11. NOISE & VIBRATION

11.1 Introduction

11.1.1 Chapter Scope

This section of the Environmental Impact Assessment Report (EIAR) describes potential noise and vibration impacts associated with the Proposed Development. Potential noise and vibration impacts are typically divided into the following categories:

- Construction noise impacts on surrounding receptors.
- Construction vibration impacts on surrounding receptors.
- Operational noise impacts on surrounding receptors.
- Operational vibration impacts on surrounding receptors.

Following a preliminary scoping exercise, it was concluded that the Proposed Development will not give rise to vibration impacts following construction, and therefore operational phase vibration impacts have been scoped out. The remaining three categories are assessed in this report, namely construction phase noise impacts, construction phase vibration impacts, and operational phase noise impacts.

11.1.2 Development Summary

Details of the Proposed Development are set out in Chapter 4 of the EIAR. The development may be summarised as follows:

- Construction of a new Water Sports Pavilion;
- The demolition of the existing water sports building and adjacent public toilet block on site;
- The redevelopment of the existing marina including an extension to the existing breakwater and the jetty to increase marina capacity;
- Construction of new landscaped public recreation areas with a playground, nature observation space, picnic areas, benches, bicycle storage and service areas, extensive planting of native trees, outdoor changing, events space and wellness meadow including the development of a continuous promenade along the lakeshore;
- Active travel and site access improvements including provision of traffic calming measures and a 3m wide shared cycle / pedestrian pathway along the L2020 Local Road, 2 no. of bus set down locations, upgraded signage, lighting, and road marking;
- Extension of the existing parking provision in the area to provide additional car parking spaces, Electric Vehicle (EV) spaces and accessible parking spaces.
- All ancillary works including site clearance, boundary treatments, associated public lighting, bin storage, hard and soft landscaping, site drainage upgrades, connections to existing utilities to include foul and surface water drainage, water supply, electrical & telecommunications networks. Boundary treatments involve upgrades to the existing golf course boundary safety netting (between 10m to 20m in height) and fencing.

11.1.3 Assessment Methodology

This report achieves the following assessment objectives:

- Standards and criteria relevant to the Proposed Development are identified.
- The nearest built receptors are identified.
- The baseline soundscape is described.
- Construction noise levels arising from the proposed works are described.
- Construction noise impacts at receptors are assessed.
- Potential vibration impacts associated with construction works are assessed.
- Operational noise emissions are described.
- Operational noise impacts at receptors are assessed.
- Potential cumulative impacts arising in conjunction with other sources are assessed.
- Mitigation measures are identified, where required.

Noise impacts are assessed with reference to terminology set out in *Guidelines on the information to be contained in environmental impact assessment reports* (Environmental Protection Agency (EPA), 2022). The most relevant aspects of the EPA scheme are summarised in Table 11-1.

Table 11-1 EPA impact assessment scheme.

Factor	Effect	Description
Quality	Positive	Improves quality of environment
	Neutral	No effects or imperceptible effects
	Adverse	Reduces quality of environment
Significance	Imperceptible	Capable of measurement, but without significant consequences
	Not significant	Causes noticeable changes to soundscape, but without significant consequences
	Slight	Causes noticeable changes to soundscape without affecting its sensitivities
	Moderate	Alters soundscape in manner consistent with existing and emerging baseline trends
	Significant	Alters soundscape due to source character, magnitude, duration or intensity
	Very significant	Significantly alters soundscape due to source character, magnitude, duration or intensity
	Profound	Obliterates soundscape
Duration	Brief	<1 day
	Temporary	<1 year
	Short term	1-7 years
	Medium term	7-15 years
	Long term	15-60 years
	Permanent	>60 years
Extent & Context	Extent	Size of area and population affected by an effect
	Context	Degree to which project conforms or contrasts with baseline soundscape
Impact type	Indirect	Secondary impacts not directly caused by project, often occurring at some distance
	Cumulative	Combined impacts attributable to project in tandem with other projects
	Worst case	Impacts where mitigation measures substantially fail
	Indeterminable	Where full consequences of change in soundscape cannot be described
	Irreversible	Impacts to soundscape which are permanent and cannot be undone
	Residual	Degree of soundscape change which will arise after implementation of mitigation
	Synergistic	Where resultant effect exceeds sum of individual component effects

11.1.4 Documents Consulted

The following documents were consulted during the assessment:

- *Report RI 8507: Structural response and damage produced by ground vibration from surface mines blasting* (US Bureau of Mines, 1980).
- *British Standard BS 7385-2:1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration* (1993).
- *Guidelines on community noise* (World Health Organisation, 1999).
- *Directive 2002/49/EC of the European Parliament and of the Council relating to the assessment and management of environmental noise* (2002), transposed into Irish law by the *European Communities (Environmental Noise) Regulations 2018* (SI No. 549/2018) and the *European Communities (Environmental Noise) Regulations 2021* (SI No. 663/2021).
- *Night noise guidelines for Europe* (World Health Organisation, 2009).
- *Measurement and assessment of groundborne noise and vibration* (Association of Noise Consultants, 2012).
- *British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise* (2014).
- *British Standard BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* (2014).
- *Good practice guidance for the treatment of noise during the planning of national road schemes* (National Roads Authority (now Transport Infrastructure Ireland), 2014).
- *Guidelines for environmental noise impact assessment* (Institute of Environmental Management and Assessment, 2014).
- *NG4 Guidance note for noise: Licence applications, surveys and assessments in relation to scheduled activities* (Environmental Protection Agency, 2016).
- *International Standard ISO 1996-2:2017 Acoustics – Description, measurement and assessment of environmental noise, Part 2: Determination of environmental noise levels* (2017).
- *Environmental noise guidelines for the European region* (World Health Organisation, 2018).

- *British Standard BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound (2019).*
- *Design manual for roads and bridges – LA111: Noise and vibration* (UK Highway Agency, 2020).
- *Guidelines on the information to be contained in environmental impact assessment reports* (Environmental Protection Agency, 2022).
- *International Standard ISO 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoors* (2024).
- *Roscommon County noise action plan 2024-2028* (Roscommon County Council, 2024).

11.1.5 Assessor Qualifications

The acoustic assessment was undertaken by MKO Acoustic Consultant, Conor Coady and MKO Project Director, Damian Brosnan.

Conor is a project manager with 25 years of experience across a variety of roles in the renewables industry. He holds a B.Eng., an MSc. in Renewable Energy Systems and has completed the Institute of Acoustics post-graduate diploma in acoustics and noise control. Conor brings a wealth of experience from his previous roles as an analyst, engineer and consultant on various projects. His particular areas of expertise include data analysis and atmospheric physics.

Damian Brosnan, MKO Project Director, Acoustics, has over 30 years of experience in both private practice and local authority, and holds an MSc in Applied Acoustics. He has completed the Institute of Acoustics post-graduate diploma and now presents tutorials to the next generation of students on Institute courses. Prior to joining MKO, Damian worked as an acoustic consultant, specialising in environmental impact assessment. Previously, Damian worked with Cork County Council's Environment Department. Damian is a corporate member of the Institute of Acoustics and sits on the Irish branch committee. He is also a founding member of the Association of Acoustic Consultants of Ireland, an industry body founded to promote acoustics best practice in Ireland. Damian has presented acoustic evidence in a number of court hearings and oral hearings. He is the lead author of *Environmental noise guidance for local authority planning & enforcement departments* (Association of Acoustic Consultants of Ireland, 2019).

11.1.6 Limitations and Difficulties Encountered

Three potential sources of uncertainty are relevant to this assessment:

- Baseline noise levels are used to inform the assessment process. Levels were measured through surveys undertaken in accordance with *International Standard ISO 1996-2:2017 Acoustics – Description, measurement and assessment of environmental noise, Part 2: Determination of environmental noise levels* (2017). Potential for uncertainty was minimised throughout the survey process, and survey equipment was calibrated in accordance with the requirements of the standard. Nonetheless, environmental noise measurement typically includes a margin of uncertainty. The standard uncertainty value attributable to the equipment is 0.5 dB (IEC 61672-1 class 1 value). While measured baseline noise levels apply chiefly to conditions prevailing only during the survey period, levels are likely to be reasonably representative of a wider range of conditions.
- Predictive modelling is undertaken using the algorithm set out in *International Standard ISO 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors, Part 2: Engineering method for the prediction of sound pressure levels outdoors* (2024). The standard estimates prediction accuracy at ±3 dB at receptors out to a distance of 1000 m where the mean propagation route lies within 5 m of ground level. Receptors beyond this distance are likely to be well outside audible range of the site.
- The predictive model relies on plant noise data obtained from a number of sources. Uncertainty values are typically not available. In the absence of such information, an uncertainty factor of ±2 dB may be assumed.

11.2 Guidance & Criteria

11.2.1 Construction Phase Noise

There are no national mandatory noise limits relating to construction works. In granting planning permission, a local authority may stipulate construction phase noise limits applicable to daytime, evening, night-time and weekend hours as appropriate. There are no national guidelines available regarding the selection of such limits. Many local authorities chose to apply a 65 dB LAeq T limit.

The chief noise guidance document applied in Ireland and the UK in construction phase noise assessments is *British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise* (2014). Annex E of the document sets out several methods to draw up suitable noise criteria applicable to the construction phase of a project. The most appropriate method here is the 'ABC method', which provides for selection of criteria based on existing ambient noise data. On the basis of noise data recorded across the surrounding area, as discussed below, a daytime LAeq 1 h criterion of 65 dB is the most appropriate criterion for this assessment.

The LAeq 1 h parameter describes the total noise emissions from all construction sources occurring during any 1 h period, averaged over that hour. The criterion is applicable to daytime working hours. With respect to the Proposed Development, evening or night-time construction works are unlikely to be required.

The 65 dB criterion is considered applicable to surrounding receptors, in their immediate curtilage. In this regard, the EPA document *NG4 Guidance note for noise: Licence applications, surveys and assessments in relation to scheduled activities* (2016) defines a noise sensitive location as:

> *Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or area of high amenity which for its proper enjoyment requires absence of noise at nuisance levels.*

The Transport Infrastructure Ireland (TII) document *Good practice guidance for the treatment of noise during the planning of national road schemes* (2014) recommends a daytime LAeq 1 h criterion of 70 dB at receptors, marginally higher than the 65 dB BS 5228-1:2009 criterion. In this case, the TII limit is considered relevant to proposed upgrade works to the L2020 Local Road.

Neither BS 5228-1:2009 nor the TII document includes a methodology for the assessment of impact significance. Such a methodology is included in *Design manual for roads and bridges – LA111: Noise and vibration* (UK Highway Agency, 2020) (DMRB), which describes a methodology based on a combination of BS 5228-1:2009 guidance and external baseline LAeq T levels. The DMRB scale of impacts with respect to daytime working hours, based on the 65 dB BS 5228-1:2009 criterion, is set out in Table 11-2. The table includes EPA impact categories drawn from Table 11-1. The seven EPA categories do not correspond exactly with the four categories listed in the DMRB scheme, and the correlation presented in Table 11-2 is therefore an approximation. Table 11-3 presents a more refined scale applied in this assessment, based on Table 11-2.

Table 11-2 DMRB construction noise impact assessment scale for daytime working hours.

Construction noise level	DMRB impact	EPA impact
Below daytime baseline LAeq TLAeq T	Negligible	Imperceptible
Daytime baseline LAeq TLAeq T to 65 dB	Minor	Not significant to slight
Daytime baseline LAeq T to 70 dB	Moderate	Moderate to significant
≥70 dB	Major	Very significant to profound

Table 11-3 Refined DMRB construction noise impact assessment scale applied in this assessment.

Construction noise level	Impact
Below daytime baseline LAeq T	Imperceptible
Daytime baseline LAeq T to 59 dB	Not significant
60-65 dB	Slight
66-67 dB	Moderate
68-69 dB	Significant
≥70 dB	Very significant

The DMRB document additionally notes that construction noise:

> *...shall constitute a significant effect where it is determined that a major or moderate magnitude to impact will occur for a duration exceeding:*
>
> *1) 10 or more days or nights in any 15 consecutive days or nights;*
>
> *2) a total number of days exceeding 40 in any 6 consecutive months.*

11.2.2 Construction Phase Traffic

Construction works may result in a temporary increase in road traffic volumes. The DMRB document also includes a scale of impacts relating to construction phase traffic noise. Unlike the scale presented in Tables 11-2 and 11-3, which is based on absolute noise levels, the DMRB construction traffic scale is based on the magnitude of noise level increase. Table 11-4 sets out this scale. EPA impact categories are again included. As before, different impact scales are used by the EPA and the DMRB, and the table correlates these as closely as possible.

Table 11-4 DMRB offsite construction traffic noise impact assessment scale.

Noise level increase	DMRB impact	EPA impact
<1 dB	Negligible	Imperceptible
1–2.9 dB	Minor	Not significant to slight
3–4.9 dB	Moderate	Moderate to significant
≥5 dB	Major	Very significant to profound

11.2.3 Construction Phase Vibration

As with noise, there are no national limits relating to groundborne vibration, and reference is usually made to guidance set out in *British Standard BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* (2014). Table 11-5 presents guidance included in the document with respect to human perception of peak particle velocity (PPV), the most commonly applied descriptor of groundborne vibration.

Table 11-5 Human perception of vibration, from BS 5228-2:2009.

PPV	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10.0 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

In order to avoid potential cosmetic or structural damage to buildings in the vicinity of construction works, reference may be made guidance included in a number of documents. In this regard, the TII document identified above has seen increasing application to non-road projects due to the absence of any other Irish guidance. TII criteria, listed in Table 11-6, are informed by documents such as *British Standard BS 7385-2:1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration* (1993). The criteria apply to the closest part of any relevant building or structure.

Table 11-6 TII building vibration criteria.

Frequency	<10 Hz	10-50 Hz	>50 Hz
PPV	8 mm/s	12.5 mm/s	20 mm/s

Limits set out above are considerably lower than criteria presented in Table 11-7, which lists PPV levels below which cosmetic damage to buildings such as hairline cracking is unlikely to occur. Limits relating to structural damage are significantly higher.

Table 11-7 Recommended vibration limits.

Structure	Lower frequencies	Higher frequencies	Source
Modern dwellings	<40 Hz: 19 mm/s	>40 Hz: 51 mm/s	1
Older dwellings	<40 Hz: 12.7 mm/s	>40 Hz: 51 mm/s	1
Industrial & heavy commercial	4-15 Hz: 50 mm/s	>15 Hz: 50 mm/s	2 & 3
Residential & light commercial	4-15 Hz: 15-20 mm/s	>15 Hz: 20-50 mm/s	2 & 3

Sources:
1: *US Bureau of Mines Report RI 8507: Structural response and damage produced by ground vibration from surface mines blasting* (1980).
2: *BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* (2014).
3: *BS 7385-2: 1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground borne vibration* (1993).

11.2.4 Operational Phase Noise

There are no national mandatory noise limits applicable to commercial, leisure or public realm projects. Noise emissions from such facilities may be assessed using World Health Organisation (WHO) guidance. Most environmental noise guidance documents issued across Europe ultimately derive limits from WHO guidance documents. The WHO document *Guidelines on community noise* (1999) sets out guideline values considered necessary to protect communities from environmental noise. With respect to residential settings, the document notes that an outdoor LAeq 16 h level of 55 dB is an indicator of serious annoyance during daytime and evening hours, with 50 dB being an indicator of moderate annoyance. The 55 dB criterion was first suggested by the WHO in their 1980 document *Environmental health criteria 12*.

Since 1980, the 55 dB criterion has become the de facto daytime limit applied by most Irish regulatory authorities to commercial and industrial operators. Although the WHO criterion applies to daytime periods of 16 hours, authorities typically specify shorter periods, and thus limits as LAeq 15 min, LAeq 30 min and LAeq 1 h are variously applied. In issuing licences to industrial facilities, the EPA typically specifies a daytime LAeq T limit of 55 dB at receptors. The EPA defines daytime as 0700–1900 h. A similar daytime limit is usually included in noise conditions attached to planning permission issued by local authorities.

The WHO's 1999 guidance document recommends an external night-time criterion of 45 dB to prevent sleep disturbance. Although the WHO document *Night noise guidelines for Europe* (2009) makes reference to a 40 dB night-time criterion, this relates to the Lnight,outside parameter, which is the long-term average measured throughout a whole year. The 45 dB criterion is considered more appropriate to short term measurement intervals. As before, LAeq 15 min, LAeq 30 min and LAeq 1 h intervals are variously applied by regulatory authorities, rather than the 8-hour period to which the WHO's 45 dB criterion applies. The EPA defines night-time as 2300–0700 h.

Neither of the WHO documents identified above refers to evening hours, and indeed their 1999 document assumes that daytime extends to 2300 h. However, a trend towards the separate assessment of evening impacts is currently evident, partly driven by the EPA's NG4 document. The original 2012 version of the document introduced the evening period 1900–2300 h. The NG4 document recommends an evening criterion of 50 dB, applicable externally at receptors.

Many authorities require that a penalty be added to measured noise levels where emissions are tonal and/or impulsive. NG4 specifies the addition of a 5 dB penalty to site specific LAeq T levels measured during daytime or evening hours. During night-time hours, the EPA prohibits tones and impulses entirely, stating that such characteristics should not be 'clearly audible or measurable'. With respect to impulsive noise events, the WHO recommends a night-time LAFmax limit of 60 dB outside bedroom windows during night-time hours. No LAFmax limit is recommended for daytime periods.

The above criteria, summarised in Table 11-8, are considered relevant to the Proposed Development. Rather than allowing daytime and evening levels to be rated for tonal or impulsive features, the table assumes that such features are avoided at all times. Criteria apply externally at receptors. The EPA definition of a noise sensitive receptor is presented above.

Table 11-8 Noise criteria appropriate to commercial emissions.

Period	Parameter	Limit
0700–1900 h	LAeq T	55 dB
1900–2300 h	LAeq T	50 dB
2300–0700 h	LAeq T	45 dB
2300–0700 h	LAFmax	60 dB

In addition to the absolute criteria above, noise impacts associated with commercial emissions may be assessed by reference to *Guidelines for environmental noise impact assessment* (Institute of Environmental Management and Assessment, 2014) (IEMA) which sets out guidance on impacts by comparison with ambient levels. Table 11-9 sets out a scale adapted from IEMA and EPA guidance. The table is considered relevant to total external ambient LAeq T levels i.e. LAeq T levels attributable to the Proposed Development may be compared to existing LAeq T levels.

Table 11-9 Assessment of impact by reference to existing noise levels.

Change	Impact	Effect
<2 dB	Imperceptible	Capable of measurement, but without significant consequences
2–4 dB	Not significant	Causes noticeable changes to soundscape, but without significant consequences
5–7 dB	Slight	Causes noticeable changes to soundscape without affecting its sensitivities
8–10 dB	Moderate	Alters soundscape in manner consistent with existing and emerging baseline trends
11–15 dB	Significant	Alters soundscape due to source character, magnitude, duration or intensity
16–20 dB	Very significant	Significantly alters soundscape due to source character, magnitude, duration or intensity
>20 dB	Profound	Obliterates soundscape

While the impact of noise emissions from certain development may also be assessed with reference to *British Standard BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound* (2019), it is noted that the standard's scope explicitly states that it is not applicable to developments such as recreational facilities. BS 4142:2014 is therefore not applicable here.

11.2.5 Operational Phase Traffic

The Proposed Development will result in a change in local traffic volumes, with a consequent change in traffic noise levels. Associated impacts may be assessed using the DMRB scheme set out in Table 11-10. The scheme applies to long term traffic noise changes, rather than short term changes associated with construction traffic as addressed in Table 11-4. As before, the EPA scale is included and correlated as closely as possible. Although the DMRB scale applies to the LAF10 18 h parameter used in the UK, it is also of some pertinence to LAeq T levels.

Table 11-10 DMRB scale for offsite operational traffic noise impact.

Noise level increase	DMRB impact	EPA impact
<3 dB	Negligible	Imperceptible
3–4.9 dB	Minor	Not significant to slight
5–9.9 dB	Moderate	Moderate to significant
≥10 dB	Major	Very significant to profound

11.2.6 Noise Action Plan

The *Roscommon County Council noise action plan 2024-2028* (Roscommon County Council, 2024) describes a strategic plan based on noise mapping undertaken in 2022. Preparation of the plan is a requirement of *Directive 2002/49/EC of the European Parliament and of the Council relating to the assessment and management of environmental noise* (2002), transposed into Irish law by the *European Communities (Environmental Noise) Regulations 2018* (SI No. 549/2018) and the *European Communities (Environmental Noise) Regulations 2021* (SI No. 663/2021).

The Directive requires preparation of noise plans for road, rail and air traffic which exceeds specified thresholds. With respect to roads, action plans are required where traffic volumes exceed three million vehicles. The noise action plan refers to the 53 dB Lden and 45 dB Lnight road noise criteria recommended by the WHO in their 2018 document *Environmental noise guidelines for the European region*. The nearest major road in Co. Roscommon subject to mapping is the N61 National Road which runs to the west of Hodson Bay, passing within 1400 m of the existing marina at its closest.

The plan identifies 'important areas', 'most important areas' and 'priority action areas' where road traffic noise levels are elevated, and where the exposed population size is sufficiently large to warrant action. Five priority action areas, where further assessment is proposed in the lifetime of the current noise action plan, are located close to the N6/M6 road at Athlone, and therefore over 3 km from the Proposed Development site. The Proposed Development will not have any implications for the identified priority action areas.

The noise action plan also describes 'quiet areas', where environmental noise levels are low and protection may be justified. No specific quiet areas have been identified in the noise action plan.

11.3 Receiving Environment

11.3.1 Location

The N61 National Road runs northwest from Athlone to Roscommon town. Approximately 4 km northwest of the M6 motorway, which bypasses Athlone, L2020 Local Road runs northeast to serve Barrymore and Yewpoint. The L2020 Local Road provides access to Athlone Golf Club, the Hodson Bay Hotel, the existing water sports facility at the Proposed Development site, and a large number of dwellings. The road terminates at Yewpoint approximately 2400 m from the N61—L2020 junction.

The Proposed Development site consists of an elongated plot on the shore of Lough Ree, with an extension southwest to the N61 National Road (see Figure 11-1 below). The central development area, consisting of carpark A and the marina, lies to the immediate southeast of the Hodson Bay Hotel. The Proposed Development site extends north from here to include the existing water sports facility and a second carpark (carpark B). Carpark C lies further north. Refer to Chapter 4, Plate 4-1 for the location of the existing carparks. To the southwest, the red line boundary follows the L2020 Local Road to the N61 National Road.

11.3.2 Receptors

There are no receptors on the Proposed Development site. The nearest residential receptors to the main development area are located at Yewpoint – here the L2020 Local Road terminates at six dwellings (receptor numbers R115—R120 shown in Figure 11-1). The nearest of these (R116) lies 90 m from the red line boundary, and 240 m from the existing water sports facility. The closest receptor to the water sports facility is Hodson Bay Hotel (R121) – the red line boundary lies immediately adjacent to the northern façade of the complex. The club house building (R122) at the golf club to the west of the site lies 160 m from the red line boundary.

The red line boundary follows the L2020 Local Road southwest, passing in close proximity to approximately 20 dwellings located alongside the road. One-off dwellings have proliferated in this area, with extensive residential development evident to the southeast of the L2020 Local Road, between N61 National Road and the lake.

There are 120 dwellings within 500 m of the red line boundary, shown in Figure 11-1. These are numbered for modelling purposes. Although some of these may be vacant or derelict, they are nonetheless included in this assessment to provide for potential future occupation. Non-residential receptors within 500 m include the hotel (R121) and golf club house (R122). For the purposes of this assessment, two hotel receptor points are assessed: R121-NE at the northeast corner of hotel, and R121-SE at the southeast corner.

599,500 600,000 600,500 601,000 601,500 602,000 602,500

747,500 747,000 746,500 746,000 745,500 745,000

N

R119 R120 R118 R115 R116 R117 R121 R122 R114 R113 R112 R111 R110 R107 R109 R108 R101 R100 R105 R098 R093 R076 R082 R097 R106 R102 R104 R103 R083 R080 R092 R099 R096 R088 R089 R075 R068 R094 R095 R090 R086 R066 R091 R085 R078 R067 R087 R081 R077 R062 R070 R079 R084 R074 R073 R064 R071 R063 R056 R055 R065 R061 R072 R053 R060 R059 R069 R045 R058 R052 R046 R049 R057 R048 R054 R041 R050 R044 R043 R042 R036 R031 R033 R047 R037 R021 R034 R032 R026 R035 R040 R051 R029 R027 R024 R030 R028 R022 R023 R013 R016 R020 R015 R012 R025 R019 R018 R003 R017 R011 R004 R010 R005 R007 R001 R008 R014 R009 R002

0 250 500 m

Map Legend

- Eircodes
- Hotels
- Golf Course
- Site Boundary - 500m Buffer
- Site Boundary

Spatial Reference
Name: TM75 Irish Grid
Datum: TM75
Projection: Transverse Mercator

N

SITE LOCATION - NOT TO SCALE

Drawing Title
Noise Receptors

Project Title
Hodson Bay - Waterfront Park

Project No.	Drawing No.	Scale
241220	1	1:10.000
Drawn By	Checked By	Date
BOC	DB	12/08/2026

Email: info@mkoireland.ie/ Website: www.mkoireland.ie

11.3.3 Baseline Noise Data

In order to assess current noise levels in the vicinity of the nearest receptors, a baseline survey was carried out during daytime hours on Saturday 07.03.26 by the MKO acoustics team. Given that construction and operational noise emissions will arise chiefly during daytime hours, evening and night-time monitoring was not required. Monitoring was undertaken at five positions shown in Plates 11-1 to 11-5 and described in Table 11-11. Locations are shown in Figure 11-2. Equipment specifications and weather conditions are listed in Tables 11-12. The sound level meters were calibrated at survey outset, and drift checked at survey completion. The daytime soundscape at all positions was influenced by local and distant road traffic, bird song/calls, barking and aircraft. Recorded time history profiles are shown in Figures 11-3 to 11-7. Noise data are presented in Table 11-13.

Table 11-11 Baseline noise station details.

Ref.	ITM NGR	Location	Representing
N1	600856 746844	Golf course 155 m W of R116	Receptors R115–R120
N2	600753 746393	25 m E of S end of Hodson Bay Hotel	Hotel
N3	600714 745968	70 m NE of R112	Receptors S of hotel close to L2020 Local Road
N4	600435 745786	20 m NE of R101	Receptors alongside L2020 Local Road
N5	601028 745634	85 m E of R083	Receptors S of hotel set back from L2020 Local Road

Table 11-12 Baseline noise survey details.

Factor	Details
Period	Saturday 07.03.26 0800–1800 h
Cloud cover	0–10%
Temperature	6 °C rising to 12 °C
Precipitation	0 mm
Wind direction	S
Wind speed	0–3 m/s
Wind speed meas.	Handheld anemometer at 2 m height
Survey operator	Conor Coady
N1 SLM details	Unit: MKO13; Type: NTi XL3; Serial: A3A-02173-F0; Microphone: A32752; Verification: 03.12.25
N2 SLM details	Unit: MK06; Type: NTi XL3; Serial: A3A-01390-F0; Microphone: A29705; Verification: 03.01.25
N3 SLM details	Unit: MKO7; Type: NTi XL3; Serial: A3A-01768-F0; Microphone: A30451; Verification: 21.07.25
N4 SLM details	Unit: MKO12; Type: NTi XL3; Serial: A3A-02107-F0; Microphone: A32691; Verification: 03.12.25
N5 SLM details	Unit: MKO11; Type: NTi XL3; Serial: A3A-02193-FO; Microphone: A32742; Verification: 03.12.25
Calibrator	Type: Bruel & Kjaer Type 4231; Serial: 2342544; Verification: 05.03.26

599,500 600,000 600,500 601,000 601,500 602,000 602,500

747,500 747,000 746,500 746,000 745,500 745,000

N

N1 N2 N3 N4 N5

0 250 500 m

Map Legend

- Site Boundary
- Site Boundary - 500m Buffer
- Noise Stations

Spatial Reference
Name: TM75 Irish Grid
Datum: TM75
Projection: Transverse Mercator

SITE LOCATION - NOT TO SCALE

Drawing Title

Noise Stations

Project Title

Hodson Bay - Waterfront Park

Project No.	Drawing No.	Scale
241220	1	1:10.000
Drawn By	Checked By	Date
BOC	DB	12/08/2026

Email: info@mkoireland.ie/ Website: www.mkoireland.ie

Plate 11-1 N1 looking N.

Plate 11-2 N2 looking SSW.

Plate 11-3 N3 looking S.

Plate 11-4 N4 looking SW.

Plate 11-5 N5 looking NE.

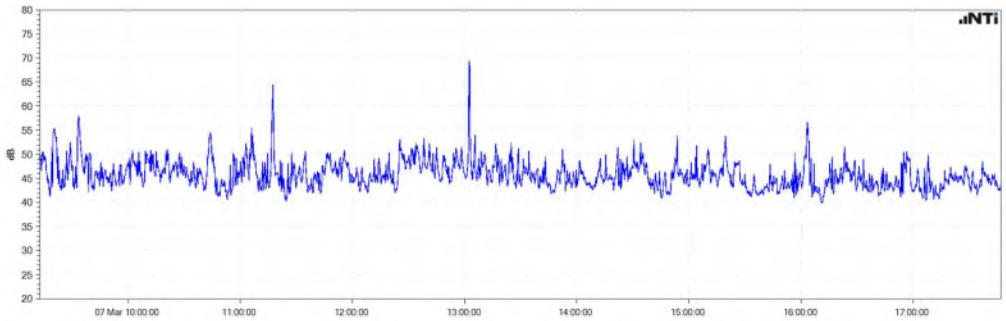

Figure 11-3 N1 LAeq 1 s profile.

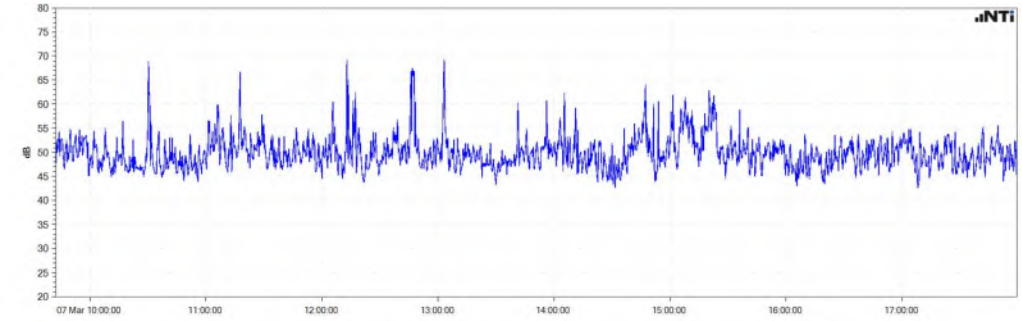

Figure 11-4 N2 LAeq 1 s profile.

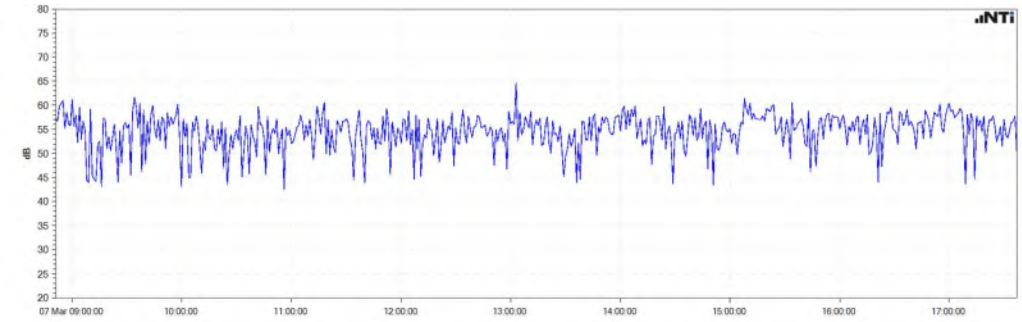

Figure 11-5 N3 LAeq 1 s profile.

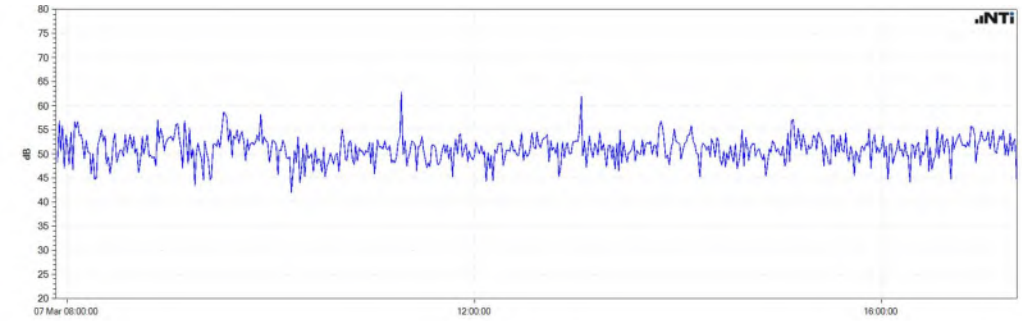

Figure 11-6 N4 LAeq 1 s profile.

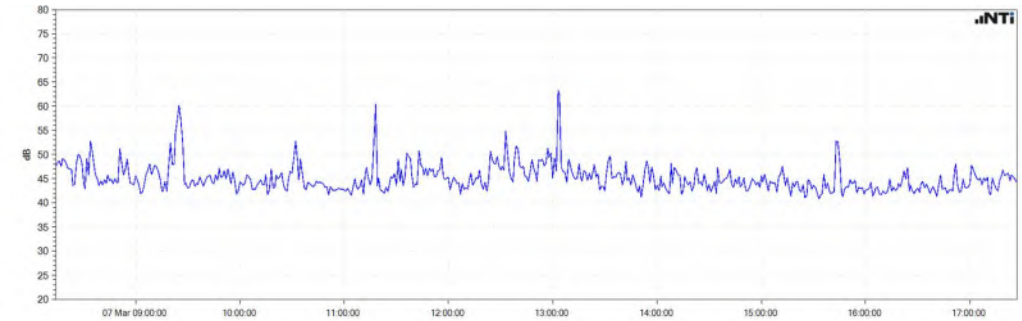

Figure 11-7 N5 LAeq 1 s profile.

Table 11-13 Measured noise data.

Interval	N1		N2		N3		N4		N5	
	LAeq	LAF90	LAeq	LAF90	LAeq	LAF90	LAeq	LAF90	LAeq	LAF90
0800–0815	-	-	-	-	-	-	53	44	-	-
0815–0830	-	-	-	-	-	-	51	44	48	42
0830–0845	-	-	-	-	-	-	52	45	47	43
0845–0900	-	-	-	-	-	-	53	45	46	43
0900–0915	-	-	-	-	55	44	53	44	46	42
0915–0930	49	41	-	-	54	43	51	44	53	42
0930–0945	50	42	-	-	58	44	55	46	45	42
0945–1000	46	43	51	47	56	44	53	46	45	42
1000–1015	48	43	49	45	54	43	50	42	44	42
1015–1030	47	44	49	45	53	43	50	43	45	42
1030–1045	47	43	55	45	55	44	50	44	47	42
1045–1100	45	41	48	45	54	44	51	44	43	41
1100–1115	48	42	53	45	56	43	51	43	44	41
1115–1130	51	41	55	47	56	45	54	45	50	41
1130–1145	46	42	50	45	55	43	50	45	48	42
1145–1200	48	45	51	46	55	44	51	45	46	44
1200–1215	45	42	56	45	55	44	50	44	44	42
1215–1230	48	43	52	45	55	45	51	46	47	43
1230–1245	49	46	51	47	56	46	52	47	49	44
1245–1300	48	44	58	46	55	46	51	46	48	44
1300–1315	56	44	55	46	58	46	54	45	55	44
1315–1330	48	43	49	45	54	45	51	46	45	42
1330–1345	46	43	50	46	54	45	51	45	46	43
1345–1400	45	42	51	46	56	43	53	44	45	41
1400–1415	45	43	53	46	57	46	52	45	45	42
1415–1430	47	42	49	44	55	43	51	46	45	42
1430–1445	47	41	50	44	55	43	51	45	45	42
1445–1500	46	41	54	45	55	44	50	44	44	42
1500–1515	47	43	56	47	57	45	53	46	45	42
1515–1530	47	43	55	47	57	45	52	45	43	41
1530–1545	43	41	51	46	56	44	52	44	47	40
1545–1600	44	41	50	46	56	45	52	45	43	41
1600–1615	48	41	48	44	56	45	51	45	43	41
1615–1630	46	42	49	44	56	44	51	44	44	41
1630–1645	44	42	50	46	56	44	52	45	43	41
1645–1700	46	42	51	46	58	46	53	45	44	41
1700–1715	44	41	51	45	57	44	53	46	45	41
1715–1730	45	43	50	45	56	45	-	-	-	-
1730–1745	45	42	49	45	-	-	-	-	-	-
Range	43–56	41–46	48–58	44–47	53–58	43–46	50–55	42–47	43–55	40–44
Arith. mean	50	43	53	45	55	44	52	45	49	42

Table 11-14 presents the assignment of measured noise data to receptors shown in Figure 11-1. In many cases, particularly at receptors to the southwest of the Proposed Development site, receptors lie closer to the public road network than their assigned noise stations, resulting in higher LAeq T levels at receptors and, conversely, lower LAeq T levels at noise stations. This results in a more conservative noise impact assessment. LAF90 T levels at receptors and corresponding noise stations are likely to be reasonably similar, given that this parameter is largely unaffected by local road traffic.

Table 11-14 Assignment of baseline noise data to receptors.

Receptor	Station	Receptor	Station	Receptor	Station	Receptor	Station
R001	N4	R032	N4	R063	N5	R093	N5
R002	N4	R033	N4	R064	N4	R094	N5
R003	N4	R034	N4	R065	N4	R095	N4
R004	N4	R035	N5	R066	N4	R096	N5
R005	N4	R036	N4	R067	N4	R097	N4
R006	N4	R037	N5	R068	N4	R098	N5
R007	N4	R038	N5	R069	N4	R099	N5
R008	N4	R039	N5	R070	N4	R100	N4
R009	N4	R040	N5	R071	N5	R101	N4
R010	N4	R041	N4	R072	N4	R102	N5
R011	N4	R042	N5	R073	N5	R103	N5
R012	N4	R043	N5	R074	N5	R104	N5
R013	N4	R044	N4	R075	N4	R105	N5
R014	N4	R045	N5	R076	N4	R106	N4
R015	N4	R046	N4	R077	N5	R107	N4
R016	N4	R047	N5	R078	N5	R108	N5
R017	N4	R048	N4	R079	N4	R109	N3
R018	N4	R049	N5	R080	N4	R110	N4
R019	N4	R050	N5	R081	N5	R111	N4
R020	N4	R051	N4	R082	N4	R112	N3
R021	N4	R052	N4	R083	N5	R113	N4
R022	N4	R053	N5	R084	N4	R114	N4
R023	N4	R054	N4	R085	N5	R115	N1
R024	N4	R055	N4	R086	N5	R116	N1
R025	N5	R056	N4	R087	N4	R117	N1
R026	N4	R057	N5	R088	N5	R118	N1
R027	N4	R058	N5	R089	N5	R119	N1
R028	N5	R059	N4	R090	N5	R120	N1
R029	N4	R060	N5	R091	N4	R121	N2
R030	N5	R061	N5	R092	N4	R122	N2
R031	N4	R062	N5				

11.3.4 Future Trends

Guidelines on the information to be contained in environmental impact assessment reports (EPA, 2022) recommends that a noise impact assessment should include a description of the likely evolution of the future receiving acoustic environment in the absence of the Proposed Development. The local noise environment is semi-rural in character, with the soundscape dominated by local and distant traffic. In the short and medium term, traffic volumes may increase due to population growth. An increase in traffic volumes is likely to result in an increase in ambient noise levels. Although the proportion of electric vehicles (EVs) in the national car fleet is likely to rise, traffic noise levels throughout the local area are dominated by tyre rolling noise rather than engine and transmission noise, as tyre rolling noise generally masks engine and transmission noise at speeds above 40-50 km/h on roads with free flowing traffic, such as the L2020. Tyre rolling noise generated by EVs is similar to that arising from conventionally powered vehicles.

Should the Proposed Development not proceed (the 'do nothing' scenario), noise emissions will continue to arise from the current water sports facility and marina.

11.4 Likely Significant Effects

11.4.1 "Do-Nothing" Scenario

If the Proposed Development were not to proceed, the site would continue to function as it does at present, with no changes to local noise emissions with noise continuing to arise from the current water sports facility and marina. The impact of this is considered neutral in the context of the EIAR.

11.4.2 Construction Phase Impacts

11.4.2.1 Construction Overview

Construction of the Proposed Development is expected to take approximately 30 months, and will involve the following stages:

- Construction of temporary site compounds.
- Erection of temporary construction hoarding.
- Installation of a cofferdam around the existing water sports area.
- Tree and vegetation removal, and demolition of existing buildings.
- L2020 Local Road improvement works to provide for a shared footpath.
- Installation of services including drainage and utilities.
- Installation of building foundations
- Construction of the water sports pavilion buildings.
- Construction of Marina extension and Marina services block building;
- Construction of new car parking areas.
- Connection to public services.
- Site reinstatement, landscaping and tree planting.

Construction works will be confined to 0700-1900 h Monday-Friday and 0800-1700 h Saturday. A proposed temporary relocation of the Baysports water sports operations to enable the Proposed Development will give rise to minimal noise emissions.

11.4.2.2 Construction Plant

During the construction phase, the chief source of noise emissions will be plant used onsite. Construction plant required onsite at various stages of the project are listed in Table 11-15. The table includes details of typical sound pressure levels, taken from BS 5228-1:2009.

Table 11-15 Expected construction plant (LZeq T at 10 m) (dB).

Plant⇩ Hz⇨	63	125	250	500	1000	2000	4000	8000	Total LAeq
Tracked excavator	80	83	76	73	72	70	69	66	78
Tracked excavator with breaker	88	88	86	89	83	83	80	76	90
Concrete mixer HGV* & pump	79	80	73	72	69	68	59	53	75
Poker vibrator	82	80	80	73	69	72	70	65	78
Dumper	82	76	75	74	68	68	64	55	76
Roller	90	84	77	81	73	68	65	61	80
Telescopic handler	85	79	69	67	64	62	56	47	71
Mobile telescopic crane (50 t)	78	69	67	64	62	57	49	40	67
Mobile elevated working platform	78	76	62	63	60	59	52	45	67
Asphalt paver & HGV	78	77	72	72	71	69	62	56	75
HGV with lifting boom	81	78	76	74	72	69	64	56	77
HGV (driving)	73	78	78	78	74	73	68	66	80

**HGV= Heavy Goods Vehicle*

11.4.2.3 Cofferdam Piling

It is proposed to install a temporary cofferdam around the existing water sports area prior to the commencement of demolition works, in order to prevent potential surface run-off into Lough Ree during demolition and construction works. The cofferdam is expected to be required for approximately 18 months.

The preferred cofferdam design includes a combination of sheet piling and an earthen bund structure. Sheet piling will be installed to refusal depth using vibratory piling. Where necessary, hammer piling may be used to push piles past refusal depth. The piling rig will operate from the existing concrete hardstanding. Noise emissions associated with both piling methods are listed in Table 11-16, taken from BS 5228-1:2009. Noise emissions from these will arise for a small portion of each day, likely to be several hours. Piles will most likely be removed by vibratory piling rig.

Table 11-16 Expected cofferdam piling plant (LZeq T at 10 m) (dB).

Plant⇩ Hz⇨	63	125	250	500	1000	2000	4000	8000	Total L_{Aeq}
Vibratory piling rig	83	82	79	82	84	82	77	67	88
Hammer piling rig	87	93	85	87	83	80	75	72	88

11.4.2.4 Marina Piling

The proposed marina extension will require placement of approximately 42 steel piles which will be driven into the lakebed. The most appropriate placement methodology will be identified at the outset of the construction phase. Vibratory piling is likely to be suitable and is the preferred method. Piling will be undertaken using a Movax piling attachment or similar fitted to a wheeled or tracked excavator. The excavator will operate on a pontoon which will be manoeuvred to each piling position as required using a workboat fitted with a diesel engine. Installation of each pile is expected to take most of one day, including pontoon manoeuvring, location fixing, preparatory works and installation. Installation of all 42 piles is expected to take 4-6 weeks. The chief noise sources present during this process are listed in Table 11-17. Noise emissions from these will arise for a small portion of each day, likely to be several hours.

Following completion of pile installation, the proposed floating jetties and breakwater will be pushed into position using workboats and attached to the piles. Gangways which will connect the floating structure to the existing breakwater will be lifted into place using the excavator on the pontoon.

Table 11-17 Expected marina piling plant (LZeq T at 10 m) (dB).

Plant⇩ Hz⇨	63	125	250	500	1000	2000	4000	8000	Total LAeq
Tracked excavator alone	80	83	76	73	72	70	69	66	78
Excavator with piling attachment[1]	80	79	76	79	81	79	74	64	85
Workboat[2]	81	79	75	70	70	70	68	65	76

[1]85 dB LAeq T level quoted at 10 m by piling contractor. Spectrum unavailable. Typical BS 5228-1:2009 vibratory piling spectrum applied, adjusted pro rata.
[2]No information available. Typical BS 5228-1:2009 diesel HGV noise data applied

11.4.3 Construction Scenarios

Noise emissions arising during the construction phase will vary considerably due to several reasons:

- During construction, plant associated with different activities will relocate around the site as required.
- Different plant will be required at different times, and construction operations will vary on a daily basis.
- Each machine may operate under different load conditions.
- Construction works may be concentrated for certain periods, followed by periods of inactivity. Localised works may require several hours of intense activity.

From the foregoing, it is clear that construction phase noise emissions will vary, and it is not possible or practical to calculate a single sound power output figure for the entire construction project. The most appropriate approach is to assess a number of likely scenarios. Table 11-18 lists construction scenarios modelled in this assessment. Noise emissions from other operations outside of the identified scenarios are likely to give rise to lower noise emissions. Noise emissions from the proposed L2020 Local Road upgrade works are assessed separately in Section 11.4.2.10 below.

Table 11-18 Assessed construction phase scenarios.

Scenario	Works zone	Works	Plant required
1	Water sports pavilion zone	Cofferdam installation	Vibratory piling rig, excavator, sporadic HGV movements
2	Water sports pavilion zone	Cofferdam installation	Hammer piling rig, excavator, sporadic HGV movements
3	Water sports pavilion zone	Building demolition	Excavator, excavator with breaker, sporadic HGV movements
4	Water sports pavilion zone	Ground preparation & foundations	Excavator, dumper, sporadic HGV movements
5	Water sports pavilion zone	Concrete pouring	Mixer HGV, concrete pump, poker vibrator, telescopic handler, sporadic HGV movements
6	Water sports pavilion zone	Steel frame erection	Crane, telescopic handler, sporadic HGV movements

7	Water sports pavilion zone	Cladding & roofing	Crane, telescopic handler, mobile elevated working platform, sporadic HGV movements
8	Marina & breakwater	Equipment staging	HGV with lifting boom, telescopic handler, sporadic HGV movements
9	Marina & breakwater	Pontoon maneuvering	Workboat
10	Marina & breakwater	Pile installation	Excavator with piling attachment on pontoon, workboat
11	Marina & breakwater	Gangway placement	Excavator on pontoon, workboat
12	Promenade area	Clearance work	Excavator, dumper, sporadic HGV movements
13	Promenade area	Infrastructure installation	HGV with lifting boom, telescopic handler, sporadic HGV movements
14	Carpark A	Ground clearance	Excavator, dumper, sporadic HGV movements
15	Carpark A	Engineering works	Excavator, roller, sporadic HGV movements
16	Carpark A	Paving works	Paver with HGV, roller, sporadic HGV movements
17	Carpark B	Ground clearance	Excavator, dumper, sporadic HGV movements
18	Carpark B	Engineering works	Excavator, roller, sporadic HGV movements
19	Carpark B	Paving works	Paver with HGV, roller, sporadic HGV movements
20	Carpark C	Ground clearance	Excavator, dumper, sporadic HGV movements
21	Carpark C	Engineering works	Excavator, roller, sporadic HGV movements
22	Carpark C	Paving works	Paver with HGV, roller, sporadic HGV movements

The following work zones are assumed in the model:

- Water sports pavilion zone: Works will arise at the south corner of this zone, closest to the hotel, in order to adopt a worst-case scenario with respect to the nearest receptor. Cofferdam construction will occur at the southern end of the cofferdam, closest to the hotel.
- Marina & breakwater: Works including piling will be undertaken close to the existing marina, again to assess impacts at the hotel.
- Promenade area: Works will take place close to the hotel.
- Carpark A: Works will take place close to the hotel.
- Carpark B: Works will occur at the northwest side of the carpark, where the carpark will be extended.
- Carpark C: Works will occur at the north end of the carpark, to assess impacts at the nearest receptors to the northeast.

HGV movements are considered between onsite work zones and the southern extent of the main works area (i.e. outside the west corner of car park A). HGV movements on L2020 Local Road, between carpark A and the N61 National Road, are considered separately in Section 11.4.2.8 below.

11.4.3.1 Construction Noise Levels At Receptors

Using DGMR iNoise Pro v2026 software, noise emissions from the 22 scenarios listed above were modelled at receptors shown in Figure 11-1. For this model iteration, it was assumed that construction works during each scenario will not overlap. Input parameters were as follows:

- Model algorithm: *International Standard ISO 9613-2:2024 Acoustics: attenuation of sound during propagation outdoors – Part 2: general method of calculation* (2024).
- Ground cover: Porous ground throughout (G = 1), apart from over water (G = 0).
- Atmospheric conditions: 10 °C and 70% relative humidity.
- Receiver height: 2 m, to assess compliance with external criteria. Additional heights of 5 and 8 m assessed at the hotel to assess impacts at upper floors.
- Plant output data: Taken from Tables 11-15, 11-16 and 11-17. 31.5 Hz levels (not provided in BS 5228-1:2009) assumed to be same as 63 Hz levels.
- Plant on-times: Excavator: 80%; Breaker: 80%; Crane 100%; Mixer HGV and pump 50%; HGV with boom 100%; Poker 100%; Working platform 50%; Boat 100%; Piling rigs: 80%; Mobile plant: Continuous movement.
- Screening: None, other than that provided by buildings.

The model output is shown in Appendix 11-1. Predicted LAeq 1 h levels at receptors are listed in Appendix 11-2. Where predicted levels fall below 20 dB, a value of <20 dB is quoted due to increasing uncertainty at such low noise levels.

At all receptors, LAeq 1 h levels received at receptors due to onsite construction activity will be lower than the identified 65 dB BS 5228-1:2009 criterion throughout the entire construction phase. The highest level received will be 61 dB, which will arise at the northeast façade of the hotel during construction scenario 10 (clearance works at the proposed promenade area), and during scenario 13 (works at carpark A).

BS 5228-1:2009 source noise data suggest that construction emissions will not be tonal. Apart from concrete breaking works during scenario 1, construction phase noise emissions are unlikely to be impulsive.

11.4.3.2 Construction Noise Impacts

Table 11-3 above sets out the DMRB scale used to assess noise impacts associated with construction noise. Appendix 11-3 presents an assessment based on this scale, applying the equivalent EPA impact category. Baseline LAeq T levels are taken from Table 11-13, assigned to receptors in accordance with Table 11-14. The assessment relates to daytime LAeq 1 h levels as these are most relevant to the construction phase.

In most cases, construction phase noise impacts will be neutral and imperceptible, or not significant adverse. Impacts will increase to slight adverse at the hotel during construction scenarios 1, 2, 10, 11, 12, 13 and 14. However, given that (a) these impacts will be temporary, and (b) construction operations will generally be confined to daytime hours, when hotel bedroom occupancy is likely to be much lower. Thus, while some occupancy may occur during daytime periods, impacts will be temporary a ns will be confined to daytime. Moreover, predicted LAeq 1 h levels at the hotel will not exceed the 65 dB BS 5228-1:2009 or 70 dB TII criteria. On this basis, residual effects will be not significant adverse at the hotel.

11.4.3.3 Combined Construction Noise Impacts

Construction impacts assessed above assume that each of the 22 scenarios modelled is undertaken separately in sequence. It is likely, however, that works will progress simultaneously at a number of zones. In this section, impacts are assessed in relation to combined operations. For the purposes of this section, it is assumed that the loudest activity in each zone will occur simultaneously. These are as follows:

- Building demolition works at the water sports pavilion zone (scenario 3).
- Pile installation at the marina (scenario 10).
- Clearance works at the promenade area (scenario 12).
- Paving works at carpark A (scenario 16).
- Paving works at carpark B (scenario 19).
- Engineering works at carpark C (scenario 21).

Noise levels at receptors due to the simultaneous undertaking of the six scenarios above are presented in Table 11-19. LAeq 1 h levels at the most exposed receptor (the hotel) will be 63 dB during combined works. At the hotel and all other receptors, combined LAeq 1 h levels will not exceed the 65 dB BS 5228-1:2009 criterion.

Table 11-19 Predicted construction phase LAeq 1 h levels (dB) at receptors due to combined scenarios.

Receptor	LAeq 1 h	Receptor	LAeq 1 h	Receptor	LAeq 1 h	Receptor	LAeq 1 h
R001	34	R033	38	R065	40	R097	34
R002	34	R034	35	R066	39	R098	46
R003	35	R035	36	R067	33	R099	46
R004	37	R036	16	R068	38	R100	43
R005	34	R037	37	R069	38	R101	42
R006	37	R038	39	R070	32	R102	44
R007	34	R039	37	R071	39	R103	46
R008	28	R040	38	R072	38	R104	43
R009	34	R041	38	R073	37	R105	46
R010	24	R042	38	R074	41	R106	45
R011	34	R043	37	R075	32	R107	45

R012	35	R044	38	R076	33	R108	47
R013	36	R045	38	R077	39	R109	39
R014	22	R046	36	R078	42	R110	42
R015	35	R047	40	R079	39	R111	44
R016	35	R048	34	R080	25	R112	47
R017	26	R049	33	R081	44	R113	46
R018	19	R050	39	R082	40	R114	44
R019	25	R051	30	R083	46	R115	53
R020	37	R052	26	R084	40	R116	56
R021	16	R053	41	R085	43	R117	57
R022	22	R054	37	R086	43	R118	50
R023	35	R055	39	R087	40	R119	51
R024	35	R056	25	R088	45	R120	51
R025	36	R057	40	R089	45	R121-NE 2 m	63
R026	37	R058	41	R090	37	R121-NE 5 m	63
R027	13	R059	29	R091	39	R121-NE 8 m	63
R028	36	R060	41	R092	40	R121-SE 2 m	63
R029	11	R061	40	R093	48	R121-SE 5 m	63
R030	38	R062	43	R094	44	R121-SE 8 m	63
R031	35	R063	41	R095	42	R122	51
R032	35	R064	33	R096	45		

Noise impacts attributable to the combined works are assessed in Appendix 11-4. Impacts will be imperceptible or not significant at most receptors, increasing to slight adverse at the hotel. As before, the temporary duration of these impacts, and the likelihood that hotel bedrooms will be generally vacant during construction times, will mitigate these impacts, and it is again considered that the residual impact will be not significant at the hotel.

11.4.3.4 Offsite Construction Traffic Noise Impacts

Onsite HGV movements in the vicinity of the main works area are included in the scenarios modelled above. Noise levels associated with HGV movements arising on the L2020 Local Road are assessed here. HGV movements on the N61 National Road will be negligible in the context of existing N61 traffic volumes and are not considered further.

HGVs will be used to export demolition waste and unused soil, and to import equipment, stone, and building materials. The traffic and transport assessment report indicates that the number of HGV movements per day will reach 30 during the peak construction period, equivalent to approximately 3 movements per hour. All HGVs will access the site via the L2020 Local Road.

At dwellings alongside the L2020 Local Road, noise levels attributable to such movements may be determined using:

$L_{Aeq\ 1\ h} = L_{AE} + 10\log[N] - 10\log[T]$.

The LAE describes the sound exposure level during a typical HGV pass, N is the number of passes, and T is the time interval. A passing HGV will typically generate a sound exposure level of 76-77 dB at 15 m, the setback distance to dwellings closest to the L2020 Local Road (outside of receptor R072 which is derelict). On this basis, LAeq 1 h levels associated with up to three movements per hour will be 46 dB at 15 m. It follows that LAeq 1 h levels associated with HGV movements on the local road network will be considerably lower than the 65 dB construction phase criterion at all receptors.

HGV movements will result in a temporary increase in traffic volumes on the local road network. The Traffic and Transport assessment (refer to Chapter 14 Material Assets for details) outlines that a worst-case assessment indicates that construction activities could generate approximately 72 two-way vehicle movements per day, including up to 30 two-way HGV movements during peak construction periods. This corresponds to an LAeq T increase of less than 0.2 dB. With reference to Table 11-4, noise impacts associated with offsite construction traffic will be neutral, imperceptible and temporary.

11.4.3.5 Construction Vibration Impacts

Four potential sources of groundborne vibration will arise onsite during the construction phase. The first of these is concrete breaking, which will arise during the initial demolition works at the existing water sports centre. Breaking of foundations and the building structure will most likely be undertaken using a breaker attachment fitted to a tracked excavator. This activity is likely to last up to three days.

While concrete breaking may give rise to relatively high levels of groundborne vibration in immediate proximity to the breaking area, the vibration tends to contain relatively little energy in the lower frequencies at which buildings and occupants are most vulnerable. In addition, higher frequencies attenuate more rapidly than low frequencies, thus minimising the impact zone. For this reason, most vibration guidance documents such as BS 5228-2:2009 ignore concrete breaking vibration. Vibration measurements undertaken previously by MKO personnel in the vicinity of sites where breaking was underway indicate that PPV levels typically fall below 0.3 mm/s at 50 m.

The nearest receptor to the proposed demolition zone is the hotel, located approximately 70 m from the nearest structure to be demolished. It is expected that PPV levels at the hotel during demolition of this structure will be considerably lower than 0.3 mm/s and therefore will be markedly lower than PPV thresholds listed in Table 11-6 and 11-7 above. PPV levels in hotel rooms are expected to be significantly lower than perception thresholds listed in Table 11-5, and it follows that groundborne vibration during demolition is unlikely to be perceptible at the hotel or any other receptor.

The second potential source of groundborne vibration is piling, in this case required on the lakebed to facilitate expansion of the marina and breakwater. Piling is likely to be required over a 4–6-week period and will last several hours each day. Vibratory piling using an excavator-mounted attachment is expected to be suitable.

BS 5228-2:2009 presents PPV levels measured at various distances from 13 sites where vibratory piling was undertaken. Levels in all cases were lower than 3 mm/s at 25 m, and in most cases were considerably lower. At the proposed marina, the distance between the nearest pile and the nearest receptor (the hotel) will be approximately 150 m. It is therefore expected that PPV levels at the hotel will fall considerably below criteria set out in Tables 11-5 to 11-7 above, and vibration levels during pile installation will be imperceptible at all receptors.

The third potential source is asphalt breaking, which may be required at the onsite carparks and along the L2020 Local Road. This will be carried out using a hydraulic breaker mounted on a wheeled or tracked excavator. In contrast with concrete, breaking of asphalt is likely to require less force and duration, and PPV levels are expected to be lower. Asphalt breaking PPV levels are thus expected to be less than 0.1 mm/s at the nearest receptors, including dwellings along the L2020 Local Road. It follows that PPV levels at receptors are expected to be lower than building damage and perception thresholds listed in Tables 11-5 to 11-7.

Finally, use of vibro-rollers to consolidate fill will generate relatively high levels of groundborne vibration locally. Vibro-rolling may be required at the carpark extension zones, and at the water sports pavilion area. Although relying on the actual application of vibration, this activity is not recognised as being a significant offsite source of groundborne vibration, due to the fluidic nature of vibrated hardcore and fill which tends to attenuate vibration transmission – most of the vibration energy is lost through stone and fill settlement before reaching underlying strata. BS 5228-2:2009 reports various PPV levels in relation to this activity, depending on the nature and depth of fill. Levels reported at 50 m range from 2.6 to 7.1 mm/s. Although these levels are lower than building damage thresholds listed in Tables 11-6 and 11-7, they are higher than the 3 mm/s human perception threshold.

Carpark works will arise within 50 m of the hotel. To ensure than cosmetic or structural damage does not arise at the hotel, it will be prudent to undertake real time vibration monitoring while vibro-rolling (if required) is undertaken. It is also considered prudent to extend the assessment distance to 100 m i.e. real time monitoring is recommended at the hotel and at any other structure where vibro-rolling is carried out within 100 m. This is included as a mitigation measure below.

On the basis of the foregoing, groundborne vibration is highly unlikely to be perceptible at any receptor during concrete breaking, asphalt breaking or piling, and impacts here will be neutral and imperceptible. PPV levels are highly unlikely to exceed building damage thresholds at any receptor.

Vibration may become perceptible at the hotel during nearby vibro-rolling, resulting in a not significant adverse impact. The impact is likely to be brief, lasting less than one day each time rolling is required.

While PPV levels at the hotel are unlikely to approach damage thresholds during vibro-rolling, real time monitoring is recommended to ensure levels remain low.

11.4.3.6 L2020 Upgrade Works

Upgrade works along the L2020 Local Road are proposed over a distance of approximately 1300 m (excluding road works undertaken near the hotel and carparks). The works will involve footpath widening, road narrowing and introduction of traffic calming measures. These works will take place in proximity to receptors along the L2020 Local Road. The nearest receptors here are R046, R068, R072, R079, R082, R084, R087, R091, R092, R095, R097, R100, R101, R106, R107, R109, R110, R111, R112 and R113. Separation distances between the road and these receptors are generally 15-20 m. Although receptor R072 lies immediately adjacent to the road, this dwelling is derelict and unlikely to be renovated and reoccupied prior to commencement of the project.

Works will involve a combination of clearance, excavation, trenching, stone placement, paving, kerb laying and landscaping. Plant required is likely to include a wheeled or tracked excavator, a dumper and a tractor and trailer. A consaw and breaker may be required to remove asphalt. A small roller will be required to consolidate backfill. Backfill aggregate will be delivered by HGV or tractor and trailer. These sources are similar to those arising on any road works project. Noise levels associated with expected plant are listed in Table 11-20, taken from BS 5228-1:2009.

Table 11-20 Road works plant noise levels (LZeq T at 10 m) (dB).

Plant⇩ Hz⇨	63	125	250	500	1000	2000	4000	8000	Total LAeq
Asphalt paving machine & tipper truck	78	77	72	72	71	69	62	56	75
Wheeled excavator	78	74	68	71	68	64	59	52	73
Mini-excavator with breaker	79	75	73	74	77	77	75	70	83
Consaw	73	67	70	68	73	78	78	77	84
Dumper/Tractor	84	81	74	73	72	68	61	53	76
Roller	87	85	75	73	75	73	69	63	80

Given the narrow works corridor width, it is likely that only one or two of the sources listed in Table 11-20 will operate simultaneously. Plant which may be used simultaneously include the excavator and dumper.

The above plant may be used in stages. For instance, road paving works may be undertaken following earlier completion of trenching works or shared path construction works. Noise levels at receptors along the L2020 Local Road will increase briefly as the works pass during each stage. Works in the vicinity of each receptor may last several days or weeks at a time.

The most practical assessment approach is to calculate the separation distance required to allow work noise levels to attenuate below the 70 dB TII criterion identified above in relation to road works. The assessment is presented in Table 11-21.

Table 11-21 Attenuation distance required to meet 70 dB TII criterion (dB).

Plant	Plant LAeq at 10 m	Total LAeq at 10 m	Distance to 70 dB
Asphalt paving machine & tipper truck	75	75	18 m
Wheeled excavator & dumper	73+76	78	25 m
Mini-excavator with breaker	83	83	45 m
Consaw	84	84	50 m
Roller	80	80	32 m

A number of dwellings lie in close proximity to the road, with setback distances less than those required to achieve compliance with the 70 dB criterion. At these receptors, it is possible that certain operations will result in noise levels which temporarily exceed the 70 dB TII criterion. The loudest noise sources here will be a consaw and a mini-excavator with breaker, both of which may be required for short periods. These sources are likely to pass each receptor within several hours. Impacts during these works are likely to be moderate to significant adverse, albeit brief. Refer to section 11.5 for recommended mitigation measures. The most effective mitigation measure will be to provide advance notification to local residents.

11.4.3.7 Cumulative Construction Noise Impacts

Potential cumulative noise impacts may arise during the construction phase due to possible overlap of onsite construction activity with concurrent construction projects in the surrounding area. Section 2.6 of Chapter 2 sets out the cumulative impact assessment methodology while Appendix 2-5 lists all the proposed projects and /or plans considered in the cumulative assessment. The cumulative project list indicates that there are no construction projects of note underway locally. Gradual development of eco-tourism lodges at Yew Point, and recurrent dwelling extension and renovation projects in the wider area, do not give rise to construction impacts of note. Additionally, there are currently no construction projects of significance in the pipeline. On this basis, offsite cumulative construction noise impacts are unlikely to arise.

11.4.4 Operational Phase Impacts

11.4.4.1 Noise Impacts Due To Onsite Activities

Appendix 5-1 of Chapter 5 outlines the estimated operational phase increase in usage of the Proposed Development Site, with an approximate increase in visitors from 80,000 (baseline) to approximately 168,000 (Predicted during operational phase of the Proposed Development).

Noise emissions will arise from a number of sources and activities at the Proposed Development once operational. These sources and activities are unsuitable for conventional predictive noise modelling due to the high variability of associated noise emissions, in terms of their frequency of occurrence, times of occurrence, duration, amplitude and frequency spectrum. Modelling of such sources cannot be undertaken practically with any degree of accuracy. There are no predictive modelling guidance documents available with respect to emissions such as those expected to arise at the Proposed Development.

Given the unsuitability of predictive modelling, the proposed sources are assessed in Table 11-22 in the context of the existing baseline soundscape. In this regard it is noted that the baseline soundscape includes noise emissions from the existing marina and water sports facility. Impacts due to traffic are assessed separately below.

Table 11-22 Operational noise sources and impacts.

Location	Source/activity	Assessment
Carparks A, B & C and roadway in vicinity of hotel	Vehicle movements	Emissions from vehicles with internal combustion engines are likely to be audible at the hotel. Carpark C movements are likely to audible at R116 and R117. Impacts are likely to be neutral and imperceptible at these receptors, and all other receptors, for the following reasons: › The proportion of EVs is expected to increase in the future, resulting in reduced noise levels. In car parking areas, engine and transmission noise is the chief vehicle noise source audible, with little or no contribution from tyre rolling noise due to the low speeds involved. As EVs do not give rise to engine and transmission noise, the expected reduction in the proportion of vehicles with internal combustion engines will result in a reduction in engine and transmission noise. › The hotel and receptors R116 and R117 are currently subject to vehicle noise. The increase in traffic volumes will be entirely offset by the increasing proportion of EVs. › The increase in noise level, regardless of EV content, will be <1 dB at receptors, based on information presented in the traffic and transport assessment. This change in noise level is imperceptible to the human ear. › Traffic speeds in these areas will be restricted, further reducing noise emissions. › Movements will be generally confined to daytime and evening hours, with minimal night-time movements expected. **Impact at receptors: Neutral and imperceptible**
Carparks & open areas	Visitor vocalisations	Vocalisations will arise from visitors accessing open areas such as the pavilion, promenade and marina. Vocalisations are expected to occur at conversational level and are therefore unlikely to be audible at residential receptors. While vocalisations may be audible in external areas at the hotel, these will be similar to the existing soundscape and will be consistent with the character of the hotel area. **Impact at receptors: Neutral and imperceptible**
Pavilion area	Fans & plant	Plant such as heating and ventilation equipment may be installed at a number of positions, in addition to extraction fans at the café. Noise emissions from these are

		likely to be entirely inaudible beyond 20 m, and thus inaudible at all receptors including the hotel. **Impact at receptors: Neutral and imperceptible**
Café area	Music	Prerecorded music may be played through external speakers at the café area. In order to facilitate conversation at tables, the playing volume is expected to be relatively low, and music is therefore unlikely to be audible outside the pavilion area. **Impact at receptors: Neutral and imperceptible**
Marina	Boat engines	The number of berths will approximately double as a result of the Proposed Development. In addition, Viking boat tours are expected to visit the marina at intervals. A worst-case scenario will result in a doubling of noise emissions due to vessel engines, equating to an increase of 3 dB. With respect to Table 11-9, this will give rise to a not significant impact at worst. Emissions from boat engines at the marina are likely to be audible only at the hotel, and likely to inaudible at residential receptors. **Impact at receptors: Not significant adverse at hotel; Neutral and imperceptible at all other receptors**
Marina	Clinking pulleys on masts & flagpoles	These emissions, which form part of the existing soundscape, are unlikely to be audible beyond 50 m, and will therefore be inaudible at all receptors including the hotel. **Impact at receptors: Neutral and imperceptible**
Marina & pavilion area	Music & organised events	There may be organised events at the marina and pavilion area from time to time, which may include amplified prerecorded and live music. LAeqT levels at such events may exceed 90 dB. These emissions are likely to be clearly audible at the hotel, where LAeqT levels may reach 60 dB. Levels are also likely to be clearly audible at receptors R116-R120 at Yewpoint, where LAeqT levels may reach 40-50 dB. These values will exceed baseline LAeqT levels by up to 7 dB and baseline LAF90T levels by up to 15 dB. The emissions are likely to be audible at a low level at the nearest receptors to the southwest. Electronic music, and live music featuring drums, is likely to include impulsive components, while bass emissions will include a strong low frequency component. **Impact at receptors: Neutral and imperceptible at distant receptors, increasing to moderate adverse at the hotel and Yewpoint receptors when emissions are present. Events however will be short and infrequent, the overall effect is therefore expected to be slight adverse.**
Vegetated areas	Mowers, strimmers, etc.	Vegetated areas are currently subject to routine landscaping maintenance. The Proposed Development will not result in any changes of significance in this activity. **Impact at receptors: Neutral and imperceptible**

Apart from potential live and prerecorded amplified music played at events, the Proposed Development will not include any sources or activities likely to give rise to LAeq T levels at residential receptors which exceed the 55 dB daytime, 50 dB evening or 45 dB night-time criteria recommended by the WHO and EPA. Similarly, the 60 dB night-time LAFmax limit recommended by the WHO is highly unlikely to be exceeded at any receptor.

Live and prerecorded amplified music played at events may result in LAeqT levels of 60 dB at the hotel and 50 dB at Yewpoint receptors. These levels will exceed the daytime 55 dB criterion at the hotel, and the 50 dB criterion if such events occur during the period 1900-2300 h. Addition of conventionally applied penalties for low frequency and impulsive content will result in an exceedance of the 50 dB evening criterion at Yewpoint receptors if such events occur during the evening.

11.4.4.2 Noise Impacts Due To Road Traffic

The Proposed Development will give rise to a negligible change in traffic volumes on the N61 National Road. It follows that no change in noise levels will arise here.

The Traffic and Transport assessment (Refer to Chapter 14 Material Assets) indicates that the Proposed Development, once operational, is expected to generate an increase of 12-25% in traffic volumes on the L2020 Local Road, varying with time of day and day of week. The 12-25% increase corresponds to an LAeq T increase of 0.5 to 1 dB. In the context of Table 11-10 above, this noise level increase equates to a neutral and imperceptible impact.

11.4.4.3 Indirect Impacts

The Hodson Bay Hotel may see an increase in the number of day visitors and accommodation visitors as a result of the Proposed Development, with a consequent increase in internal noise emissions in hotel

common areas and function rooms. Such emissions are not audible externally, and no impacts will arise at residential receptors. While there may be an increase in noise levels from increased use of external seating areas, these emissions are also inaudible at residential receptors, and no impacts will arise. There will likely be an increase in noise levels within the hotel itself due to increased patron numbers. Noise levels within the hotel is under the control of hotel management.

The existing waterpark in the lake may also see increased activity. Patron vocalisations at the waterpark are currently clearly audible at receptors R115-R120 to the north. The Hodson Bay Tourism and Economic Study (Appendix 5-1 of this EIAR), notes that the number of visitors accessing the water sports facility is expected to double as a result of the Proposed Development. This may result in an increase in the frequency of patron vocalisations audible at receptors R115-R120.

A doubling of noise emissions equates to an increase of 3 dB. Thus the proposed increase is the number of visitors may be expected to give rise to an increase of 3 dB in LAeqT levels i.e. LAeqT levels associated with the water sports facility may be expected to increase by 3 dB as an indirect result of the Proposed Development. From Table 11-9, this increase will give rise to a not significant adverse effect.

11.4.5 Cumulative Noise Impacts

With reference to Table 11-22 above, noise impacts at all residential receptors as a result of the Proposed Development will be neutral and imperceptible. It follows that the Proposed Development is highly unlikely to contribute to any potential cumulative impacts which may arise due to other developments. No proposed developments in the vicinity of the Proposed Development site have been identified in any case. Emissions from the existing waterpark are assessed in Section 11.5.3.

11.5 Mitigation

11.5.1 Construction Phase

LAeq 1 h levels at all receptors due to onsite construction works will be lower than the 65 dB BS 5228-1:2009 criterion, and specific mitigation measures are not warranted. Proposed works along the L2020 Local Road may give rise to brief or temporary exceedances of the 70 dB TII criterion at receptors alongside the road. Consaw and breaker noise will be the most significant sources. The applicant proposes to apply the following mitigation measures throughout the construction phase:

- Construction operations will in general be confined to 0700–1900 h Monday-Friday and 0800-1700 h Saturday.
- Any works outside these hours, if required, will be limited to quieter operations, and will be agreed in advance with the planning authority.
- Drivers of plant and vehicles will be instructed to avoid hooting onsite at all times.
- Plant used onsite during the construction phase will be maintained in a satisfactory condition and in accordance with manufacturer recommendations. In particular, exhaust silencers will be fitted and operating correctly at all times. Defective silencers will be immediately replaced.
- Queuing of trucks on public roads near receptors will be prohibited.
- Machinery not in active use will be shut down.
- Driver training will be provided to ensure smooth machinery operation, to minimise unnecessary noise generation.
- A site representative will be appointed as a liaison officer with the local community. Prior to road improvement works along the L2020 Local Road, notification will be given to the residents along this road via letter drop.
- Any complaints of noise received during the construction phase will be logged in a register and investigated immediately. Details of follow-up action will be included in the register.
- Where it is proposed to import potentially noisy plant to the site, the potential impact of noise emissions will be assessed in advance.
- Guidance set out in BS 5228-1:2009 with respect to noise control will be applied throughout the construction phase.

11.5.2 Operational Phase

Apart from one exception, operational phase noise levels will give rise to neutral and imperceptible impacts at all residential receptors, and specific mitigation is not warranted. However, consideration will be given to the following general measures:

- Maintenance personnel will be instructed to avoid use of vehicle horns while onsite.
- A representative will be appointed as a liaison officer with the local community.
- Any complaints of noise received will be logged in a register and investigated immediately. Details of follow-up action will be included in the register.

The single exception identified relates to potential music events at the marina and pavilion area, where amplified prerecorded and live music may be played on occasion during daytime hours, and potentially during evening hours. When present, such events will give rise to a moderate adverse impact at the hotel and at six Yewpoint receptors to the north. However, these events are expected to occur infrequently, and will be short (several hours at most) when undertaken. On this basis, the overall impact will be slight adverse. A single mitigation measure is proposed here: It is proposed to provide advance notification of such events to the hotel and to receptors at Yewpoint.

11.5.3 Monitoring

Operational phase noise monitoring is not proposed. Construction phase noise monitoring is also not warranted. However, it is proposed to carry out construction phase vibration monitoring at the hotel and at any other structure while vibro-rolling is undertaken within 100 m. The following is proposed:

- Vibration monitoring in accordance with *Measurement and assessment of groundborne noise and vibration* (Association of Noise Consultants, 2012).
- Measurement using a calibration vibrograph with tri-axial transducer.
- Measurement of PPV levels, frequency and displacement.
- Measurement at nearest point of hotel to vibro-rolling area.
- Measurement for duration of vibro-rolling.
- Prior agreement with hotel management.
- Alert system to notify where PPV levels exceed 10 mm/s.

11.6 Residual Effects

11.6.1 Residual Impacts

Residual construction noise impacts post-mitigation are assessed in Table 11-23. Residual operational noise impacts are assessed in Table 11-24.

Table 11-23 Residual construction impacts.

Source	Receptors	Factor	Impact
Onsite construction noise	Hotel	Impact	LAeq 1 h levels will reach 63 dB during worst case scenario combined works; Levels will not exceed the 65 dB BS 5228-01:2009 criterion at any stage
		Effect	Not significant adverse, taking into account the likelihood that hotel bedrooms will be vacant during construction works
		Duration	Temporary
	All other receptors	Impact	LAeq 1 h levels will reach 57 dB during worst case scenario combined works; Levels will not exceed the 65 dB BS 5228-01:2009 criterion at any stage
		Effect	Neutral and imperceptible or not significant adverse
		Duration	Temporary
Onsite construction vibration	Hotel	Impact	PPV levels will be imperceptible throughout, although may become perceptible during local vibro-rolling
		Effect	Neutral and imperceptible, increasing to not significant adverse during vibro-rolling
		Duration	Generally temporary, although brief in the case of vibro-rolling
	All other receptors	Impact	PPV levels will be imperceptible throughout
		Effect	Neutral and imperceptible
		Duration	Temporary
L2020 upgrades construction noise	Receptors alongside L2020	Impact	LAeq 1 h levels may exceed 70 dB over short periods, thus exceeding BS 5228-01:2009 and TII criteria
		Effect	Potentially moderate or significant adverse
		Duration	Brief or temporary
	All other receptors	Impact	LAeq 1 h levels will not exceed the 65 dB BS 5228-01:2009 criterion at any stage
		Effect	Neutral and imperceptible or not significant adverse
		Duration	Brief or temporary
Offsite construction traffic noise	All receptors	Impact	Construction traffic will give rise to a negligible increase in traffic noise levels
		Effect	Neutral and imperceptible
		Duration	Temporary

Table 11-24 Residual operational impacts.

Source	Receptors	Factor	Impact
Onsite activity excluding music events	All receptors	Impact	LAeq T levels are unlikely to change, although an increase of 3 dB may arise at the hotel in relation to marina boat engines
		Effect	Neutral and imperceptible, increasing to not significant adverse at the hotel in relation to marina boat engines
		Duration	Long term
Music events	Hotel & Yewpoint receptors	Impact	LAeqT levels during events may reach 60 dB at the hotel and 50 dB at Yewpoint receptors, with potential low frequency and impulsive content
		Effect	While the effect is likely to be moderate adverse at the time, the overall effect will be slight adverse due to the short duration and infrequency of events
		Duration	Long term (brief when actually occurring)
	All other receptors	Impact	Levels during events may be slightly audible at the nearest receptors
		Effect	Neutral and imperceptible due to the low audibility, short duration and infrequent occurrence
		Duration	Long term
L2020 traffic	All receptors	Impact	The traffic increase will be minimal, and will give rise to a negligible increase over baseline noise levels
		Effect	Neutral and imperceptible
		Duration	Long term

11.6.2 Overall Residual Effects

Overall residual effects associated with the Proposed Development, once commissioned, are described in Table 11-25. While vessel engines at the marina may give rise to a not significant adverse impact at the hotel, the overall impact attributable to the development in its entirely is likely to be neutral, long term and imperceptible at receptors. Although music events will give rise to slight adverse impacts at the hotel and Yewpoint receptors, these events will be infrequent and brief, and thus the overall impact of the Proposed Development is expected to remain neutral and imperceptible.

Table 11-25 Summary of operational effects.

Factor	Effect
Quality	Neutral *Positive (improves soundscape); Neutral (no perceptible changes); Adverse (reduces quality of soundscape)*
Significance	Imperceptible *Imperceptible (capable of measurement, but without significant consequences, <2 dB change); Not significant (causes noticeable changes to soundscape, but without significant consequences, 2-4 dB change); Slight (causes noticeable changes to soundscape without affecting its sensitivities, 4-6 dB change); Moderate (alters soundscape in manner consistent with existing and emerging baseline trends, 6-10 dB change); Significant (alters soundscape due to source character, magnitude, duration or intensity, 10-15 dB change); Very significant (significantly alters soundscape due to source character, magnitude, duration or intensity, 15-20 dB change); Profound (obliterates soundscape, >20 dB change)*
Duration	Long term *Momentary (seconds or minutes); Brief (<1 day); Temporary (<1 year); Short term (1-7 years); Medium term (7-15 years); Long term (15-60 years); Permanent (>60 years)*
Frequency	Emissions will chiefly arise during daytime and early evening hours *Occurrence of impacts*
Context	Proposed Development will represent a continuation of existing site use *Conformity or contrast with existing and emerging soundscape*
Extent	Local, chiefly confined to marina, promenade and pavilion areas *Development area size, receiving area affected, number of receptors affected, proportion of population affected*
Probability	Impacts expected to arise as predicted above if permission granted *Likely (reasonably expected to occur); Unlikely (reasonably expected not to occur)*
Reversibility	Emissions and impacts will cease at project cessation *Reversible (may be undone in the future); Irreversible (cannot be undone following onset, thus permanent)*
Cumulative	No cumulative impacts identified *Combined impacts with other projects or sources*
Indirect	No indirect impacts identified, apart from potential increased hotel and waterpark usage, although impacts will continue to be neutral and imperceptible *Secondary impacts not directly attributable to development, often removed from site*
Worst case	Mitigation not critical to noise control; No additional worst-case impacts expected *Where mitigation measures substantially fail*
Indeterminable	Indeterminable impacts unlikely *Where full consequences of change in soundscape cannot be described*
Synergistic	No synergistic effects identified *Where synergistic effect is greater than sum of its constituents*

11.6.3 Population & Human Health

The assessment of impacts on human health is typically undertaken by reference to WHO guidance, which has been revised over the last four decades according as noise and health studies have been published. The WHO currently recommends the following:

- In residential settings, a daytime/evening $L_{Aeq\,16\,h}$ level of 50 dB is an indicator of moderate annoyance.
- A night-time $L_{Aeq\,8\,h}$ level of 45 dB is recommended to prevent sleep disturbance, although this may reduce to 40 dB in future years.
- With respect to short term impulsive sources, the WHO recommends a night-time L_{AFmax} limit of 60 dB outside bedroom windows during night-time hours.

Following commissioning, daytime and night-time WHO criteria are highly unlikely to be exceeded at any residential receptor as a result of onsite emissions. The Proposed Development will not give rise to impulsive emissions. On this basis, it is concluded that there will be no adverse noise impact on the local population or on human health.