 1999) are partially superseded by the WHO Environmental Noise Guidelines for the European Region, 2018. However, the guideline values for internal noise and maximum noise levels from regular noise events remain relevant in the WHO CNG.

The Building Regulations Approved Document O – Overheating

A2.4.26 The Building Regulations Approved Document O (ADO) – Overheating states that windows are likely to be closed during sleeping hours (23:00hrs to 07:00hrs) if noise within bedrooms exceeds 40 dB $L_{Aeq,T}$ and/or 55 dB L_{AFmax}.

A2.4.27 For new residential development in a moderate risk area[12], the window opening sizes advised in ADO under the simplified method equate to approximate 9 dB(A) sound reduction from outside to inside. Accordingly, this provides corresponding external noise levels of 49 dB $L_{Aeq,8hr}$ and 64 dB L_{AFmax}.

A2.4.28 Above these noise levels it is assumed that windows are likely to be closed during sleeping hours in bedrooms, therefore the minimum free areas required by the ADO simplified method cannot be met. As a result, dynamic thermal modelling should be used. However, this does not preclude the use of open windows or other passive means of providing overheating mitigation.

A2.4.29 Whilst this is a Building Regulations matter, there could be implications at planning stage in relation to the building envelope design.

[12] Defined in ADO as all of England excluding large parts of Greater London and some parts of Greater Manchester.

A3 Sound Level Meter Specifications

Table A3-1: Sound Level Meter Specifications

Equipment	Make	Model	Serial	Date of Calibration
Sound level meter	Rion	NL-52	01009670	10/03/2021
Sound level meter			01176433	26/07/2021
Acoustic calibrator		NC-75	34291339	25/07/2022

A4 Measured Noise Levels

Table A4-1: Daytime results from ST1

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
24/11/2022 10:40:00	50.4	55.0	51.5	49.2
24/11/2022 10:45:00	50.9	58.1	52.3	49.2
24/11/2022 10:50:00	49.5	54.1	50.9	48.0
24/11/2022 10:55:00	50.0	58.6	51.6	48.0
24/11/2022 11:00:00	51.2	61.2	53.6	47.8
24/11/2022 11:05:00	52.7	67.4	56.0	48.5
25/11/2022 11:17:00	47.2	52.5	49.2	45.3
25/11/2022 11:22:00	58.2	74.0	58.9	46.2
25/11/2022 11:27:00	54.6	70.0	56.0	47.6

Table A4-2: Daytime results from ST2

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
24/11/2022 12:15:00	52.3	60.0	54.3	49.8
24/11/2022 12:20:00	52.3	60.7	53.9	49.9
24/11/2022 12:25:00	56.8	71.7	59.0	50.0
24/11/2022 12:30:00	57.2	70.6	61.3	49.7
24/11/2022 12:35:00	57.1	73.8	59.0	50.9
24/11/2022 12:40:00	59.1	73.6	63.2	52.1
25/11/2022 10:55:00	50.1	58.0	52.0	47.9
25/11/2022 11:00:00	58.9	76.3	60.2	47.8
25/11/2022 11:05:00	48.6	57.5	50.3	46.9

Table A4-3: Daytime results from ST3

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
24/11/2022 10:40:00	48.4	53.8	49.1	47.7
24/11/2022 10:45:00	49.7	64.6	50.9	48.0
24/11/2022 10:50:00	48.0	55.0	48.9	46.9
24/11/2022 10:55:00	47.9	55.4	48.9	46.8

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
24/11/2022 11:00:00	53.0	73.4	55.0	46.5
24/11/2022 11:05:00	51.0	64.1	53.3	47.5
25/11/2022 11:20:00	52.1	66.0	55.5	46.2
25/11/2022 11:25:00	51.8	68.0	54.7	45.7
25/11/2022 11:30:00	49.3	56.5	51.2	46.6

Table A4-4: Daytime results from ST4

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
24/11/2022 09:59:00	50.1	53.0	50.7	49.6
24/11/2022 10:04:00	50.1	55.7	50.6	49.4
24/11/2022 10:09:00	50.0	55.6	50.9	49.3
24/11/2022 10:14:00	49.7	53.7	50.1	49.2
24/11/2022 10:19:00	49.5	57.9	49.9	49.0
24/11/2022 10:24:00	49.6	57.5	50.0	49.0
25/11/2022 11:40:00	48.6	56.3	50.1	46.6
25/11/2022 11:45:00	48.2	56.2	50.0	46.0
25/11/2022 11:50:00	49.3	59.1	51.3	46.5

Table A4-5: Daytime results from ST5

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
24/11/2022 09:50:00	50.7	54.7	51.4	50.0
24/11/2022 09:55:00	50.5	57.3	50.8	49.6
24/11/2022 10:00:00	49.9	52.2	50.4	49.4
24/11/2022 10:05:00	49.8	52.2	50.3	49.2
24/11/2022 10:10:00	49.8	52.4	50.5	49.0
24/11/2022 10:15:00	49.6	52.1	50.2	49.0
25/11/2022 11:48:00	46.6	54.8	49.1	43.7
25/11/2022 11:53:00	46.2	51.6	48.1	44.5
25/11/2022 11:58:00	45.5	51.8	46.9	43.9

Table A4-6: Daytime results from ST6

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
24/11/2022 09:15:00	50.2	56.7	51.2	49.4
24/11/2022 09:20:00	50.0	53.9	50.6	49.3
24/11/2022 09:25:00	50.1	58.3	50.8	49.3
24/11/2022 09:30:00	50.9	60.2	51.5	49.9
24/11/2022 09:35:00	51.5	58.8	52.6	50.2
24/11/2022 09:40:00	52.8	70.0	52.5	50.4
25/11/2022 12:05:00	45.8	52.8	46.9	44.7
25/11/2022 12:10:00	48.5	62.2	50.5	44.8
25/11/2022 12:15:00	46.3	55.4	47.6	44.8

Table A4-7: Daytime results from ST7

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
24/11/2022 09:10:00	60.9	65.6	61.4	60.2
24/11/2022 09:15:00	60.7	63.8	61.3	60.1
24/11/2022 09:20:00	Data excluded due to idling car			
24/11/2022 09:25:00	60.9	65.0	61.8	60.0
24/11/2022 09:30:00	61.9	69.2	62.9	60.7
24/11/2022 09:35:00	62.0	67.6	62.8	61.2
25/11/2022 12:15:00	64.0	74.9	64.7	62.2
25/11/2022 12:20:00	63.6	73.2	64.1	62.4
25/11/2022 12:25:00	63.4	69.0	64.7	62.2

Table A4-8: Daytime results from ST8

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
24/11/2022 11:35:00	72.0	83.4	76.3	50.6
24/11/2022 11:40:00	71.7	86.2	76.0	50.6
24/11/2022 11:45:00	73.2	85.3	76.6	50.9
24/11/2022 11:50:00	71.2	83.2	75.6	51.8
24/11/2022 11:55:00	71.6	81.4	76.0	50.1
24/11/2022 12:00:00	71.8	80.6	76.3	49.1

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
25/11/2022 10:46:00	71.8	81.7	77.0	51.8
25/11/2022 10:51:00	71.5	85.0	77.0	52.5
25/11/2022 10:56:00	72.0	82.5	76.5	53.6

Table A4-9: Night-time results from ST1

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
25/11/2022 03:03:00	43.6	46	44.4	42.7
25/11/2022 03:08:00	44.5	51	46	43

Table A4-10: Night-time results from ST2

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
25/11/2022 04:27:00	44.3	46.1	45.1	43.5
25/11/2022 04:32:00	44.7	48.5	45.9	43.2
25/11/2022 04:37:00	44.9	47.9	45.8	43.9

Table A4-11: Night-time results from ST3

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
25/11/2022 04:10:00	41.9	43.8	42.7	40.9
25/11/2022 04:15:00	43.7	47.9	45.2	42.1

Table A4-12: Night-time results from ST4

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
25/11/2022 03:54:00	44.8	51.7	47.8	42.2
25/11/2022 03:59:00	42.8	46.1	43.5	41.9
25/11/2022 04:48:00	47.4	55.1	49.5	45.1
25/11/2022 04:53:00	45.3	49.3	46.1	44.3

Table A4-13: Night-time results from ST5

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
25/11/2022 03:30:00	42.5	52.9	43.1	41.3

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
25/11/2022 03:35:00	41.6	46.7	42.4	40.6
25/11/2022 05:08:00	45.4	47.4	46.6	44.4
25/11/2022 05:13:00	45.7	48.0	46.5	44.9

Table A4-14: Night-time results from ST6

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
25/11/2022 02:34:00	40.0	48.8	40.5	38.8
25/11/2022 02:39:00	40.5	49.1	42.4	38.3
25/11/2022 02:44:00	40.7	56.3	43.1	38.0

Table A4-15: Night-time results from ST7

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
25/11/2022 02:33:00	43.5	55.2	43.0	40.8
25/11/2022 02:38:00	43.7	51.6	46.1	40.6
25/11/2022 05:26:00	47.7	54.1	49.7	45.9
25/11/2022 05:31:00	47.5	57.7	48.9	45.9

Table A4-16: Night-time results from ST8

Measurement Start Time	$dBL_{Aeq,5m}$	dBL_{AFmax}	$dBL_{A10,5m}$	$dBL_{A90,5m}$
25/11/2022 02:14:00	41.2	48.5	41.8	40.2
25/11/2022 02:19:00	42.5	49.5	44.1	40.8
25/11/2022 05:41:00	68.8	83.2	72.9	47.5
25/11/2022 05:46:00	67.4	86.4	68.6	47.8

A5 Survey Photographs

Figure A5-1: Monitoring Location ST1

Figure A5-2: Monitoring Location ST2

Figure A5-3: Monitoring Location ST3

Figure A5-4: Monitoring Location ST4

Figure A5-5: Monitoring Location ST5

Figure A5-6: Monitoring Location ST6

Figure A5-7: Monitoring Location ST7

A6 Construction Phase Assumptions

Table A6-1: Construction Phase Sub-activities

Phase No.	Item of Works	Sub-activities
1	Establish site compound and install noise barriers	Distribution
		Drainage
		Road Construction
		Site Compound (Area Source)
2	Dredging of Lake / remove islands	Distribution
		Reclamation (offshore)
		Civils (offshore)
		Drainage
		Road Construction
		Site Compound (Area Source)
3	Reclamation of Land southeast	Distribution
		Reclamation (on land)
		Site Compound (Area Source)
4	Creating of Islands	Distribution
		Civils (offshore)
		Site Compound (Area Source)
5	Creating of reed beds	Distribution
		Civils (offshore)
		Site Compound (Area Source)
6	Demolition of obsolete infrastructure	Distribution
		Civils (on land)
		Earthworks (on land)
		Road Construction
		Site Compound (Area Source)
7	Utilities	Distribution
		Civils (on land)
		Earthworks (on land)
		Drainage
		Site Compound (Area Source)

Phase No.	Item of Works	Sub-activities
8	Road building, resurfacing (including car parks)	Distribution
		Earthworks (on land)
		Road Construction
		Site Compound (Area Source)
9	Construction - Main Buildings	Distribution
		Civils (on land)
		Drainage
		Site Compound (Area Source)
10	Construction of outdoor activities incl. zipwire etc	Distribution
		Civils (on land)
		Drainage
		Site Compound (Area Source)
11	Demolition of existing sailing Club	Distribution
		Civils (on land)
		Earthworks (on land)
		Road Construction
		Site Compound (Area Source)
12	Landscaping	Distribution
		Civils (on land)
		Site Compound (Area Source)

Table A6-2: Construction Plant Sound Emission Data

Plant Item	BS5228 Ref.	Notes	Lw dBA
12m JCB telehandler	C2.35	Site Preparation	99
Flatbed transit truck	C2.34	Site Preparation	108
21 ton excavator	C4.65	General Site Activities	99
9 ton cabbed forward tipping dumper	C2.30	Site Preparation	107
Rammax compactor plate	C2.42	Site Preparation	106
HG 130 roller	C5.19	Road Roller	108
JCB 3CX	C4.14	General Site Activities	95
Vogele asphalt Paver – 3000	C5.31	Road Construction	105

Plant Item	BS5228 Ref.	Notes	Lw dBA
9 ton cabbed forward tipping dumper	C2.30	Site Preparation	107
Wacker Plate	C2.41	Site Preparation	108
Vibratory Roller	C5.20	Site Preparation	103
Floor Saw	C4.72	General Site Activities	107
8T Excavator with Breaker	C1.9	Road Construction Works	118
Diesel generator	C6.39	Power	93
Wheel wash	C4.88	General Site Activities	96
Wheeled excavator	C4.10	General Site Activities	94
30 ton excavator	C2.16	Site Preparation	103
Diesel generator	C6.39	Power	93
30 ton excavator	C2.16	Site Preparation	103
30 ton articulated dump truck	C8.16	Site Preparation	109
9 ton cabbed forward tipping dumper	C4.4	General Site Activities	104
Twin Drum 1380mm Wide 4t Roller	C2.39	Site Preparation	102
Single drum 13 ton sheep foot roller	C5.26	Site Preparation	105
CAT D6 Dozer	C2.12	Site Preparation	109
200ton Crane	C4.38	General Site Activities	106
Wheel wash	C4.88	General Site Activities	96
CAT D6 Dozer	C2.12	Site Preparation	109
30 ton articulated dump truck	C8.16	Site Preparation	109
Twin Drum 1380mm Wide 4t Roller	C2.39	Site Preparation	102
Single drum 13 ton sheep foot roller	C5.26	Site Preparation	105
30 ton excavator	C2.16	Site Preparation	103
9 ton cabbed forward tipping dumper	C4.4	General Site Activities	104
CFA piling rig (Tracked)	C3.21	Piling & Ancillary Operations	107
Pile Cropper	C4.65	General Site Activities	99
21 ton excavator	C4.65	General Site Activities	99
9 ton cabbed forward tipping dumper	C2.30	Site Preparation	107

Table A6-3: Construction Plant Assumptions for Different Construction Phases

Phase No.	Item of Works	Sub-activity	Plant Item	BS5228 Ref.	Notes	Quant.	% On-time	Lw dB A
1	Establish site compound and install noise barriers	Distribution	12m JCB telehandler	C2.35	Site Preparation	1	50%	99
			Flatbed transit truck	C2.34	Site Preparation	1	50%	108
		Drainage	21 ton excavator	C4.65	General Site Activities	1	50%	99
			9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	50%	107
			Rammax compactor plate	C2.42	Site Preparation	1	50%	106
		Road Construction	HG 130 roller	C5.19	Road Roller	1	50%	108
			JCB 3CX	C4.14	General Site Activities	1	50%	95
			Vogele asphalt Paver – 3000	C5.31	Road Construction	1	50%	105
			21 ton excavator	C4.65	General Site Activities	1	50%	99
			9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	50%	107
			Wacker Plate	C2.41	Site Preparation	1	50%	108
			Vibratory Roller	C5.20	Site Preparation	1	50%	103
			Floor Saw	C4.72	General Site Activities	1	50%	107
			8T Excavator with Breaker	C1.9	Road Construction Works	1	50%	118

Phase No.	Item of Works	Sub-activity	Plant Item	BS5228 Ref.	Notes	Quant.	% On-time	Lw dB A
		Site Compound (Area Source)	Diesel generator	C6.39	Power	1	100%	93
			Wheel wash	C4.88	General Site Activities	1	10%	96
			Wheeled excavator	C4.10	General Site Activities	1	100%	94
2	Dredging of Lake / remove islands	Distribution	12m JCB telehandler	C2.35	Site Preparation	1	50%	99
			Flatbed transit truck	C2.34	Site Preparation	1	50%	108
		Reclamation (offshore)	30 ton excavator	C2.16	Site Preparation	1	100%	103
			Diesel generator	C6.39	Power	1	100%	93
		Civils (offshore)	Diesel generator	C6.39	Power	1	50%	93
			21 ton excavator	C4.65	General Site Activities	1	50%	99
			9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	50%	107
		Drainage	21 ton excavator	C4.65	General Site Activities	1	50%	99
			9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	50%	107
			Rammax compactor plate	C2.42	Site Preparation	1	50%	106
		Road Construction	HG 130 roller	C5.19	Road Roller	1	50%	108
			JCB 3CX	C4.14	General Site Activities	1	50%	95

Phase No.	Item of Works	Sub-activity	Plant Item	BS5228 Ref.	Notes	Quant.	% On-time	Lw dB A
			Vogele asphalt Paver – 3000	C5.31	Road Construction	1	50%	105
			21 ton excavator	C4.65	General Site Activities	1	50%	99
			9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	50%	107
			Wacker Plate	C2.41	Site Preparation	1	50%	108
			Vibratory Roller	C5.20	Site Preparation	1	50%	103
			Floor Saw	C4.72	General Site Activities	1	50%	107
			8T Excavator with Breaker	C1.9	Road Construction Works	1	50%	118
		Site Compound (Area Source)	Diesel generator	C6.39	Power	1	100%	93
			Wheel wash	C4.88	General Site Activities	1	10%	96
			Wheeled excavator	C4.10	General Site Activities	1	100%	94
3	Reclamation of Land southeast	Distribution	12m JCB telehandler	C2.35	Site Preparation	1	50%	99
			Flatbed transit truck	C2.34	Site Preparation	1	50%	108
		Reclamation (on land)	30 ton excavator	C2.16	Site Preparation	1	50%	103
			30 ton articulated dump truck	C8.16	Site Preparation	1	50%	109

Phase No.	Item of Works	Sub-activity	Plant Item	BS5228 Ref.	Notes	Quant.	% On-time	Lw dB A
			9 ton cabbed forward tipping dumper	C4.4	General Site Activities	1	50%	104
			Twin Drum 1380mm Wide 4t Roller	C2.39	Site Preparation	1	50%	102
			Single drum 13 ton sheep foot roller	C5.26	Site Preparation	1	50%	105
			CAT D6 Dozer	C2.12	Site Preparation	1	50%	109
		Site Compound (Area Source)	Diesel generator	C6.39	Power	1	100%	93
			Wheel wash	C4.88	General Site Activities	1	10%	96
			Wheeled excavator	C4.10	General Site Activities	1	100%	94
4	Creating of Islands	Distribution	12m JCB telehandler	C2.35	Site Preparation	1	50%	99
			Flatbed transit truck	C2.34	Site Preparation	1	50%	108
		Civils (offshore)	Diesel generator	C6.39	Power	1	50%	93
			200ton Crane	C4.38	General Site Activities	1	50%	106
		Site Compound (Area Source)	Diesel generator	C6.39	Power	1	100%	93
			Wheel wash	C4.88	General Site Activities	1	100%	96
			Wheeled excavator	C4.10	General Site Activities	1	100%	94

Phase No.	Item of Works	Sub-activity	Plant Item	BS5228 Ref.	Notes	Quant.	% On-time	Lw dB A
5	Creating of reed beds	Distribution	12m JCB telehandler	C2.35	Site Preparation	1	50%	99
			Flatbed transit truck	C2.34	Site Preparation	1	50%	108
		Civils (offshore)	Diesel generator	C6.39	Power	1	50%	93
			21 ton excavator	C4.65	General Site Activities	1	50%	99
		Site Compound (Area Source)	Diesel generator	C6.39	Power	1	100%	93
			Wheel wash	C4.88	General Site Activities	1	100%	96
			Wheeled excavator	C4.10	General Site Activities	1	100%	94
6	Demolition of obsolete infrastructure	Distribution	12m JCB telehandler	C2.35	Site Preparation	1	50%	99
			Flatbed transit truck	C2.34	Site Preparation	1	50%	108
		Civils (on land)	21 ton excavator	C4.65	General Site Activities	1	50%	99
			9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	50%	107
		Earthworks (on land)	CAT D6 Dozer	C2.12	Site Preparation	1	75%	109
		Road Construction	Floor Saw	C4.72	General Site Activities	1	50%	107
			8T Excavator with Breaker	C1.9	Road Construction Works	1	50%	118
			Diesel generator	C6.39	Power	1	100%	93

Phase No.	Item of Works	Sub-activity	Plant Item	BS5228 Ref.	Notes	Quant.	% On-time	Lw dB A
		Site Compound (Area Source)	Wheel wash	C4.88	General Site Activities	1	10%	96
			Wheeled excavator	C4.10	General Site Activities	1	100%	94
7	Utilities	Distribution	12m JCB telehandler	C2.35	Site Preparation	1	50%	99
			Flatbed transit truck	C2.34	Site Preparation	1	50%	108
		Civils (on land)	9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	50%	107
		Earthworks (on land)	30 ton articulated dump truck	C8.16	Site Preparation	1	75%	109
			Twin Drum 1380mm Wide 4t Roller	C2.39	Site Preparation	1	75%	102
			Single drum 13 ton sheep foot roller	C5.26	Site Preparation	1	75%	105
			CAT D6 Dozer	C2.12	Site Preparation	1	75%	109
		Drainage	21 ton excavator	C4.65	General Site Activities	1	50%	99
			Rammax compactor plate	C2.42	Site Preparation	1	50%	106
		Site Compound (Area Source)	Diesel generator	C6.39	Power	1	100%	93
			Wheel wash	C4.88	General Site Activities	1	10%	96

Phase No.	Item of Works	Sub-activity	Plant Item	BS5228 Ref.	Notes	Quant.	% On-time	Lw dB A
			Wheeled excavator	C4.10	General Site Activities	1	100%	94
8	Road building, resurfacing (including car parks)	Distribution	12m JCB telehandler	C2.35	Site Preparation	1	50%	99
			Flatbed transit truck	C2.34	Site Preparation	1	50%	108
		Earthworks (on land)	30 ton excavator	C2.16	Site Preparation	1	75%	103
			30 ton articulated dump truck	C8.16	Site Preparation	1	75%	109
			9 ton cabbed forward tipping dumper	C4.4	General Site Activities	1	75%	104
			CAT D6 Dozer	C2.12	Site Preparation	1	75%	109
		Road Construction	HG 130 roller	C5.19	Road Roller	1	50%	108
			JCB 3CX	C4.14	General Site Activities	1	50%	95
			Vogele asphalt Paver – 3000	C5.31	Road Construction	1	50%	105
			21 ton excavator	C4.65	General Site Activities	1	50%	99
			Wacker Plate	C2.41	Site Preparation	1	50%	108
			Vibratory Roller	C5.20	Site Preparation	1	50%	103
		Site Compound (Area Source)	Diesel generator	C6.39	Power	1	100%	93
			Wheel wash	C4.88	General Site Activities	1	10%	96

Phase No.	Item of Works	Sub-activity	Plant Item	BS5228 Ref.	Notes	Quant.	% On-time	Lw dB A
			Wheeled excavator	C4.10	General Site Activities	1	100%	94
9	Construction - Main Buildings	Distribution	12m JCB telehandler	C2.35	Site Preparation	1	50%	99
			Flatbed transit truck	C2.34	Site Preparation	1	50%	108
		Civils (on land)	CFA piling rig (Tracked)	C3.21	Piling & Ancillary Operations	1	50%	107
			21 ton excavator	C4.65	General Site Activities	1	50%	99
			9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	50%	107
			200ton Crane	C4.38	General Site Activities	1	50%	106
			Pile Cropper	C4.65	General Site Activities	1	50%	99
		Drainage	21 ton excavator	C4.65	General Site Activities	1	50%	99
			9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	50%	107
			Rammax compactor plate	C2.42	Site Preparation	1	50%	106
		Site Compound (Area Source)	Diesel generator	C6.39	Power	1	100%	93
			Wheel wash	C4.88	General Site Activities	1	10%	96

Phase No.	Item of Works	Sub-activity	Plant Item	BS5228 Ref.	Notes	Quant.	% On-time	Lw dB A
			Wheeled excavator	C4.10	General Site Activities	1	100%	94
10	Construction of outdoor activities incl. zipwire etc	Distribution	12m JCB telehandler	C2.35	Site Preparation	1	50%	99
			Flatbed transit truck	C2.34	Site Preparation	1	50%	108
		Civils (on land)	CFA piling rig (Tracked)	C3.21	Piling & Ancillary Operations	1	50%	107
			21 ton excavator	C4.65	General Site Activities	1	50%	99
			9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	50%	107
			200ton Crane	C4.38	General Site Activities	1	50%	106
			Pile Cropper	C4.65	General Site Activities	1	50%	99
		Drainage	21 ton excavator	C4.65	General Site Activities	1	50%	99
			9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	50%	107
			Rammax compactor plate	C2.42	Site Preparation	1	50%	106
		Site Compound (Area Source)	Diesel generator	C6.39	Power	1	100%	93
			Wheel wash	C4.88	General Site Activities	1	10%	96

Phase No.	Item of Works	Sub-activity	Plant Item	BS5228 Ref.	Notes	Quant.	% On-time	Lw dB A
			Wheeled excavator	C4.10	General Site Activities	1	100%	94
11	Demolition of existing sailing Club	Distribution	12m JCB telehandler	C2.35	Site Preparation	1	50%	99
			Flatbed transit truck	C2.34	Site Preparation	1	50%	108
		Civils (on land)	21 ton excavator	C4.65	General Site Activities	1	50%	99
			9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	50%	107
		Earthworks (on land)	CAT D6 Dozer	C2.12	Site Preparation	1	75%	109
		Road Construction	Floor Saw	C4.72	General Site Activities	1	50%	107
			8T Excavator with Breaker	C1.9	Road Construction Works	1	50%	118
		Site Compound (Area Source)	Diesel generator	C6.39	Power	1	100%	93
			Wheel wash	C4.88	General Site Activities	1	10%	96
			Wheeled excavator	C4.10	General Site Activities	1	100%	94
12	Landscaping	Distribution	12m JCB telehandler	C2.35	Site Preparation	1	50%	99
			Flatbed transit truck	C2.34	Site Preparation	1	50%	108
		Civils (on land)	21 ton excavator	C4.65	General Site Activities	1	75%	99

Phase No.	Item of Works	Sub-activity	Plant Item	BS5228 Ref.	Notes	Quant.	% On-time	Lw dB A
			9 ton cabbed forward tipping dumper	C2.30	Site Preparation	1	75%	107
		Site Compound (Area Source)	Diesel generator	C6.39	Power	1	100%	93
			Wheel wash	C4.88	General Site Activities	1	10%	96
			Wheeled excavator	C4.10	General Site Activities	1	100%	94

Table A6-4: Indicative Construction Phasing

Phase No.	Item of Works	Indicative Works Periods			
		Start	End	Start	End
1	Establish site compound and install noise barriers	Sep - 2026	Sep - 2026	-	-
2	Dredging of Lake / remove islands	Sep - 2026	Sep - 2026	-	-
3	Reclamation of Land southeast	Sep - 2026	Sep - 2026	-	-
4	Creating of Islands	Sep - 2026	Sep - 2026	-	-
5	Creating of reed beds	Sep - 2026	Sep - 2026	-	-
6	Demolition of obsolete infrastructure	Sep - 2026	Sep - 2026	-	-
7	Utilities	Sep - 2026	Oct - 2027	-	-
8	Road building, resurfacing (including car parks)	May - 2026	Aug - 2026	Sep - 2027	Feb - 2028
9	Construction - Main Buildings	Sep - 2026	Aug - 2027	-	-
10	Construction of outdoor activities incl. zipwire etc	Feb - 2027	May - 2027	-	-
11	Demolition of existing sailing Club	Sep - 2027	Sep - 2027	-	-
12	Landscaping	Nov - 2026	Jun - 2027[13]	Sep - 2027	Dec - 2027

[13] Excluding January 2027

Figure A6-1: Construction Programme

Phase	Activity	Month																					
		May-26	Jun-26	Jul-26	Aug-26	Sep-26	Oct-26	Nov-26	Dec-26	Jan-27	Feb-27	Mar-27	Apr-27	May-27	Jun-27	Jul-27	Aug-27	Sep-27	Oct-27	Nov-27	Dec-27	Jan-28	Feb-28
1	**Enabling Works Site Preparation**																						
1a	Protection of ecological value haitats being retained (fencing and initial acoustic barriers)																						
1b	Install first main site cabin and toilets																						
1c	Mark out location of main construction compounds																						
1d	Clearance to failitate sitting of compounds and cabins under an ecological watching brief																						
1e	Removal of rubble heaps and waste water under ecological watching brief (for reptiles)																						
1f	Installation of site compounds and facilities																						
2	**Enabling Works - Site Access Road**																						
3	**Enabling Works - In lake Works**																						
3a	Deployment of tern rafts, floating reedbeds and new buoys, artificial reefs and kingfisher fishing platforms																						
3b	Deployment of submerged tree planters to create partition between sailing area and south-west nature reserve																						
3c	Installation of kingfisher tunnels (lake banks)																						
3d	Dredge of eastern channel																						
3e	beach creation																						
4	**Initial Landscaping Planting & Ecological Mitigation (on land)**																						
4a	Planting of new woodland area with shrubs																						
4b	Strengthening of boundary with canal towpath, creation of hedgehog highway / mammal gaps. Placement of bat boxes along access and at pennisula																						
5	**Construction - Main Works on Peninsula**																						
5a	Vehicle Parking																						
5b	Utilities Installation																						
5c	Toilet Block on camp site and Anglers Store																						
5d	Workshop																						
5e	Energy Centre																						
5f	Safety Equipment Shed and Boat Store																						
5g	Main Building																						
5h	Internal Access Paths																						
5i	Land based activities (caving, high ropes, swing rope etc.)																						
5j	Lanscape planting around main facility and campsite, including acoustic barrier																						
5k	Activity Shelters																						
5l	Fencing and Gates																						
6	**Demolition of existing BSC facility**																						
7	**Creation of new footpath along access road**																						
8	**Landscaping and Ecological Enhancements at former BSC Land**																						

A7 Road Traffic Data

Table A7-1: Construction Road Traffic Data

Road Link ID	Name	2024 Without Development DMCY				2024 With Development DSCY			
		HDV	LDV	Total	%HGV	HDV	LDV	Total	%HGV
1	A412	1,017	10,437	11,454	9%	1,022	10,460	11,482	9%
2	Breakspear Road North	37	2,689	2,726	1%	37	2,690	2,727	1%
3	Chalfron Lane	322	5,219	5,540	6%	322	5,219	5,540	6%
4	Church Hill	481	10,848	11,329	4%	481	10,855	11,336	4%
5	Coppermill Lane	164	3,081	3,245	5%	164	3,081	3,245	5%
6	Harvil Road	322	9,690	10,012	3%	322	9,730	10,052	3%
7	High Street	416	8,742	9,158	5%	416	8,762	9,178	5%
8	Moorfield Road	155	4,456	4,611	3%	160	4,503	4,663	3%
9	Moorhall Road (East)	131	4,209	4,340	3%	131	4,243	4,374	3%
10	Moorhall Road (West)	131	4,209	4,340	3%	136	4,256	4,392	3%
11	Northwood Road	89	3,605	3,695	2%	89	3,611	3,701	2%
12	Park Lane	162	3,291	3,452	5%	162	3,291	3,452	5%
13	Rickmansworth Road	183	3,734	3,916	5%	183	3,739	3,921	5%

Table A7-2: Operational Road Traffic Data

Road Link ID	Name	2025 Without Development DMFY				2025 With Development DSFY			
		HDV	LDV	Total	%HGV	HDV	LDV	Total	%HGV
1	A412	1,027	10,537	11,564	9%	1,029	10,560	11,589	9%
2	Breakspear Road North	37	2,715	2,753	1%	37	2,716	2,754	1%
3	Chalfron Lane	325	5,269	5,594	6%	325	5,269	5,594	6%
4	Church Hill	486	10,952	11,438	4%	487	10,959	11,446	4%
5	Coppermill Lane	165	3,111	3,276	5%	165	3,111	3,276	5%
6	Harvil Road	326	9,783	10,109	3%	330	9,822	10,152	3%
7	High Street	420	8,826	9,246	5%	422	8,846	9,268	5%
8	Moorfield Road	157	4,499	4,655	3%	162	4,545	4,706	3%
9	Moorhall Road (East)	133	4,249	4,382	3%	136	4,282	4,418	3%
10	Moorhall Road (West)	133	4,249	4,382	3%	138	4,295	4,433	3%
11	Northwood Road	90	3,640	3,730	2%	91	3,645	3,736	2%
12	Park Lane	163	3,322	3,485	5%	163	3,322	3,485	5%
13	Rickmansworth Road	184	3,770	3,954	5%	185	3,775	3,960	5%

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