11. NOISE & VIBRATION

11.1 Introduction

11.1.1 Overview

This chapter of the EIAR assesses potential noise and vibration impacts in relation to the Proposed Development. Potential noise and vibration impacts are typically divided into the following categories:

- Construction phase noise impacts on surrounding receptors.
- Construction phase vibration impacts on surrounding receptors.
- Operational phase noise impacts on surrounding receptors.
- Operational phase vibration impacts on surrounding receptors.
- Noise impacts within the completed development from external sources ('inward impacts').

The Proposed Development will not give rise to any vibration impacts following construction, and therefore operational phase vibration impacts have been scoped out. The remaining four categories are assessed in this chapter.

The Proposed Development is described in detail in Chapter 4 of this EIAR. In summary, it is proposed to construct 362 residential units, consisting of a mixture of townhouses, apartments and duplexes, as well as a childcare facility, an access road, and ancillary infrastructure. The Proposed Development is a component of a larger residential development project (Proposed Project). The Proposed Project involves the construction of more than 500 residential units, and the development will require separate, individual planning applications for each part of the project.

This chapter of the EIAR provides baseline information on the Proposed Project area as a whole with specific impact assessment sections relative to the Proposed Development site being contained in Section 11.4.

11.1.2 Statement of Authority

Damian Brosnan

Damian Brosnan (Project Director Acoustics with MKO) has over 30 years of experience in both private practice and local authority. Damian holds an MSc in Applied Acoustics from the University of Derby. Following graduation from UCC in 1993, Damian worked with Cork County Council's Environment Department. From 2001 to 2023, he worked as an acoustic consultant where he specialised in environmental impact assessment and acoustics. Damian joined MKO in 2023, heading up the new MKO acoustics unit.

The MKO acoustics unit has extensive experience in assessing noise impacts associated with industry, quarrying, waste management and renewable energy, as well as a wide variety of other projects, through planning applications, SID applications and the EPA licensing system. The unit has undertaken several inward noise impact assessments for large-scale residential developments, including one of the largest developments approved in Ireland to date.

Damian is a 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.

Sinead Fagan

Sinéad Fagan is an acoustic consultant who joined MKO in November 2023, with over 18 years of experience in private practice. Sinéad holds M.A. (Hons) in Environmental Resources Management from NUI Maynooth, and is a member of the Institute of Acoustics. Prior to working for MKO Sinéad worked as an environmental consultant where she gained extensive experience in noise monitoring across a wide range of sectors including quarrying, industry and waste management facilities. In this role she developed an in-dept knowledge of environmental standards and guidance documents, and noise assessment methodologies. Within MKO as part of the acoustic unit Sinéad manages compliance monitoring programmes and noise management plans for many clients across a range of sectors, and advises clients faced with acoustic issues such as allegations of excessive noise.

11.1.3 Difficulties

No difficulties were encountered in undertaking the noise impact assessment.

11.2 Assessment Methodology

11.2.1 Description of Effects

Ambient noise levels across the local area were measured, and these were used to identify appropriate construction phase noise criteria. Likely construction plant were identified, and their noise emissions data used to predict noise levels at surrounding receptors. Predicted levels were assessed in the context of identified criteria, and mitigation measures identified where required. Potential sources of vibration during the construction phase were identified, and impacts assessed by reference to commonly applied criteria.

Noise sources associated with the operational phase of the Proposed Development were reviewed, and potential impacts assessed. Such impacts relate chiefly to traffic. An assessment of inward noise impacts was undertaken, and the requirement for enhanced façade treatments was assessed.

This chapter achieves the following assessment objectives:

- Standards and criteria relevant to the Proposed Development are identified.
- The nearest receptors are identified.
- The baseline soundscape is described.
- Construction noise levels arising from the proposed works are described.
- Construction works noise impacts at receptors are assessed.
- Potential vibration impacts associated with construction works are assessed.
- Noise emissions from activities associated with the operational development are described.
- Operational phase noise impacts at receptors are assessed.
- Potential cumulative impacts arising in conjunction with other sources are assessed.
- An assessment of potential inward noise impacts is undertaken.
- Mitigation measured are identified, where required.

Noise impacts were assessed with reference to the scheme set out in *Guidelines On The Information To Be Contained In Environmental Impact Assessment Reports* (EPA, 2022). The most relevant aspects of the 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
	Negative	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

Construction phase noise impacts due to onsite construction works and offsite construction traffic are typically assessed with reference to a scale of impacts set out in *Design Manual For Roads And Bridges – LA111: Noise And Vibration* (UK Highway Agency, 2020). The scale does not correspond to the Environmental Protection Agency (EPA) scale set out in Table 11-1. To facilitate assessment of construction works and construction traffic in the context of the EPA scale, impact categories in both scales are aligned as closely as possible, as described where relevant below.

Inward noise impacts are assessed with reference to *ProPG Planning And Noise: Professional Practice Guidance On Planning And Noise – New Residential Development* (2017), jointly issued by the Association of Noise Consultants, the Institute of Acoustics and the Chartered Institute of Environmental Health. The methodology is set out in detail below.

11.2.2 Guidance Documents And Assessment Criteria

The following documents were consulted during the preparation of this chapter:

- *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 Groundborne Vibration* (1993).
- *Guidelines in 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).

- *NANR116: Open/Closed Window Research – Sound Insulation Through Ventilated Domestic Windows* (Prepared by the Napier University Building Performance Centre for DEFRA, 2007).
- *Guidance Note for Noise Action Planning* (Environmental Protection Agency, 2009).
- *Night Noise Guidelines for Europe* (World Health Organisation, 2009).
- *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).
- *British Standard BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings* (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).
- *Technical Guidance Document TGD-021-5: Acoustic Performance in New Primary and Post Primary School Buildings* (Department of Education and Skills, 2015).
- *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).
- *ProPG Planning and Noise: Professional Practice Guidance on Planning and Noise – New Residential Development* (Association of Noise Consultants, Institute of Acoustics and Chartered Institute of Environmental Health, 2017).
- *Environmental Noise Guidelines for the European Region* (World Health Organisation, 2018).
- *Design Manual for Roads and Bridges – LA111: Noise and Vibration* (UK Highway Agency, 2020).
- *Galway City Development Plan 2023-2029* (Galway City Council, 2022).
- *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports* (Environmental Protection Agency, 2022).
- *Galway City Council Noise Action Plan 2024-2028* (Galway City Council, 2024).
- *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).

11.2.2.1 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 $L_{Aeq\ T}$ 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 the 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 $L_{Aeq\ 1\ h}$ criterion of 65 dB is the most appropriate criterion for this assessment.

The $L_{Aeq\ 1\ h}$ 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.*

Construction noise criteria set out in the National Roads Authority (NRA, now TII) document *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes* (2014) are occasionally applied to non-road projects, particularly in relation to temporary louder activities. The document recommends a daytime $L_{Aeq\ 1\ h}$ criterion of 70 dB at receptors, marginally higher than the 65 dB BS 5228:2009 criterion. In this case, the NRA limit is considered relevant to specific construction operations which may generate elevated noise levels over a short period, bearing in mind that permitting isolated periods of intense activity may eliminate the need for more drawn out and less efficient construction methods.

Neither BS 5228-1:2009 nor the NRA document includes a methodology for the assessment of impact significance. The UK Highways Agency document *Design Manual for Roads and Bridges – LA111: Noise and Vibration* (2020) (DMRB) includes a methodology based on a combination of BS 5228-1:2009 guidance and external baseline $L_{Aeq\ T}$ 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. 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 $L_{Aeq\ T}$	Negligible	Imperceptible
Daytime baseline $L_{Aeq\ T}$ to 65 dB	Minor	Not significant to slight
Daytime baseline $L_{Aeq\ T}$ to 70 dB	Moderate	Moderate
≥70 dB	Major	Significant, very significant or profound

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

Construction noise level	Impact
Below daytime baseline $L_{Aeq\ T}$	Imperceptible
Daytime baseline $L_{Aeq\ T}$ to 59 dB	Not significant
60-65 dB	Slight
66-69 dB	Moderate
70-74 dB	Significant
75-79 dB	Very significant
≥80 dB	Profound

11.2.2.2 Construction Phase Traffic

Construction works may result in an increase in road traffic volumes. The DMRB document 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 and the correlation between DMRB impact and EPA impact.

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

11.2.2.3 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+A1:2014

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.

Separate criteria are typically referenced in relation to buildings in order to avoid potential cosmetic or structural damage. The NRA document identified above has seen increasing application to non-road projects due to the absence of any other Irish guidance. NRA 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 Building vibration criteria, from the National Roads Authority (2014).

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 describe thresholds below which cosmetic damage (hairline cracking, etc.) to buildings 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 7385-02: 1993 Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Ground Borne Vibration* (1993).

11.2.2.4 Operational Phase Noise

There are no national mandatory noise limits applicable to operational developments. Two elements of the operational development may give rise to noise emissions:

- Noise emissions from onsite residential activities such as grass cutting, children playing, use of garden amenities, vehicle movements on Proposed Development roadways, and landscape maintenance activities undertaken across the site from time to time. These activities are considered to form part of the normal soundscape in an urban residential area, and are not subject to noise impact assessment.
- Noise emissions from increases in traffic volumes on the surrounding road network resulting from the Proposed Development. These are discussed in Section 11.2.2.5.

The Proposed Development will not include any non-residential or commercial activities or noise sources. It follows that criteria typically applied to such sources, such as criteria recommended in the EPA's NG4 document, are not relevant to the Proposed Development.

11.2.2.5 Operational Phase Traffic

Local offsite receptors are currently subject to existing traffic noise levels on the surrounding road network. The Proposed Development may result in an increase in local traffic volumes, with a consequent increase in traffic noise levels. Associated impacts may be assessed using the DMRB scheme set out in Table 11-8. The scheme applies to long term traffic noise increases, rather than short term increases associated with construction traffic as addressed in Table 11-4. Although the DMRB scale applies to the $L_{AF10\ 18\ h}$ parameter, it is also of some pertinence to $L_{Aeq\ T}$ levels.

Table 11-8 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

11.2.2.6 Inward Noise Impacts

The assessment of inward noise impacts on proposed residential developments is a relatively new feature in the Irish planning system, and no national guidance has been issued to date. In the absence of Irish guidance, assessments are typically undertaken in accordance with UK guidance. Most UK assessments are now carried out using *ProPG Planning and Noise: Professional Practice Guidance on Planning and Noise – New Residential Development* (2017), jointly issued by the Association of Noise Consultants, the Institute of Acoustics and the Chartered Institute of Environmental Health. ProPG provides for good acoustic design through a five step process:

- Stage 1: Initial noise risk assessment of the Proposed Development site.
- Stage 2 element 1: Demonstrating a good acoustic design process.
- Stage 2 element 2: Observing internal noise level guidelines.
- Stage 2 element 3: Undertaking an external amenity area noise assessment.
- Stage 2 element 4: Consideration of other relevant issues.

Internal noise guidelines recommended by ProPG, drawn from *British Standard BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings* (2014), are presented in Table 11-9.

Table 11-9 Recommended internal criteria from BS 8233:2014 and ProPG.

Activity	Location	0700-2300 h	2300-0700 h
Resting	Living room	$L_{Aeq\ 16\ h}$ 35 dB	-
Dining	Dining area	$L_{Aeq\ 16\ h}$ 40 dB	-
Sleeping or daytime resting	Bedroom	$L_{Aeq\ 16\ h}$ 35 dB	$L_{Aeq\ 8\ h}$ 30 dB

BS 8233:2014 adds that:

> *Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values.*

ProPG adds further advice here:

> *In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used to that individual noise events to not normally exceed 45 dB L_{AmaxF} 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 the source, number, distribution, predictability and regularity of noise events.*

The 45 dB L_{AFmax} criterion applies internally, and the ProPG document equates this to a 60 dB external criterion. With respect to external amenity areas such as gardens in the curtilage of dwellings, BS 8233:2014 states:

> *For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq\ T}$, with an upper guideline value of 55 dB $L_{Aeq\ T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such a city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces, but should not be prohibited.*

With respect to the proposed childcare facility, there are no specific criteria in force. Reference may be made to *Technical Guidance Document TGD-021-5: Acoustic Performance in New Primary and Post Primary School Buildings* (Department of Education & Skills, 2015). The document recommends an indoor ambient $L_{Aeq\ 30\ min}$ level of 35 dB. This criterion is applied in this assessment.

Achieving compliance with the above recommendations in internal spaces at the Proposed Development will require consideration at detailed design stage, particularly in relation to internal transmission between rooms. The chief consideration with respect to the planning application stage is to identify if external noise levels due to road traffic are elevated, thus indicating if enhanced building fabric treatments including glazing will be required.

11.2.2.7 World Health Organisation (WHO)

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 $L_{Aeq\ 16\ h}$ 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 $L_{Aeq\ 15\ min}$, $L_{Aeq\ 30\ min}$ and $L_{Aeq\ 1\ h}$ are variously applied. In issuing licences to industrial facilities, the EPA typically specifies a daytime $L_{Aeq\ T}$ limit of 55 dB at receptors. 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 $L_{night,outside}$ 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, $L_{Aeq\ 15\ min}$, $L_{Aeq\ 30\ min}$ and $L_{Aeq\ 1\ h}$ intervals are variously applied by regulatory authorities, rather than the 8-hour period to which the WHO's 45 dB criterion applies.

The WHO recommendations subsequently informed internal criteria given in BS 8233:2014 and ProPG as discussed above. Corrections from external to internal levels are typically based on a 15 dB attenuation factor through an open window. This factor is consistent with the 12-18 dB range reported in *NANR116: Open/Closed Window Research – Sound Insulation Through Ventilated Domestic Windows* (prepared by the Napier University Building Performance Centre for DEFRA, 2007) with respect to road traffic noise.

The WHO document *Environmental Noise Guidelines for the European Region* (2018) updated their guidance with respect to certain sources. Of relevance here are updated guidelines in relation to road traffic. In this regard, the document states:

> *For average noise exposure, the GDG (Guideline Development Group) strongly recommends reducing noise levels produced by road traffic below 53 decibels (dB) Lden, as road traffic noise above this level is associated with adverse health effects.*
>
> *For night noise exposure, the GDG strongly recommends reducing noise levels produced by road traffic during night time below 45 dB L_{night}, as night-time road traffic noise above this level is associated with adverse effects on sleep.*

It is noted that the 53 L_{den} and 45 dB L_{night} criteria recommended in the 2018 document are lower than criteria set out in other documents. In this regard, the 2018 guidelines are considered aspirational, and are likely to form the basis of national and local guidance over the next two decades.

While the 2018 WHO document also includes recommendations in relation to other sources such as rail and aircraft traffic, these are not relevant to the Knocknacarra area.

11.2.2.8 Noise Action Plan

The *Galway City Council Noise Action Plan 2024-2028* (Galway City Council, 2024) describes a strategic plan based on noise mapping undertaken in 2022 ('round 4' mapping). 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 2024-2028 plan focusses chiefly on road traffic noise. The Directive requires preparation of noise action plans for all roads with annual traffic volumes over 3 million vehicles. The nearest such roads are the Western Distributor Road (L1012-L1013) 130 m north of the site, regional route R337 which runs adjacent to the southern site access, the R336 490 m to the southwest, and the R338 500 m to the east.

With respect to road traffic noise criteria, the noise action plan refers to the 53 dB L_{den} and 45 dB L_{night} criteria recommended by the WHO, as discussed above. 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. Six priority action areas are described, where further assessment is proposed. One of these is a section of the Western Distributor Road 1250 m to the west of the Proposed Development site. All six priority action areas will be investigated during the lifetime of the Noise Action Plan with a view to reducing the number of people exposed locally to elevated traffic noise through measures such as traffic calming, barriers, and improved dwelling glazing. The Proposed Development will not have any implications for the Western Distributor Road priority action area.

The Noise Action Plan also describes 'quiet areas', where environmental noise levels are low and protection may be justified. No quiet areas have been identified in Galway City.

The Noise Action Plan refers to two policy objectives set out in the *Galway City Development Plan 2023-2029* (Galway City Council, 2022) which are of relevance to the Proposed Development application. Policy objective 9.6-2 states that the local authority will:

> *Ensure the design of development incorporates measures to minimise noise levels in their design and reduce the emission and intrusion of any noise or vibration which might adversely impact on amenities, in particular residential amenities where appropriate.*

Policy objective 9.6-3 notes that the authority will:

> *Consider the details of Galway City Council Noise Action Plan 2019-2023 in the assessment and design of relevant development applications in the interests of protecting future amenity.*

This assessment has been undertaken bearing in mind both policy objectives above. With respect to policy objective 9.6-3, it should be noted that the 2019-2023 Noise Action Plan Has now been superseded, as discussed above. While section 11.4.1 of the development plan refers to consideration of noise mitigation, this requirement applies to the city centre area rather than the outer suburbs wherein the Proposed Development site is located.

11.3 Receiving Environment

11.3.1 Location

The Western Distributor Road (L1012-L1013, referenced WDR here) runs east from regional route R338 through Knocknacarra. The WDR provides access to the Gateway Shopping Centre on the northern side of the road, and which includes a number of commercial retail units. A small residential estate, An Logán, lies on the southern side of the WDR, opposite the shopping centre. The Proposed Development site lies to the south of An Logán. The Proposed Development site is predominately greenfield with some areas of infill/brownfield in the north. The Proposed Development site is bordered by a number of residential estates. The Proposed Development site is shown in Figure 11-1.

The local area outside the site is distinctly suburban in character, with a large number of residential estates interspersed with retail facilities, educational premises, sports grounds and a golf course. The Proposed Development site itself consists of a number of fields in the southern half, currently under grass and scrub. The northern half of the Proposed Development site consists of disturbed ground with areas of infill. The Proposed Development site is currently accessed from an access road serving Knocknacarra National School to the west and may also be accessed from a private road off the R337 (Kingston Road) to the south.

The Proposed Development site is separated from the WDR by an undeveloped plot outside the northwest corner. This undeveloped zone, and the Proposed Project site, together form the Knocknacarra Masterplan area. Under two separate schemes, it is proposed to construct an urban village retail centre and a recently permitted aquatic centre on this plot. These do not form part of the current Proposed Development site proposal, and are subject to entirely separate planning applications. However, the proposed retail centre and recently permitted aquatic centre will inform the cumulative noise assessment, as discussed below.

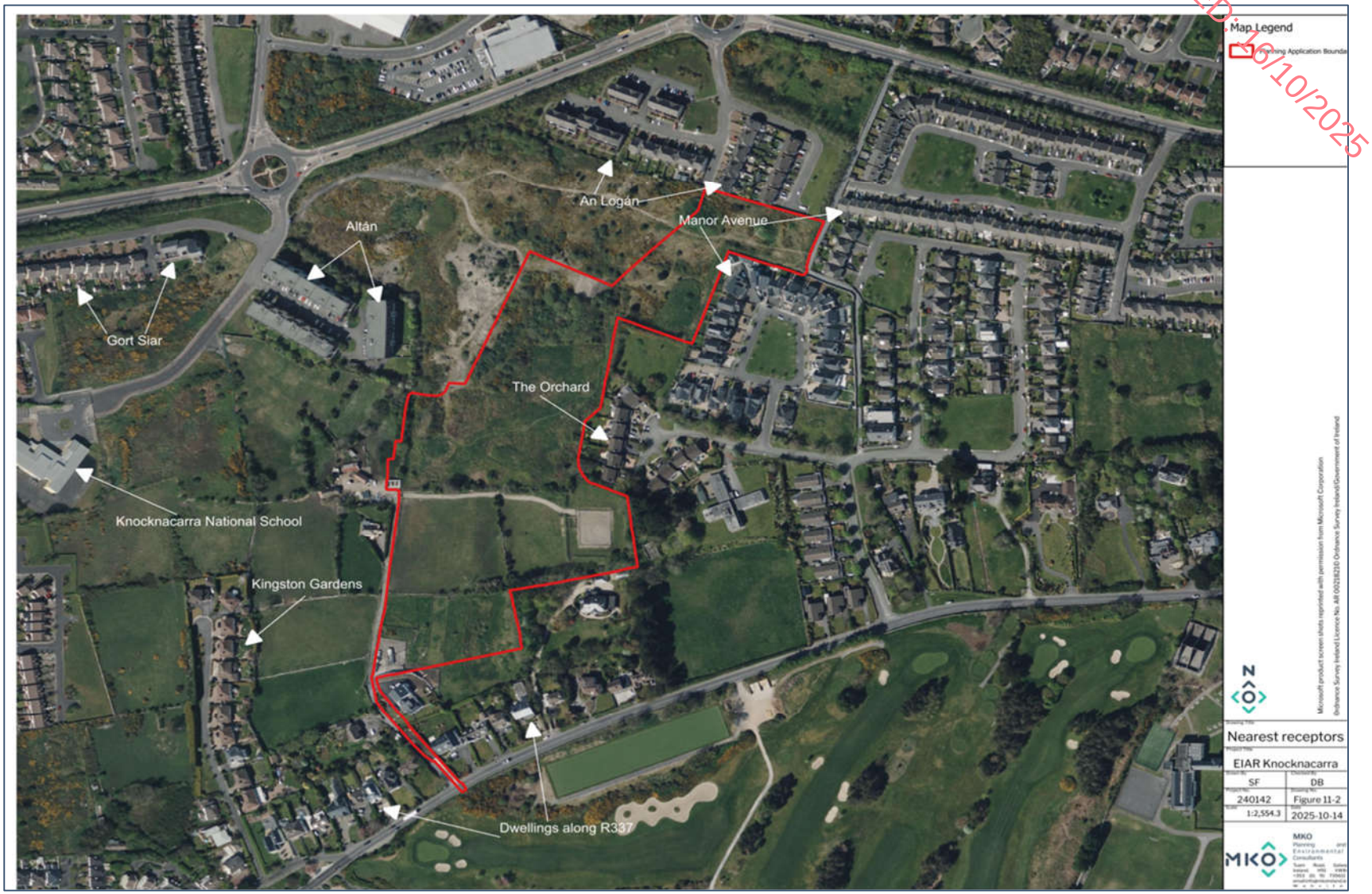
11.3.2 Receptors

There are no dwellings on the Proposed Development site. The Proposed Development site's position behind other residential areas results in a large number of receptors around the Proposed Development site boundary, consisting of scattered residential estates, apartment complexes, and ribbon development along the R337. Surrounding receptors are as follows:

- A single dwelling lies on the Knocknacarra masterplan site, 12 m from the Proposed Development site boundary.
- An Logán residential estate, consisting of a mixture of dwellings and duplex apartments, lies outside the northeast corner, although the Proposed Development site boundary adjoins only the southeast corner of the estate. There are 61 residential units at An Logán. Duplex units extend to three storeys. Several units clearly overlooking the Proposed Development site.
- The eastern boundary of the Proposed Development site adjoins a network of residential estates – Manor Avenue to the north, and The Orchard to the south. Here, 17 dwellings directly border the Proposed Development site, a number of which extend to three storeys.
- The southeast corner of the Proposed Development site borders a detached dwelling set back from the R337. A number of dwellings along the R337 at this point are separated from the Proposed Development site by an intervening field.
- The southwest corner approaches several dwellings adjacent to an access road which connects the Proposed Development site to the R337.
- A small residential estate, Kingston Gardens, lies 100 m west of the southwest site corner, separated from the Proposed Development site by intervening fields.
- The western boundary of the Proposed Development site approaches to within 20 m of the nearest apartment block at Altán, an apartment complex consisting of approximately 200 apartments over three blocks of four storeys. One of the apartments is occupied by a childcare facility.
- To the west of Altán lies a smaller apartment complex of approximately 30 units at the eastern end of Gort Siar residential estate. This complex lies 190 m from the Proposed Development site.

The nearest receptors are shown in Figure 11-2. In addition to the foregoing, a number of other receptors are located in the surrounding area:

- An ecclesiastical premises at The Orchard residential estate, 60 m from the Proposed Development site boundary.
- Knocknacarra National School 245 m west of the Proposed Development site.
- An ecclesiastical premises adjoining the national school.
- A childcare facility at the Altán apartment complex, 20 m from the boundary.
- A Gaelsoil 330 m north of the Proposed Development site.
- A secondary school 450 m southeast of the site, with a second school 100 m further south.



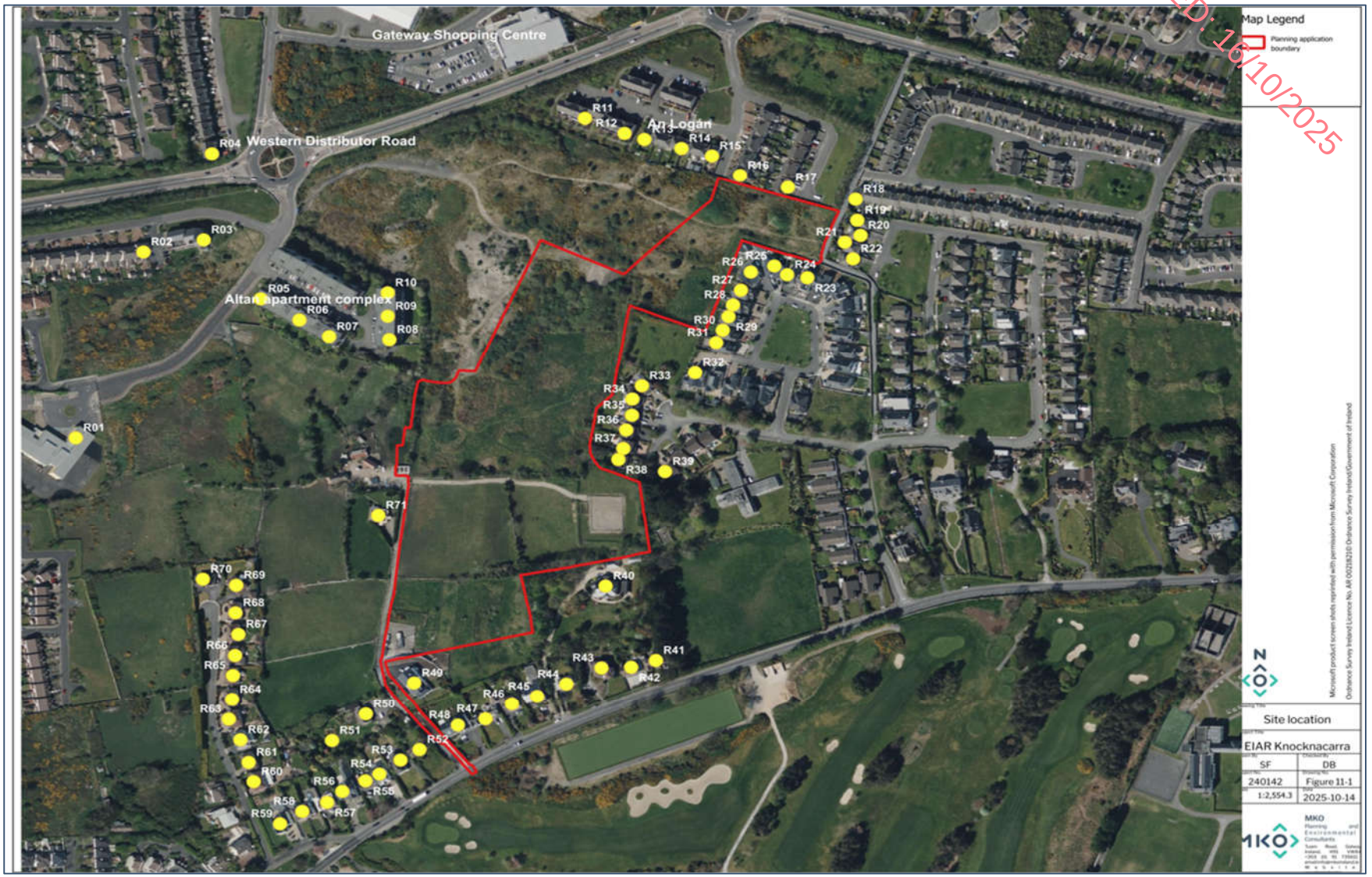
All identified receptors in the surrounding area consist of residential units, schools, ecclesiastical premises, and a childcare facility. No particularly vulnerable receptors such as care centres or nursing homes have been identified within 500 m, with the nearest being located 630 m to the southwest. Retail and commercial unts to the north of the site are not considered noise-sensitive. Similarly, a golf course to the south, 100 m from the main site area, is also not considered noise-sensitive due to the transient nature of usage.

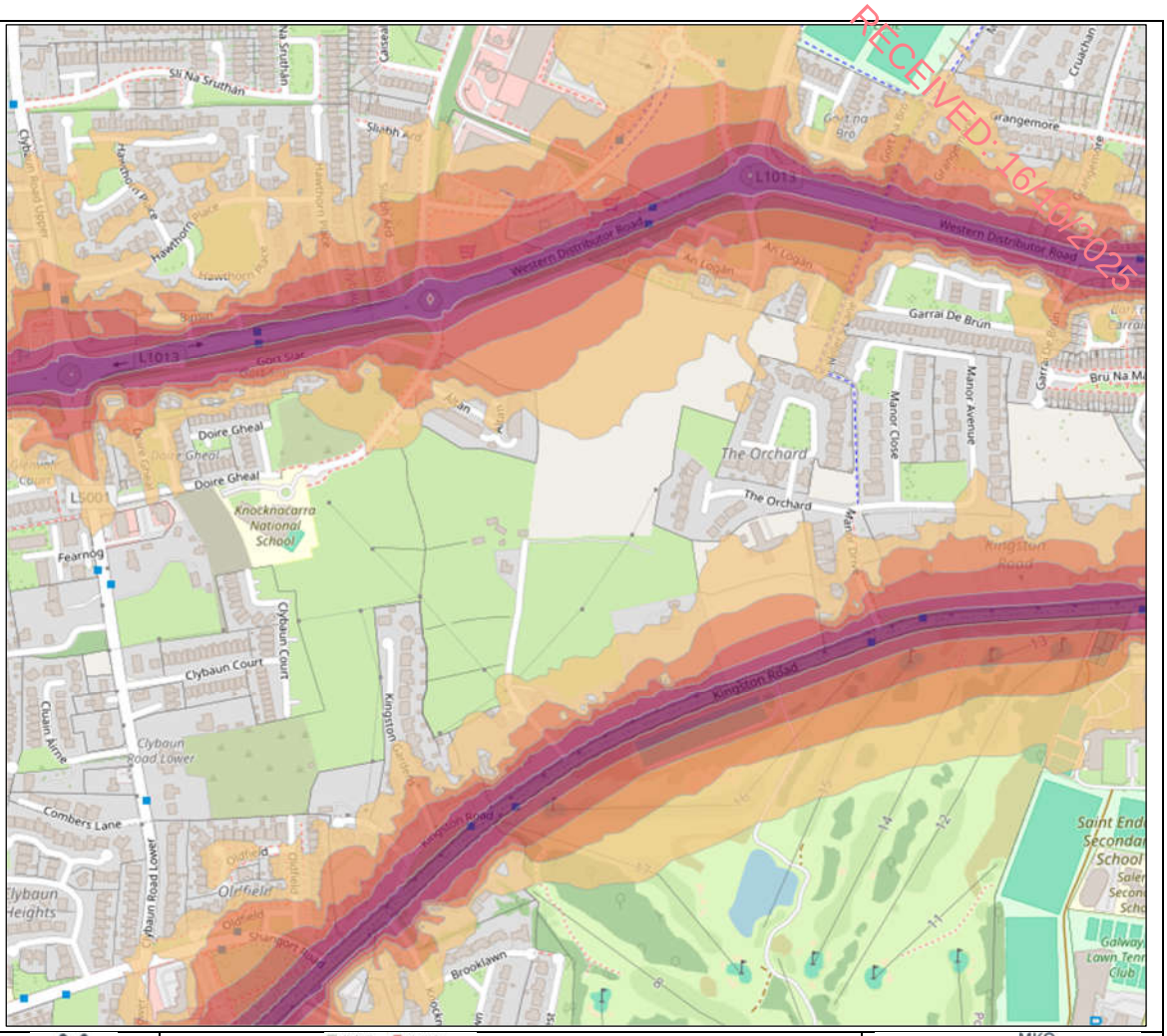
Receptors in the surrounding area are numbered for modelling purposes. Figure 11-3 shows the numbering arrangement. In several cases (e.g. Altán and An Logán), one receptor may represent several residential units.

11.3.3 Noise Mapping

Round 4 noise mapping, as required by Directive 2002/49/EC, has been completed recently. Maps for the local area are shown in Figures 11-4 and 11-5. The maps show the impact of roads traffic noise along the WDR and R337 corridors. Despite this impact, L_{den} and L_{night} levels across the Proposed Development site are relatively low, being highest at the northern end of the site where L_{den} levels nudge approximately 56-57 dB. L_{night} levels reach 45 dB at their highest. L_{den} and L_{night} levels are lower across the majority of the site, and are likely to fall below 50 and 40 dB respectively. The set back distance between the main site area and the R337 is sufficient to maintain low L_{den} and L_{night} levels at the southern end of the site.

Apart from the northern and southern margins, mapped noise levels across the Proposed Development site are lower than the 53 dB L_{den} and 45 dB L_{night} threshold values identified in the local authority's Noise Action Plan. At the northeast and southwest corners, the L_{den} criterion is currently exceeded by an estimated 2-4 dB. It should be noted that the WDR and R337, which respectively give rise to these noise levels at the northeast and southwest corners, are separated from the Proposed Development site by existing housing stock.





Drawing title	Drawn by	Checked by	Date
Mapped L_{den} contours	DB	SF	29.09.25

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Figure 11-1 Mapped L_{den} contours

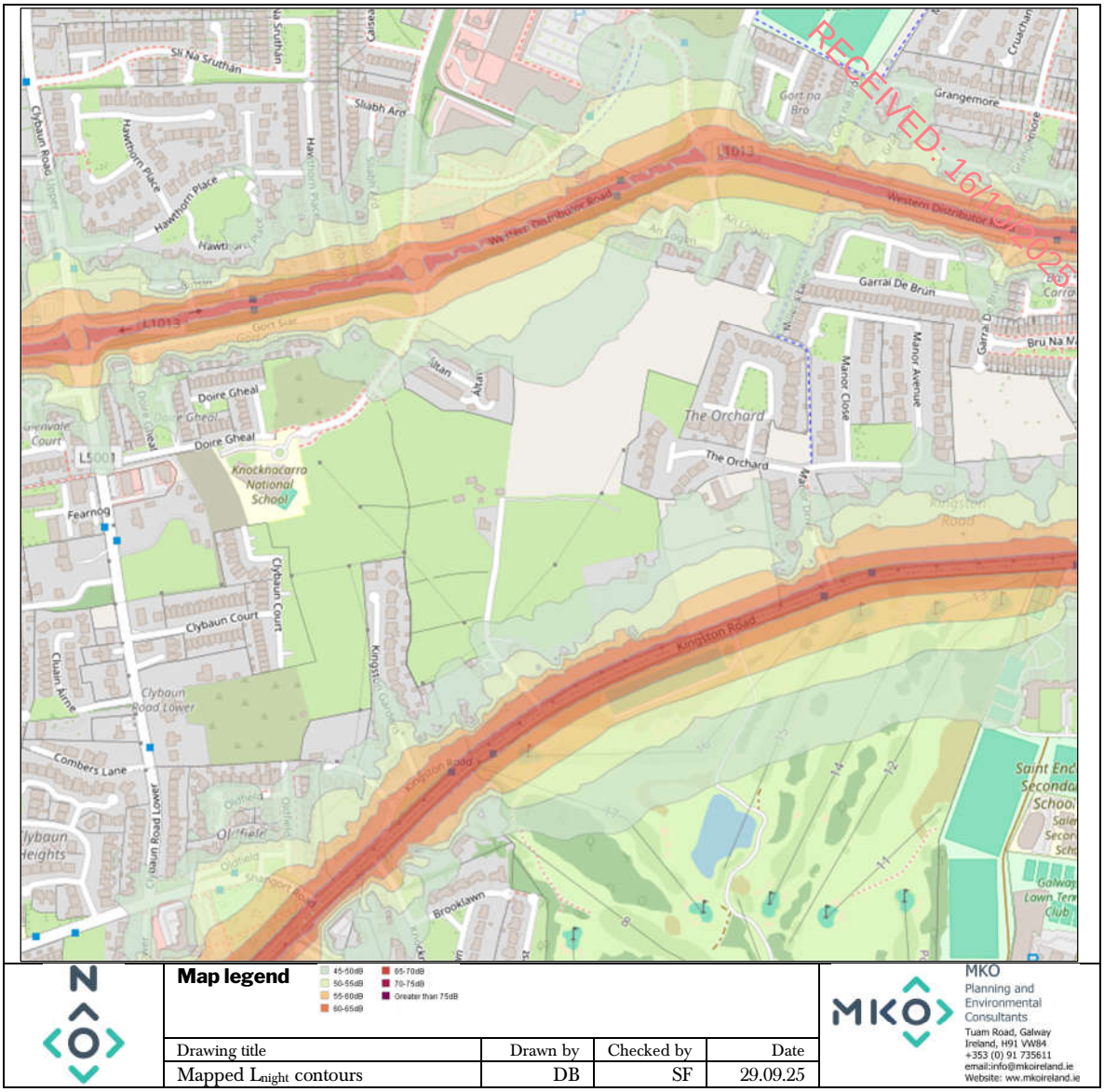

Figure 11-2 Mapped L_{night} contours

11.3.4 Baseline Noise Data

In order to assess current daytime, evening and night-time noise levels in the vicinity of the nearest receptors, a survey was carried out Wednesday 17th April 2024 to Thursday 18th April 2024. Monitoring was undertaken at five positions shown in Figure 11-6 and Plates 11-1 to 11-5 and described in Table 11-10. Equipment specifications and weather conditions are listed in Table 11-11. Recorded time history profiles are shown in Figures 11-7 to 11-11. Noise data are presented in Table 11-12 and summarised in Table 11-13.

Figure 11-3 Baseline noise stations

Table 11-10 Baseline noise station details

Ref.	Grid reference	Location	Reason for selection
N1	526808 724962	Close to N boundary, to rear of An Logán residential estate	To represent soundscape at S façade of An Logán dwellings, and to validate traffic noise model.
N2	526782 724682	Near SE corner of site, adjacent to The Orchard residential estate	To represent soundscape at The Orchard, and to validate traffic noise model.
N3	526624 724607	Close to S boundary of site, adjacent to access road	To represent soundscape at dwellings to S and W, and to validate traffic noise model.
N4	526533 724803	Near NW corner, to rear to Altán apartment development	To represent soundscape at apartments overlooking site, and to validate traffic noise model.
N5	526558 724863	N side of Altán development	To represent soundscape at apartments overlooking N end of site, and to validate traffic noise model; Noise levels at upper apartments likely to be higher than measured at N5.

Table 11-11 Survey details

Factor	Details
Cloud cover	80-100 % during day, temporarily clearing to 30 % overnight
Temperature	10 °C at set up, falling to 7 °C overnight, rising to 11 °C 18.04.24
Precipitation	0 mm throughout
Wind direction	W during 17.04.24, veering NW overnight and into next morning
Wind speed	0-4 m/s 17.04.24, falling 0-2 m/s overnight, returning to 0-4 m/s next morning
Wind speed meas.	Handheld anemometer at 2 m height
Survey operators	Damian Brósnan & Sinead Fagan
N1 SLM details	Type: NTi XL2; Serial: A2A-14337-E0; Microphone: A14972; Verification: 10.05.23
N1 SLM calibration	Date: 17.04.24; Time: 1049; Sensitivity: 42.3 mV/Pa; Post survey drift check: <0.2 dB
N2 SLM details	Type: NTi XL2; Serial: A2A-15392-E0; Microphone: A16340; Verification: 11.05.23
N2 SLM calibration	Date: 17.04.24; Time: 0936; Sensitivity: 42.0 mV/Pa; Post survey drift check: <0.2 dB
N3 SLM details	Type: NTi XL2; Serial: A2A-13658-E0; Microphone: A14735; Verification: 11.05.23
N3 SLM calibration	Date: 17.04.24; Time: 0934; Sensitivity: 39.3 mV/Pa; Post survey drift check: <0.2 dB

Factor	Details
N4 SLM details	Type: NTi XL2; Serial: A2A-15429-E0; Microphone: A16329; Verification: 05.03.24
N4 SLM calibration	Date: 17.04.24; Time: 0956; Sensitivity: 41.1 mV/Pa; Post survey drift check: <0.2 dB
N5 SLM details	Type: NTi XL2; Serial: A2A-17932-E0; Microphone: A18747; Verification: 06.03.24
N5 SLM calibration	Date: 17.04.24; Time: 1016; Sensitivity: 41.9 mV/Pa; Post survey drift check: <0.2 dB
Calibrator	Type: Bruel & Kjaer Type 4231; Serial: 3017723; Verification: 06.03.24

Plate 11-1: N1, looking E

Plate 11-2: N2, looking N

Plate 11-3: N3, looking SE

Plate 11-4: N4, looking NW

Plate 11-5: N5, looking W

Table 11-12 Recorded noise levels (dB) 17.04.23-18.04.23. 30 minute intervals are presented here.

Interval	N1			N2			N3			N4			N5		
	L_{Aeq}	L_{AF10}	L_{AF90}	L_{Aeq}	L_{AF10}	L_{AF90}	L_{Aeq}	L_{AF10}	L_{AF90}	L_{Aeq}	L_{AF10}	L_{AF90}	L_{Aeq}	L_{AF10}	L_{AF90}
1000-1030	-	-	-	47	49	43	53	57	39	-	-	-	-	-	-
1030-1100	-	-	-	47	50	44	52	48	38	-	-	-	-	-	-
1100-1130	-	-	-	48	51	45	51	46	40	49	51	46	-	-	-
1130-1200	-	-	-	49	52	46	50	46	41	50	52	47	-	-	-
1200-1230	50	52	46	48	51	45	45	45	40	49	51	46	52	55	46
1230-1300	51	53	46	57	62	47	51	48	41	53	55	49	49	51	45
1300-1330	50	52	46	59	63	44	51	44	39	49	51	45	51	53	45
1330-1400	50	53	44	54	52	42	44	43	38	47	50	44	49	50	45
1400-1430	49	52	45	48	50	44	46	45	39	50	52	47	50	52	46
1430-1500	48	51	45	47	49	44	48	46	40	49	51	46	49	51	45
1500-1530	48	50	43	57	62	44	45	45	40	48	50	45	48	50	46
1530-1600	46	48	42	46	48	43	45	44	40	47	49	44	49	51	46
1600-1630	48	52	43	46	49	42	43	45	39	48	50	45	49	51	46
1630-1700	48	50	44	50	53	43	44	46	41	49	51	46	50	52	46
1700-1730	47	50	43	49	51	45	43	45	41	47	50	45	50	52	48
1730-1800	48	50	45	49	51	47	43	45	41	48	50	45	50	52	48
1800-1830	49	51	44	52	54	47	45	46	42	51	53	46	52	54	49
1830-1900	50	49	42	53	53	43	46	45	40	48	50	44	49	51	46
1900-1930	51	54	44	52	54	47	43	45	41	49	51	45	51	52	48
1930-2000	47	49	42	56	49	42	44	45	40	46	47	43	50	51	46
2000-2030	46	48	42	46	47	41	43	46	38	45	46	42	49	50	45
2030-2100	45	48	41	46	48	40	41	44	37	44	46	41	51	55	44
2100-2130	44	47	40	46	49	40	42	44	37	44	47	41	51	54	44
2130-2200	44	46	38	46	50	38	41	44	36	43	46	39	47	49	42
2200-2230	41	44	34	39	41	37	36	38	34	40	42	36	44	46	38
2230-2300	40	43	34	40	43	36	36	38	34	40	42	36	43	46	38
2300-2330	39	42	31	41	44	34	35	37	32	38	41	32	42	45	34
2330-0000	36	41	27	35	39	30	33	36	29	35	38	29	40	43	29
0000-0030	35	39	23	31	33	28	31	34	27	32	36	24	37	41	25
0030-0100	33	37	22	29	32	26	29	31	26	31	34	23	34	39	24
0100-0130	33	37	20	29	32	25	30	32	26	30	34	21	35	39	23
0130-0200	34	38	21	30	32	23	29	30	24	32	35	22	34	38	22
0200-0230	31	36	20	28	31	22	27	29	23	29	33	22	30	35	19
0230-0300	31	35	20	28	31	22	27	29	23	30	33	23	29	34	19
0300-0330	36	40	20	32	35	21	32	31	23	34	38	23	34	39	18
0330-0400	32	35	20	29	33	21	27	29	23	30	33	22	34	39	18
0400-0430	35	37	21	33	38	22	29	32	23	31	35	23	39	44	19
0430-0500	40	43	29	37	41	28	32	34	25	38	42	26	48	52	35
0500-0530	41	44	32	42	43	31	32	35	27	44	49	29	56	61	42
0530-0600	47	50	39	53	57	43	57	61	35	52	56	42	58	63	47
0600-0630	48	50	42	51	53	44	56	51	38	48	50	43	52	55	40
0630-0700	54	56	46	46	49	43	52	46	38	52	52	43	49	52	42
0700-0730	52	54	45	46	48	43	51	53	39	49	49	45	49	50	43
0730-0800	52	56	45	48	51	44	49	45	39	50	52	45	49	51	44
0800-0830	52	55	45	48	49	42	50	48	38	50	53	45	47	47	43
0830-0900	50	52	45	46	49	42	50	50	37	49	51	44	51	52	43
0900-0930	53	55	46	47	49	44	47	45	39	50	51	46	47	49	43
0930-1000	50	52	46	47	48	44	51	49	39	47	49	45	49	51	43
1000-1030	49	51	45	-	-	-	-	-	-	47	48	44	48	50	41
1030-1100	50	52	46	-	-	-	-	-	-	51	54	46	48	49	43
1100-1130	50	51	46	-	-	-	-	-	-	-	-	-	48	51	43

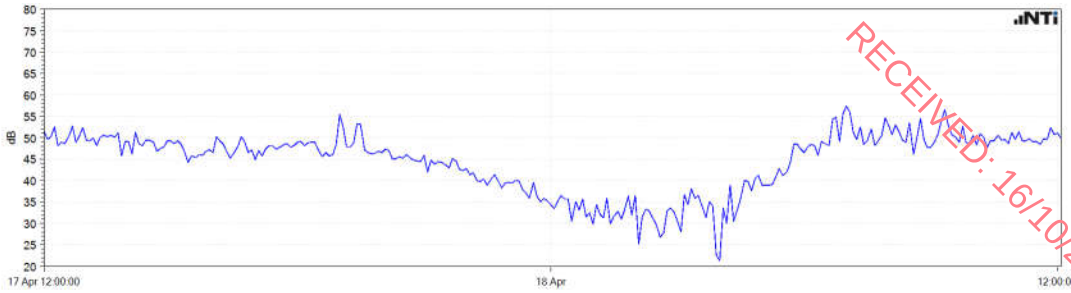

Figure 11-4 $L_{Aeq\ 1\ s}$ profile at N1.

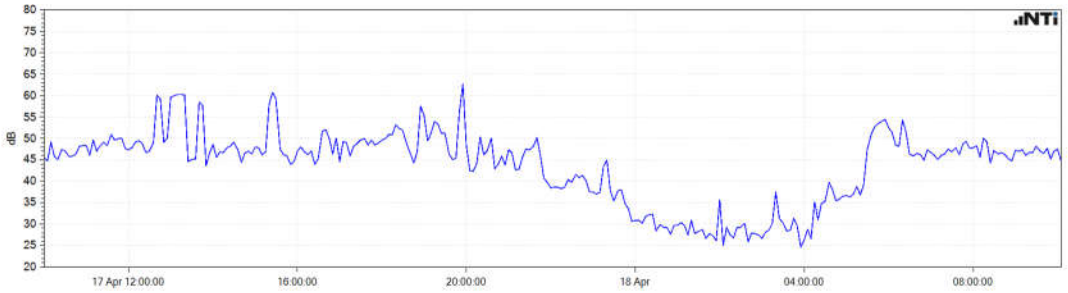

Figure 11-5 $L_{Aeq\ 1\ s}$ profile at N2.

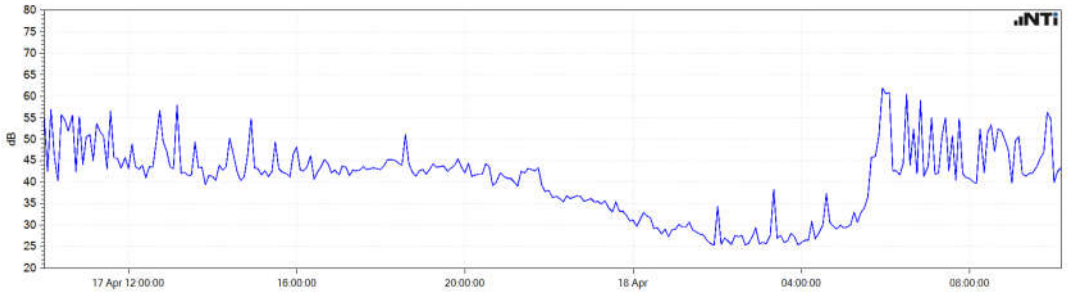

Figure 11-6 $L_{Aeq\ 1\ s}$ profile at N3.

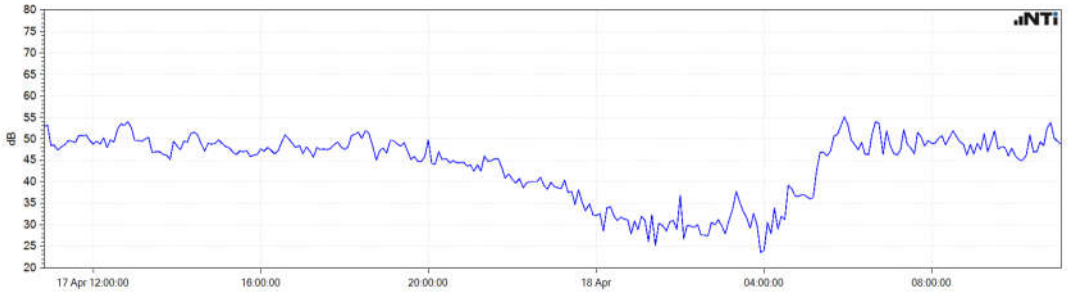

Figure 11-7 $L_{Aeq\ 1\ s}$ profile at N4.

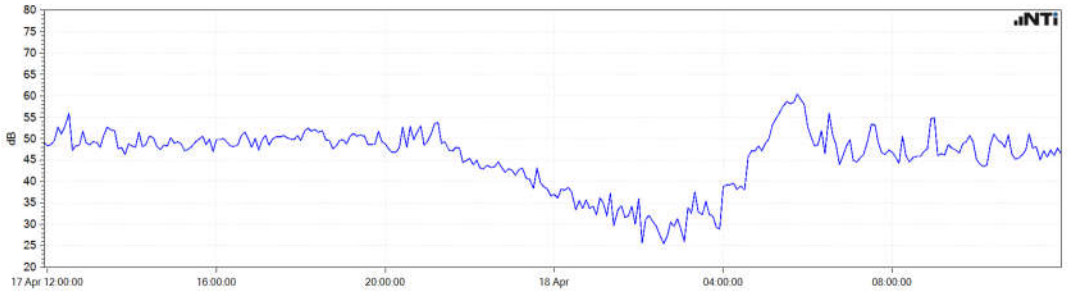

Figure 11-8 $L_{Aeq\ 1\ s}$ profile at N5.

Table 11-13 Noise data summary (dB).

Period	Parameter	Type	N1	N2	N3	N4	N5
Daytime	$L_{Aeq\ 30\ min}$	Range	46-53	46-59	43-53	47-53	47-52
		Average	50	49	48	49	49
	$L_{AF90\ 30\ min}$	Range	42-47	42-47	37-42	44-49	41-49
		Average	45	44	40	45	45
Evening	$L_{Aeq\ 30\ min}$	Range	40-51	39-56	36-44	40-49	43-48
		Average	45	46	41	44	51
	$L_{AF90\ 30\ min}$	Range	34-44	36-47	34-41	36-45	38-48
		Average	39	40	37	40	43
Night-time	$L_{Aeq\ 30\ min}$	Range	31-54	28-53	27-57	29-52	29-58
		Average	38	36	35	37	41
	$L_{AF90\ 30\ min}$	Range	20-46	21-44	23-38	21-43	18-47
		Average	27	29	28	28	28
Daytime + Evening	$L_{Aeq\ 16\ h}$	-	49	51	48	48	49
Night-time	$L_{Aeq\ 8\ h}$ / L_{night}	-	44	44	48	44	49
24 h	L_{den}	-	52	53	54	52	56

The soundscape at all stations was dominated by road traffic across the surrounding area, with station N5 also influenced by its exposure to the WDR traffic noise. Road traffic noise was almost continuously audible through the night. Other sources audible during the daytime and evening were distant playing children, barking dogs, mowers/strimmers, and birdsong. The last was particularly evident during the dawn chorus from 0530h which resulted in elevated noise levels towards the end of the night-time period. There were no night-time road traffic noise events which resulted in L_{AFmax} levels above 60 dB at any of the five stations.

Stations N1 and N5 were located in proximity to the WDR. A comparison between measured L_{den} levels listed in Table 11-13 and mapped levels shown in Figure 11-4 suggests that the former are approximately 5 dB lower than mapped levels. This discrepancy may be due to screening of road traffic noise provided by a wall near N1, and local stockpiles of soil near N5. As at all sites, it is necessary to treat mapped levels with caution, and measured data are considered more relevant than mapped data as an indicator of local baseline noise levels.

For the purposes of the construction phase impact assessment described below, baseline noise station data are applied to surrounding receptors as indicated in Table 11-14.

Table 11-14 Assignment of baseline noise data.

Receptor	Station	Receptor	Station	Receptor	Station	Receptor	Station	Receptor	Station
R01	N4	R15	N1	R29	N1	R43	N3	R57	N3
R02	N5	R16	N1	R30	N1	R44	N3	R58	N3
R03	N5	R17	N1	R31	N1	R45	N3	R59	N3
R04	N5	R18	N1	R32	N1	R46	N3	R60	N3
R05	N4	R19	N1	R33	N2	R47	N3	R61	N3
R06	N4	R20	N1	R34	N2	R48	N3	R62	N3
R07	N4	R21	N1	R35	N2	R49	N3	R63	N3
R08	N4	R22	N1	R36	N2	R50	N3	R64	N3
R09	N4	R23	N1	R37	N2	R51	N3	R65	N3
R10	N4	R24	N1	R38	N2	R52	N3	R66	N3
R11	N1	R25	N1	R39	N2	R53	N3	R67	N3
R12	N1	R26	N1	R40	N2	R54	N3	R68	N3
R13	N1	R27	N1	R41	N3	R55	N3	R69	N3
R14	N1	R28	N1	R42	N3	R56	N3	R70	N3
								R71	N3

11.3.1 Noise Risk Assessment

The ProPG document includes guidance on undertaking a risk assessment with respect to inward noise affecting a proposed development site. The ProPG risk assessment is based on Figure 11-12. Data presented in Table 11-13 suggest that the entire site is low risk. In this regard, ProPG states that:

> *...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 acoustic design statement which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.*

ProPG notes that the risk category of a particular site will be influenced by the number of L_{AFmax} events which exceed 60 dB externally during night-time hours. Where the number of such events exceeds 10, mitigation may be required even where L_{night} levels are below relevant criteria. Measured data indicate that night-time L_{AFmax} levels due to traffic on surrounding roads do not exceed 60 dB.

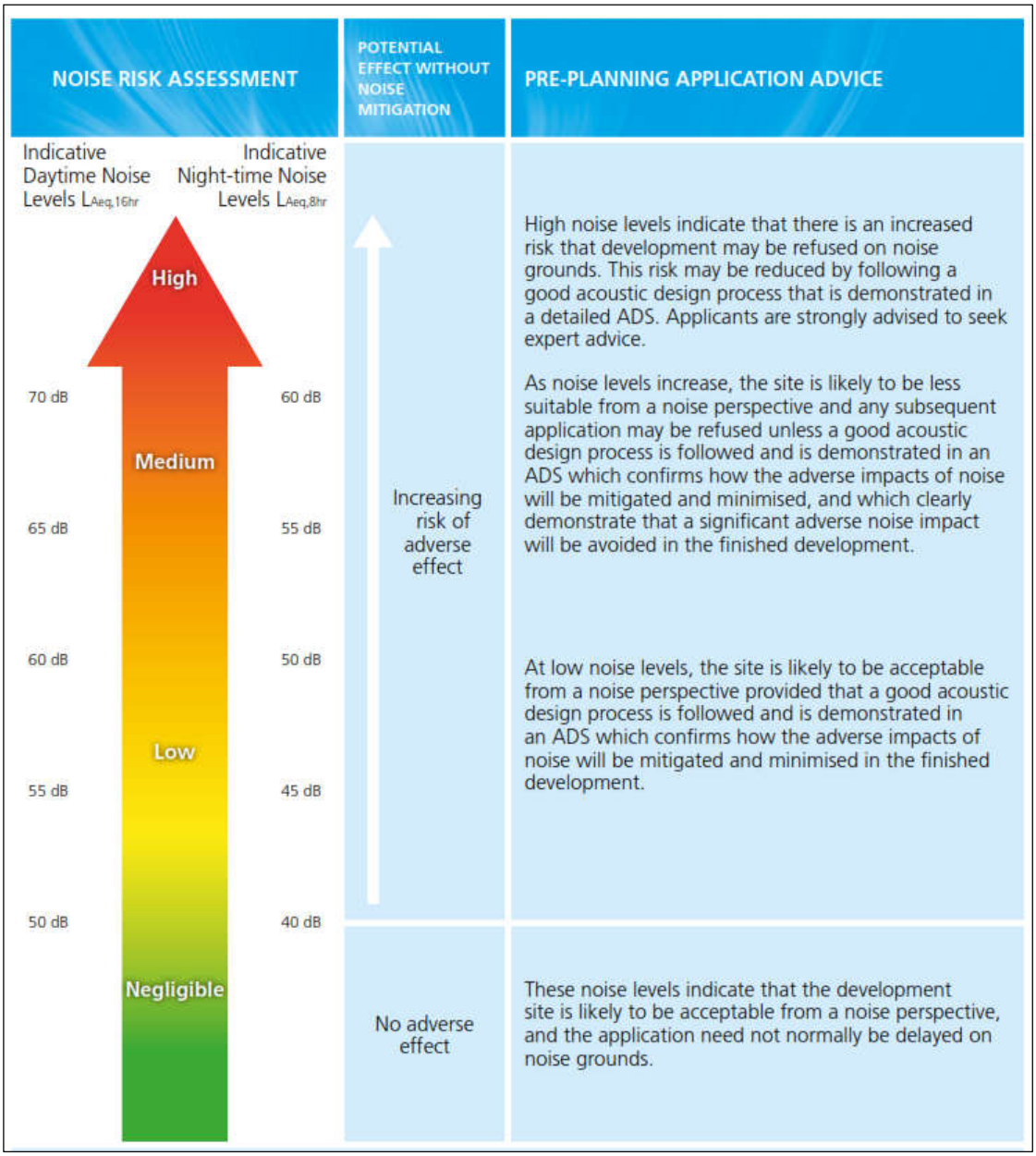

Figure 11-9 ProPG risk assessment.

11.3.2 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 suburban in character, with the soundscape dominated by local and distant traffic. In the short and medium term, traffic volumes are likely to continue to increase into the future, due to ongoing development along the western side of Galway City. Such an increase in traffic volumes is likely to result in an increase in ambient noise levels.

In the longer term, traffic noise volumes may reduce, due to a combination of several factors:

- The expected increase in the proportion of electric vehicles in the national car fleet will gradually reduce the engine and transmission noise contribution to traffic noise. At speeds below 50 km/h, these are the chief contributors to traffic noise.
- The increasing trend in lowering urban speed restrictions, if applied locally, will further reduce traffic noise.
- Increased use of public transport resulting from government and local authority policies is likely to reduce car volumes on the surrounding road network.
- Construction of the mooted Galway bypass may remove some traffic from the WDR and the R337.

11.4 Likely Significant Effects

11.4.1 Do Nothing Scenario

If the Proposed Development does not proceed, it is expected that the site will remain as it is at present, with occasional noise emissions from land use and maintenance activities such as livestock and agricultural machinery. The potential for construction stage employment, as well as addition to the local housing stock, would be lost.

11.4.2 Construction Phase Noise Levels

Construction will be managed from a temporary construction compound. Works will be confined to daytime hours Monday-Friday, with some additional works on Saturday. Full details are presented in Chapter 4 of the EIAR.

Construction works will include the following activities, undertaken variously throughout the construction phase and in different areas of the site:

- Soil stripping & temporary stockpiling.
- Installation of a temporary construction compound.
- Provision of hardcore stone on onsite roadways.
- Demolition of certain structures.
- Excavation of foundations.
- Excavation of ground services trenches.
- Installation of services including sewerage network.
- Steel frame erection in apartment buildings.
- Pouring and floating of concrete floor slabs.
- Block work and roof work.
- Building finishing (windows, doors, etc.).
- Internal fit out in buildings.
- Laying of asphalt.
- Site landscaping.

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 (dB at 10 m).

Plant	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Total L_{Aeq}
Asphalt paving machine with HGV	78	77	72	72	71	69	62	56	75
Discharging concrete mixer HGV	80	69	66	70	71	69	64	58	75
Concrete pump boom	71	76	71	76	76	72	66	62	79
6x6 dump truck	85	87	77	75	76	73	69	62	81
Tracked excavator (22 t)	80	83	76	73	72	70	69	66	78
Dumper	84	81	74	73	72	68	61	53	76
ViBró-roller	88	83	69	68	67	65	62	59	74
Telescopic handler	85	79	69	67	64	62	56	47	71
HGV (driving)	73	78	78	78	74	73	68	66	80

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

- The site is relatively large. Emissions will arise from plant operating across the site, and thus the site will not constitute a single point source.
- The large construction area will result in differing propagation conditions with respect to receptors at different locations.
- The construction phase will last two years. During this time, 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. There may be extended periods during the construction phase with minimal noise emissions.
- Each machine item may operate under different loading conditions or may be in varying states of repair.
- Construction works may be concentrated for certain periods, followed by periods of inactivity. Localised works may require several hours of intense activity.
- During later stages of the construction phase, emissions from some operations will be screened by previously completed buildings.
- As buildings near completion, activity will gradually relocate indoors.
- A number of different construction firms are likely to be contracted, each using different plant.
- With respect to particular plant, the models selected will change depending on requirements. The method of construction may be modified shortly before commencement, resulting in the need to import different equipment. Construction projects tend to be fluid in nature, with plant requirements changing as the site is progressed and circumstances change on the ground. The need for specific plant may often be established only following the start of a project.

From the foregoing, it is clear that construction phase noise emissions will vary in time and location, and it is not possible to determine a single overall noise output figure for the construction phase. The most appropriate approach here is to assess a number of worst case scenarios, particularly scenarios which involve use of plant close to offsite noise sensitive receptors. Table 11-16 lists construction scenarios modelled in this assessment.

The scenarios assessed are entirely worst case. Noise emissions from other operations outside of the identified scenarios are likely to give rise to lower noise emissions.

Table 11-16 Assessed construction phase scenarios. Works area refers to the onsite works zone assumed in each scenario for the purposes of modelling – the worst case scenario is assumed in relation to offsite receptors.

Scenario	Works	Works area	Plant
1	Site clearance & building demolition	Altán corner, NE corner, SE corner, SW corner	Excavator, 6x6 dump truck in each works area
2	Access road works	R337 access	Excavator, roller, dumper, sporadic HGVs
3	Building construction	Altán corner, NE corner, SE corner, SW corner	Concrete mixer HGV, telescopic handler in each works area, sporadic HGVs
4	Apartment construction	E of Altán	Concrete mixer HGV, concrete pump HGV with boom, telescopic handler, sporadic HGVs
5	Roadway construction	Altán corner, NE corner, SE corner, SW corner	Roller, asphalt paver, in each works area, sporadic HGVs

Noise emissions from the above were modelled using DGMR iNoise v2024 software. 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: Mixture of hard and porous ground (G = 0.5).
- Atmospheric conditions: 10 °C and 70 % relative humidity.
- Screening: None, other than that provided by boundary walls and buildings.
- Receiver height: 2 m (representing ground floors and external amenity areas) and 4 m (representing upper floors at two-storey properties). In addition, construction works in the vicinity of An Logán duplex units, Manor Avenue, and Gort Siar apartments were also assessed at 6 m to assess upper floors. Works in the vicinity of Altán were assessed at 6 and 8 m.
- Plant output data: Taken from Table 11-15. 31.5 Hz levels (not provided in BS 5228-1:2009) assumed to be same as 63 Hz levels.
- Plant on-times per hour: Paver (100 %); Mixer HGV (50 %); Boom (50 %); Excavator (80 %). Roller, dumper, 6x6 and handler movements continuous.

The model output is presented in Appendix 11-1. $L_{Aeq\ 1\ h}$ levels received at receptors will in most cases not exceed the 65 dB BS 5228-1:2009 criterion. Exceptions will arise in a small number of cases. From the tables, it is concluded that exceedances of the 65 dB criterion, and potentially of the 70 dB criterion, may arise at receptors immediately outside the site boundary when site clearance works or building works are undertaken close to the boundary. This applies to receptors at An Logán, Manor Avenue, The Orchard, and dwellings immediately adjacent to the southern boundary. In all cases, such works will be temporary – while construction of the Proposed Development will last two years, works at any particular location near the site boundary are likely to last days or weeks at most. In the case of initial site clearance works, activity at any particular location is expected to last only 1-2 days. Impacts and mitigation are discussed below.

BS 5228-1:2009 source noise data suggests that construction phase emissions will not be tonal. Emissions are also unlikely to be impulsive.

11.4.3 Construction Phase Noise Impacts

Table 11-3 above sets out the DMRB scale used to assess noise impacts associated with construction noise. Appendix 11-2 presents an assessment based on this scale, applying the equivalent EPA impact category. With respect to each receptor, a range of predicted $L_{Aeq\ 1\ h}$ levels is presented, reflecting the various receiver heights modelled – in some cases, the range is relatively wide due to screening provided at ground level by intervening walls. Baseline $L_{Aeq\ T}$ levels are taken from Table 11-13, with baseline levels at each receptor assigned in accordance with Table 11-14. The assessment relates to daytime $L_{Aeq\ 1\ h}$ levels, as these are most relevant to the construction phase.

In most cases, construction phase noise impacts will be imperceptible to slight negative. Exceptions are as follows:

- During ground clearance works, impacts will increase to moderate negative at receptors immediately adjacent to the northeast corner These impacts will be temporary, likely to last locally 1-2 days at most.
- During the same works, the impact will increase to significant negative at receptor R49 adjacent to the southwest corner. This impact will again be temporary, likely to last 1-2 days.
- Onsite roadway construction works may give rise to moderate negative impacts at R40 and R49. Works in proximity to these receptors is likely to take approximately one day, and impacts will therefore be brief.

Given that construction noise impacts, where increased, will last several hours or days at most, engineering solutions such as barriers are not warranted. A more suitable mitigation option here will be advance notification to local residents prior to commencement of any onsite works within 50m, and this is proposed as a mitigation option below.

11.4.4 Construction Phase Traffic Noise

During the construction phase, vehicles will arrive at, and depart from, the site during the working day. Vehicle movements will be associated with workers' arrival and departure and delivery of materials. The approximate numbers of workers employed onsite over the entire construction period will fluctuate depending on schedules. Numbers are unlikely to exceed 50 throughout the Proposed Development. Worker arrival and departure will be concentrated during the peak AM and PM periods. The number of HGV movements associated with material deliveries and spoil removal is unlikely to exceed five in any one hour.

Personnel vehicles and deliveries will access the Proposed Development site via the WDR. The Traffic and Transport Assessment document indicates that 795 vehicles currently pass the site on the WDR during the AM peak, increasing to 828 vehicles during the PM peak. In this context, traffic movements associated with up to 50 construction workers will give rise to a traffic noise $L_{Aeq\ 1\ h}$ increase of less than 0.3 dB. This increase will be negligible.

WDR traffic volumes throughout the day are lower than during the AM and PM peaks. However, traffic count data indicate that traffic volumes passing the site do not fall below 160 movements in any hour. In this context, up to five HGV movements associated with materials delivery and spoil removal will result in an $L_{Aeq\ 1\ h}$ increase of less than 0.3 dB, which again will be negligible, resulting in an imperceptible impact.

On this basis, it is concluded that construction phase traffic noise impacts will be imperceptible and short term.

11.4.5 Construction Phase Vibration

Potential sources of groundborne vibration during the construction phase are as follows:

- Delivery truck movements: Trucks may give rise to vibration at positions adjacent to the road. However, such emissions are typically imperceptible beyond 5-10m and are highly unlikely to be perceptible at dwellings alongside site access routes.
- Plant movements: The movement of plant onsite is not considered to constitute a source of groundborne vibration and is not listed in typical vibration documents such as BS 5228-2:2009. In addition, plant machinery used onsite is likely to be small to mid-sized, and similar to those used on other urban construction projects.

- Ground works: Excavation of trenches and pits for foundation and services will be required. These activities are not typically associated with offsite groundborne vibration impacts. It is noted that piling is not proposed. In addition, rock breaking is unlikely to be required.

On the basis of the above, no construction vibration impacts are expected at offsite receptors.

11.4.6 Cumulative Construction Phase Noise Impacts

The Proposed Development is a component of a larger residential development project. The Proposed Project involves the construction of more than 500 residential units, and the development will require separate, individual planning applications for each part of the project. Where construction of the Proposed Development coincides with construction of other elements of the Proposed Project, cumulative noise impacts may arise at surrounding receptors. These impacts are assessed here. Six scenarios are assessed, as listed in Table 11-17.

Table 11-17 Assessed cumulative Proposed Project construction phase scenarios.

Scenario	Works	Works area	Plant
6	Site clearance & building demolition	Altán corner, NE corner, SE corner, SW corner	Excavator, 6x6 dump truck in each works area
7	Access road works	Altán access, R337 access	Excavator, roller, dumper in each works area, sporadic HGVs
8	Building construction	Altán corner, NE corner, SE corner, SW corner, S boundary	Concrete mixer HGV, telescopic handler in each works area, sporadic HGVs
9	Apartment construction	E of Altán	Concrete mixer HGV, concrete pump HGV with boom, telescopic handler in each works area, sporadic HGVs
10	Roadway construction	Altán corner, NE corner, SE corner, SW corner, S boundary	Roller, asphalt paver, in each works area, sporadic HGVs
11	Knocknacarra road works	Road outside Altán corner	Excavator, dumper, telescopic handler, concrete mixer HGV

The noise model described above was rerun to reflect the six identified scenarios. Given that receptor R71 is expected to be demolished as part of the Proposed Project, this receptor is omitted from the revised model. The model output is presented in Appendix 11-3.

$L_{Aeq\ 1\ h}$ levels received at receptors will in most cases not exceed the 65 dB BS 5228-1:2009 criterion. Exceptions will arise in a small number of cases. From the tables, it is concluded that exceedances of the 65 dB criterion, and potentially of the 70 dB criterion, may arise at receptors immediately outside the site boundary when site clearance works or building works are undertaken close to the boundary. This applies to receptors at Altán, An Logán, Manor Avenue, The Orchard, Kingston Gardens and dwellings immediately adjacent to the southern boundary. In addition, levels may be elevated at Gort Siar apartments when local road infrastructure works are underway. In all cases, these works will be temporary (while the overall project will last two years, works at any particular location near the site boundary are likely to last days or weeks at most. In the case of initial site clearance works, activity at any particular location is expected to last only 1-2 days. Impacts and mitigation are discussed below.

BS 5228-1:2009 source noise data suggests that construction phase emissions will not be tonal. Emissions are also unlikely to be impulsive.

Appendix 11-4 presents an assessment of cumulative construction noise impacts based on the DMRB scale. With respect to each receptor, a range of predicted $L_{Aeq\ 1\ h}$ levels is presented, reflecting the various receiver heights modelled.

In most cases, construction phase noise impacts will be imperceptible to slight negative. Exceptions are as follows:

- During ground clearance works, impacts will increase to moderate at receptors immediately adjacent to the southwest corner, and potentially to significant. These impacts will be temporary, likely to last locally 1-2 days at most.
- At the same receptors, impacts may increase to moderate when building construction is underway, in cases where buildings are erected close to receptors. This activity may arise at intervals during the building construction period, although experience with such works indicates that periods of intensive operations typically last several hours at most when present e.g. concrete mixer HGV discharging. Thus, such impacts, where they arise, will be brief.
- Onsite roadway construction works may also give rise to moderate impacts. While this may arise chiefly in relation to receptors R40 and R65, it may also occur at other receptors immediately outside the boundary, close to proposed onsite roadways. Onsite roadway construction (rolling and paving) in any particular zone is likely to take approximately one day, and impacts will therefore be brief.
- Road infrastructure upgrade works outside the northwest of the site may give rise to moderate impacts at Gort Siar apartments. These impacts will be temporary, lasting several days at most.

Given that construction noise impacts, where increased, will last several hours or days at most, engineering solutions such as barriers are not warranted. A more suitable mitigation option here will be advance notification to local residents prior to commencement of any onsite works within 50m, and this is proposed as a mitigation option below.

11.4.7 Cumulative Onsite & Offsite Construction Phase Noise

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. In this regard, two projects have been identified as follows:

- A proposed urban retail centre including a supermarket at the northwest corner of the Knocknacarra masterplan area, to the immediate north and northeast of Altán.
- A permitted aquatic centre on the northern boundary of the masterplan area, to the immediate east of the proposed retail centre, and to the immediate south of An Logán.

The MKO acoustics team previously assessed noise impacts associated with both projects.

No other offsite projects of potential cumulative construction noise significance have been identified. While other construction projects are likely to occur across the surrounding area at intervals, noise emissions from these are likely to be masked by continuous road traffic noise throughout the area. Receptors most vulnerable to cumulative noise from the Masterplan site (namely, receptors located immediately outside the Masterplan area boundary) are likely to be potentially affected only by construction works undertaken within the Masterplan area.

In order to assess potential cumulative impacts from all three Masterplan projects (the Proposed Project including the Proposed Development, the proposed retail centre, and the permitted aquatic centre), the most practical approach here is to undertake predictive modelling of all six scenarios described in Table 11-17 above, combined with simultaneous emissions from construction operations at the proposed retail centre and the permitted aquatic centre. For modelling purposes, a likely worst case scenario is assumed, involving simultaneous operation of two tracked excavators at the retail centre site, in addition to operation of two excavators at the aquatic centre site, as well as sporadic HGV movements at both sites. The construction phase noise model used above to assess the six residential

development construction scenarios was modified to include these sources. These scenarios are numbered construction scenarios 12, 13, 14, 15, 16 and 17. The model was run at several heights to assess impacts at buildings with various heights in the vicinity of the retail centre and aquatic centre. The model output is shown in Appendix 11-5. Impacts are assessed in Appendix 11-6.

In most cases, cumulative noise impacts will be imperceptible, not significant or slight negative, increasing to moderate negative in a small number of cases. At receptors R11 and R12, representing duplex units at An Logán, impacts will rise to significant negative when ground clearance works are underway at the site boundary. In these cases, the chief noise contribution will arise from plant operating at the retail centre construction site and/or aquatic centre construction site, due to proximity of plant to nearby receptors. Minimal contribution will arise from the Proposed Development. However, mitigation is proposed here, as discussed below.

11.4.8 Operational Phase Noise Impacts

At the completed development, noise emissions will arise from typical residential estate sources such as playing children, lawnmowers, heat pumps and car movements. Emissions will also arise from vans associated with deliveries, and waste collection trucks. All such emissions are highly unlikely to be significant onsite or offsite. Onsite traffic speeds will be low, thus minimising tyre noise. There will be no commercial emissions. No emissions of note will arise from the proposed onsite childcare facility, apart from children playing at an outdoor play area.

The proposed site layout will incorporate open spaces which will be grassed and planted with trees. It is likely that a maintenance contract will be awarded to one or more local landscaping companies. Maintenance activities undertaken at the proposed site will chiefly include regular mowing of open green areas. While mower emissions are likely to be audible at the nearest receptors, such emissions will blend into the urban soundscape, particularly during the summer when the daytime/evening noise environment in any urban area tends to include at least one mower audible in the distance at any time.

From the forgoing, nose emissions arising within the completed site will be urban-residential in character, and will be identical in character to emissions arising within surrounding residential zones. It is concluded that the Proposed Development, once completed, will give rise to neutral and imperceptible noise impacts at surrounding receptors.

11.4.9 Operational Phase Traffic Noise Impacts

The impact of traffic noise associated with the Proposed Development may be divided into three categories:

- Impacts at surrounding receptors due to movements on onsite roadways across the site.
- Impacts at Altán receptors due to movements on the northwest access road.
- Impacts across the wider area due to increases in road traffic on the surrounding road network as a result of the Proposed Development.

These are assessed separately below.

11.4.9.1 Impacts At Surrounding Receptors Due To Movements On Onsite Roadways Across The Site.

Noise impacts at offsite receptors attributable to car movements on roadways within the completed Proposed Development site are expected to be neutral and imperceptible due to a combination of low traffic speeds, low numbers of movements, screening by buildings, separation distance, and elevated background noise levels due to distant traffic. In addition, this noise source will be entirely consistent with the soundscape at surrounding receptors at Altán, An Logán, Manor Close, The Orchard,

Kingston Gardens, receptor R71, and along the R337, all of which are influenced by public road and residential estate roadway traffic noise.

11.4.9.2 Impacts At Altán Receptors Due To Movements On The Access Roadway

The Proposed Development will be accessed from the cul de sac serving Knocknacarra National School. South facing units at the southwest Altán block of apartments, and east and west facing units on the east block, will receive increased noise levels due to traffic movements on the proposed access. Ground floor units will benefit from screening provided by a boundary wall. This screening will not benefit units above ground floor level.

Predictive noise modelling using ISO 9613 or CRTN is typically used to determine traffic noise levels at receptors. Such models, however, are suitable only for freely flowing traffic where tyre rolling noise dominates. These models are unsuitable where vehicles travel at low speed, or undergo acceleration or braking as will occur in this case. Vehicle noise arising on the access roadway in the vicinity of these receptors will consist entirely of engine and transmission noise in the case of vehicles with combustion engines, or motor noise where vehicle are electric. Emissions from the latter will be negligible. In order to quantify the impacts of noise emissions from vehicles with combustion engines at these receptors, the following equation was applied:

$L_{Aeq\ T} = L_{AE} + 10\log N - 10\log T - 10\log d2/d1$

where:

$L_{Aeq\ T}$: The noise level received at a receptor over any measurement interval (one hour assumed in this case).

L_{AE}: The sound exposure level generated by an individual vehicle pass. For the purposes of this assessment, a typical level of 70 dB is applied at a distance of 10 m, based on a car or van (with internal combustion engine) accelerating to 30 km/h or decelerating from 30 km/h. This level is drawn from MKO survey experience.

N: The number of vehicle movements during the interval in question, in this case one hour. This is 161-163, as noted above.

d: The distance between the dwelling and the roadway (d2). d1 is 10 m. An attenuation factor of 10log rather than 20log is applied to reflect a line source.

The traffic and transport assessment indicates that the number of movements on the access road passing the southern side of Altán will be approximately 170 during peak hours.

Table 11-18 presents $L_{Aeq\ T}$ levels received at the most exposed facades of the Altán apartments during AM and PM peaks, determined using the above equation. Levels at other facades will be less.

The traffic and transport assessment does not include traffic movements expected to arise outside of AM and PM peaks. For the purposes of this assessment, the following assumptions are applied:

- Offpeak daytime traffic movements during any hour will be 50 % of peak periods.
- Evening traffic movements will be 20 % of peak periods.
- Night-time traffic movements will fall to 5 % of peak periods.

AM and PM peak calculations are based on the 1 h parameter, to align with the traffic and transport assessment. Offpeak daytime, evening and night-time calculations apply to any interval of T – the calculations assume that traffic movements are distributed evenly across any interval of T. For the

purposes of this assessment, it is assumed that all movements will consist of cars or light vans. It is also assumed that 80 % of these will be propelled by combustion engines, and that noise emissions from the remaining 20 % will be negligible. Dwelling numbers are shown in Figure 11-3 above.

Table 11-18 $L_{Aeq\ T}$ levels at receptors adjacent to access road due to cars and light vans (dB).

Receptor	Peak daytime	Offpeak daytime	Evening	Night-time
Upper floor Altán apartments on SW block, S facade	51-52*	48-49*	44-45*	38-39*
Upper floor Altán apartments on E block, W façade, S end	49	46	42	36

*Range due to variation in separation distances from access road.

Levels predicted in Table 11-18 may be assessed in the context of baseline $L_{Aeq\ T}$ levels. Given that baseline levels are dominated by traffic noise on surrounding roads, the assessment may be undertaken with reference to DMRB guidance set out in Table 11-8 above. Table 11-19 presents an assessment of impacts undertaken in this manner.

Table 11-19 Access road traffic noise impacts (dB).

Receptor	Period	Predicted $L_{Aeq\ 1\ h}$	Baseline $L_{Aeq\ T}$	Combined	Increase	Impact
Upper floor Altán apartments on SW block, S facade	Daytime peak	51-52	49	53-54	4-5	Slight to moderate
	Daytime offpeak	48-49	49	52	3	Not significant
	Evening	44-45	44	48	4	Slight
	Night-time	38-39	37	41	4	Slight
Upper floor Altán apartments on E block, W facade	Daytime peak	49	49	52	3	Not significant
	Daytime offpeak	46	49	51	2	Imperceptible
	Evening	42	44	46	2	Imperceptible
	Night-time	36	37	40	3	Not significant

In most cases, impacts will range from imperceptible to slight negative. During peak daytime hours, impacts at south facing Altán units will increase to slight to moderate negative. These impacts will arise due to the introduction of traffic movement noise to facades not currently exposed to local road traffic. Impacts may be mitigated through speed restriction measures.

11.4.9.3 Impacts Across The Wider Area Due To Increases In Road Traffic On The Surrounding Road Network As A Result Of The Proposed Development

Offsite receptors located close to existing roads are currently exposed to road traffic noise across the surrounding area. These receptors will be exposed to increased traffic volumes on the existing road network as a result of the Proposed Development. Of greatest relevance here are receptors in proximity to the WDR, which will be used by traffic accessing the Proposed Development. Table 11-20 presents traffic WDR data predicted by the traffic and transport assessment in relation to the design year 2041. Included in the table are $L_{Aeq\ 1\ h}$ increases associated with these increases. While traffic volumes throughout the daytime, evening and night-time will vary, the percentage increase in traffic volumes resulting from the Proposed Development is likely to be consistent across daytime, evening and night-time periods.

Table 11-20 Increase in road traffic volumes and noise levels (dB) due to the Proposed Development.

Junction	Period	2041 baseline incl. committed developments	2041 baseline + Proposed Development	Traffic increase	$L_{Aeq\ 1\ h}$ increase
WDR roundabout	AM peak	2064	2353	289	0.6 dB
	PM peak	2032	2573	541	1.0 dB

$L_{Aeq\ 1\ h}$ increases calculated in Table 11-20 may be compared to the scale of impacts set out in Table 11-8. On this basis, noise impacts at receptors in the vicinity of the WDR and R337 due to increases in road network traffic volumes will be imperceptible.

11.4.10 Cumulative Operational Phase Noise

As part of the assessment, the MKO project team compiled a list of permitted projects, and recently applied-for projects, across the surrounding area which may contribute to cumulative noise impacts. Apart from the proposed Knocknacarra Masterplan projects (proposed retail centre and proposed aquatic centre), no other developments were identified which will contribute to the cumulative soundscape in the vicinity of the Proposed Development site. Moreover, the Proposed Development will not give rise to noise emissions of significance, and will therefore not continue to cumulative noise impacts.

Notwithstanding the above, it is noted that traffic associated with the proposed retail centre and permitted aquatic centre will exit the Masterplan area on a proposed roadway running outside the southern boundary of the Altán site. The roadway will also serve the Proposed Development and other elements of the Proposed Project. Traffic from all elements of the Masterplan site will thus use this roadway.

Predicted $L_{Aeq\ T}$ values are calculated using the equation above, modified to include the increased traffic volumes, based on information taken from the traffic and transport assessment. The increased volumes applied here are taken from the noise impact assessments undertaken by MKO in relation to the retail and aquatic centre projects, as follows:

- Aquatic centre daytime movements will be 105 during peak hour periods, reducing to approximately 80 movements during off-peak hours, and 40 during the evening. There will be no night-time movements.
- Retail centre traffic movements will be 210 during the AM peak and 521 during the PM peak. For the purposes of this assessment, a daytime peak of 520 is assumed, with an off-peak daytime value of 250, and an evening value of 100. No night-time movements are assumed.

The levels are presented in Table 11-21. With respect to the assessment of impacts at Altán facades listed in Table 11-21, inward movements are not of relevance, as retail village centre and aquatic centre traffic will access the respective sites via a separate inward access road. Only outward movements are therefore of relevance here (i.e. 50 % of total movements). As before, it is assumed that 20% of vehicles will be electric.

Table 11-21 LAeq 15 min levels at receptors adjacent to access roads due to cars and light vans (dB).

Receptor	Period	Predicted $L_{Aeq\ 1\ h}$	Baseline $L_{Aeq\ T}$	Combined	Increase	Impact
Upper floor Altán apartments on SW block, S facade	Daytime peak	56-57	49	57-58	8-9	Significant
	Daytime offpeak	53-54	49	54-55	5-6	Moderate
	Evening	49-50	44	50-51	6-7	Moderate
	Night-time	39-40	37	41-42	4-5	Slight to moderate
Upper floor Altán apartments on E block, W facade	Daytime peak	54	49	55	6	Moderate
	Daytime offpeak	51	49	53	4	Slight
	Evening	47	44	49	5	Slight
	Night-time	37	37	40	3	Not significant

Impacts due to total traffic at Altán façades facing the proposed access road will be slight negative to significant negative during the daytime, and slight negative to moderate negative during the evening, due almost entirely to retail centre traffic movements. Night-time impacts will be as before. Impacts will be mitigated through a proposed 50 km/h speed restriction to be applied on the access roadway.

11.4.11 Inward Noise Impacts

11.4.11.1 ProPG Assessment Process

Inward impacts relate to noise immissions (i.e. received noise levels) received at a receptor due to emissions emitted by one or more nearby or distant sources. Emerging best practice provides for the design of new developments such that occupants are not subject to high immissions from existing and potential future offsite noise sources. Such sources usually consist of transport (road, rail and aircraft), and industry. Internal and external criteria considered appropriate to new residential developments are identified above. The criteria and assessment process are set out in the ProPG document.

Stage 1 of the ProPG process (site noise risk assessment) has been undertaken above. At the Proposed Development site, inward immissions currently arise from traffic on the WDR and the R337, as well as more distant roads. Although traffic noise is continuously audible on a 24/7 basis, the current noise risk is low. Moreover, road traffic noise does not give rise to night-time L_{AFmax} events above the 60 dB WHO/ProPG threshold.

Stage 2 of the ProPG process involves four elements:

- Stage 2 element 1: Demonstrating a good acoustic design process.
- Stage 2 element 2: Observing internal noise level guidelines.
- Stage 2 element 3: Undertaking an external amenity area noise assessment.
- Stage 2 element 4: Consideration of other relevant issues.

In this assessment, the four elements above are assessed through the following steps:

- Step 1: Comment on acoustic principles considered in the scheme design.
- Step 2: Construction of a noise model relating to the baseline situation.
- Step 3: Validation of the noise model with reference to measured data and strategic noise maps.
- Step 4: Addition of the Proposed Development to the model.
- Step 5: Provision for future traffic growth in the model, including development traffic.
- Step 6: Review of received noise levels.
- Step 7: Assessment of received noise levels – Internal.
- Step 8: Assessment of received noise levels – External.
- Step 9: Assessment of L_{AFmax} levels.
- Step 10: Assessment of cumulative impacts.
- Step 11: Consideration of other relevant issues.
- Step 12: Summary of mitigation requirements for inward noise.

11.4.11.2 Step 1: Acoustic Principles Considered In Scheme Design

At the outset, the Proposed Development layout incorporates several good acoustic design elements as follows:

- Buildings with more dense accommodation (apartment blocks) are located near the site centre, increasing the separation distance from the WDR and the R337.
- External amenity areas on apartment blocks (i.e. balconies) also benefit from the increased separation distance.

- The proposed layout, including paved zones, will promote low onsite traffic speeds, thus minimising onsite night-time L_{AFmax} events.
- The site will incorporate a number of landscaped features, including trees and green spaces, to soften the soundscape, both acoustically and psycho-acoustically.
- It is additionally noted that the site does not directly border the WDR or R337, and therefore is not exposed to immediately adjacent road traffic.

11.4.11.3 Step 2: Noise Model – Baseline Situation

To allow subsequent modelling of road traffic noise impacts at the Proposed Development site, a baseline model was built using DGMR iNoise Pro v2024. The following input parameters were applied:

- Model algorithm: *International Standard ISO 9613-2:1996 Acoustics – Attenuation of sound during Propagation Outdoors, Part 2: Engineering Method for the Prediction of Sound Pressure Levels Outdoors* (2024). Although less widely applied to road traffic modelling than the CRTN or CNOSSUS models, ISO 9613 is suitable here as validation through onsite noise data is possible.
- Modelled height: 1.5 m and 4 m to allow comparison with measured and mapped data.
- Traffic noise emissions: Light vehicle and HGV noise levels taken from the CNOSSUS-EU database.
- Traffic speed: 50 km/h.
- Traffic volumes: See below.

The soundscape at the Proposed Development site is chiefly influenced by traffic on the following roads:

- The WDR segment to the north of the site.
- The WDR segment to the northwest.
- The WDR segment to the northeast.
- Bóthar Stiofain.
- Gort na Bró.
- The R337 (Kingston Road) to the south.

All other roads are sufficiently distant that their contributions to the soundscape at the Proposed Development site are minimal, particularly due to the urban speed restrictions in effect which minimises tyre rolling noise. Traffic speeds on roadways in closer proximity to the site, such as residential estate roadways and the Knocknacarra national school access roadway, are particularly low, and tyre rolling noise does not arise. Vehicle engine noise on such roads cannot be practically modelled.

Traffic volumes on the WDR, Bóthar Stiofain and Gort na Bró are available from 2023 traffic count data included in Chapter 15 Material Assets. The data are presented in Table 11-22. Given that the objective here is to model traffic noise levels with respect to 2024 (to allow validation with measured noise data), no correction is applied to the 2023 traffic count data. Available count data relates solely to daytime hours (0700-1900 h). The count data are used to estimate evening and night-time levels, based on a typical daytime-evening-night-time distribution of 80-13-7 % seen at other urban sites.

Table 11-22 includes traffic count data taken from the R337 south of the site in 2019. A 10 % increase is applied to the traffic count volumes (in this case from 2019) to allow comparison with 2024 noise data. As before, evening and night-time volumes are unavailable, and these are again estimated in Table 11-22 using the same distribution pattern.

Table 11-22 Traffic volumes applied in the noise model.

Route	0700-1900		1900-2300		2300-0700	
	Cars+LGV	HGV	Cars+LGV	HGV	Cars+LGV	HGV
WDR N of site	8300	644	1349	105	726	56
WDR NW of site	12908	742	2098	121	1129	65

Route	0700-1900		1900-2300		2300-0700	
WDR NE of site	11158	894	1813	145	976	78
Bóthar Stiofan	8239	607	1339	99	721	53
Gort na Bró	1444	128	235	21	126	11
R337 S of site	11639	498	1891	81	1018	44

11.4.11.4 Step 3: Model Validation

Table 11-23 presents a comparison of modelled, measured and mapped L_{den} and L_{night} levels in relation to the five baseline noise stations, as well as a sample of six receptor points around the site. Discrepancies of 0-3 dB are evident in most cases, and this is considered acceptable. Minor discrepancies between modelled and measured levels may be explained by factors such as:

- Variations in modelled and real world road traffic speeds.
- The model focuses on major roads, whereas measured data were also affected by traffic throughout surrounding residential estates.
- Measured data were additionally influenced by extraneous sources such as aircraft, birdsong, barking, and distant construction noise.
- Modelling of road traffic is based on parameters associated with free flowing traffic. Two roundabouts on this segment of the WDR alter the free flow, and introduce an element of engine and exhaust noise which cannot be accurately modelled.

Minor discrepancies between modelled and mapped levels are most likely due to variations in assumptions applied, as well as differences in road traffic volumes modelled. With respect to the latter, it is noted that mapped levels are based on assumed data, whereas modelled data are based on traffic count data.

Discrepancies greater than 3 dB are evident in four cases:

- The modelled L_{night} level at N3 (43 dB) is 5 dB lower than measured. This is most likely linked to night-time intrusion from distant traffic not factored in the model, distant extraneous noise such as barking, and potentially higher speeds on the R337 at night than permitted.
- A difference of 5 dB is evident between modelled and measured L_{den} levels at N5. This may be a result of partial screening of WDR traffic noise provided by a local soil stockpile. Modelled levels are consistent with mapped levels however, and the model is therefore considered valid.
- At R11, a difference of 4 dB is evident between modelled and mapped L_{night} levels. This discrepancy may be a result of a boundary wall along the southern side of An Logán, which does not appear to be included in noise mapping. In contrast, the wall is included in the MKO noise model. The wall may influence noise levels received from WDR traffic to the southwest, and R337 traffic to the south.
- A similar 4 dB difference arises between modelled and mapped L_{den} levels at R59. The source of this discrepancy is not clear. It may be connected with assumed traffic speeds and volumes, as well as interpretation of mapping contours.

Table 11-23 Comparison on modelled, measured and mapped levels (dB).

Position	Height	Modelled		Measured		Mapped	
		L_{den}	L_{night}	L_{den}	L_{night}	L_{den}	L_{night}
N1	1.5 m	55	45	52	44	-	-
N1	4 m	55	45	-	-	58	45
N2	1.5 m	53	44	53	44	-	-
N2	4 m	54	45	-	-	<55	<45
N3	1.5 m	52	43	54	48	-	-
N3	4 m	53	44	-	-	<55	<45
N4	1.5 m	52	42	52	44	-	-

Position	Height	Modelled		Measured		Mapped	
N4	4 m	53	44	-	-	<55	<45
N5	1.5 m	61	51	56	49	-	-
N5	4 m	60	51	-	-	63	50
R04	4 m	73	64	-	-	75	64
R10	4 m	56	46	-	-	59	47
R11	4 m	57	46	-	-	60	50
R26	4 m	53	43	-	-	55	<45
R40	4 m	54	45			55	45
R59	4 m	53	44	-	-	57	47

Overall, the noise model is reasonably consistent with measured and mapped levels. The model is therefore considered valid for the purposes of this assessment. The model output (L_{Aeq16h}, L_{den} and L_{night} contours at 4 m) is shown in Figures 11-13 to 11-15. The contours are considered representative of 2024 traffic conditions.

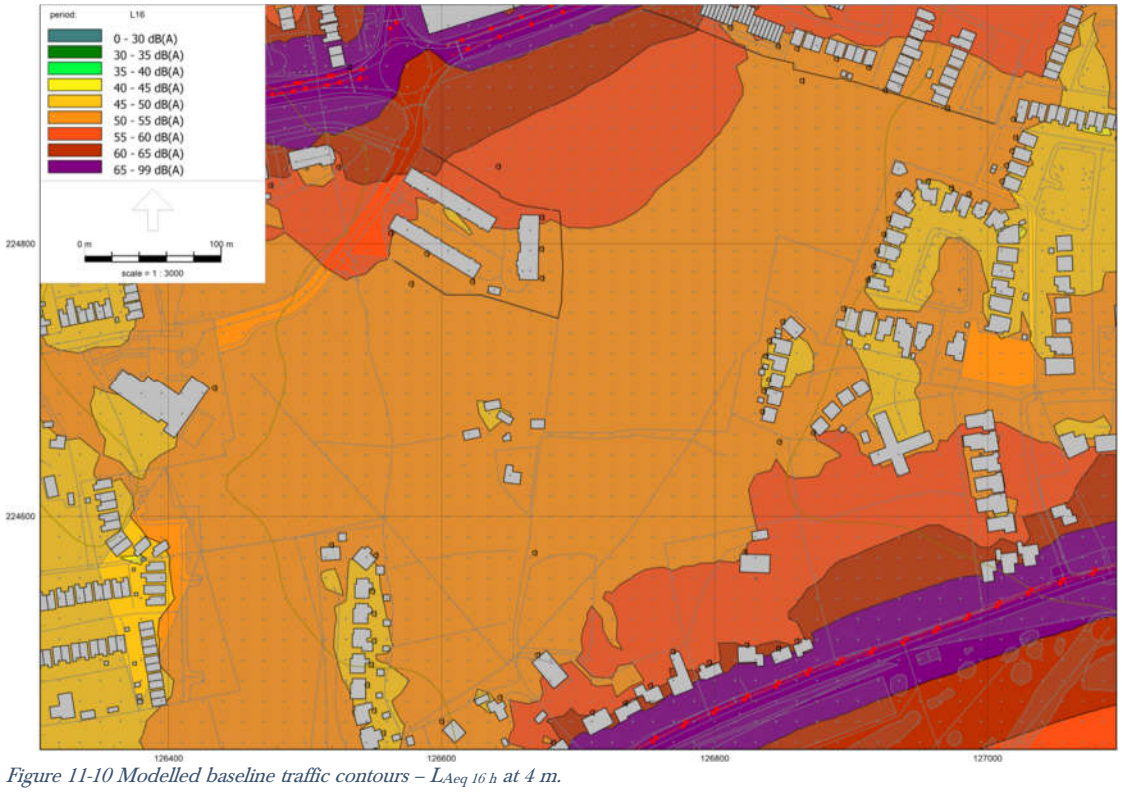

Figure 11-10 Modelled baseline traffic contours – $L_{Aeq\ 16\ h}$ at 4 m.

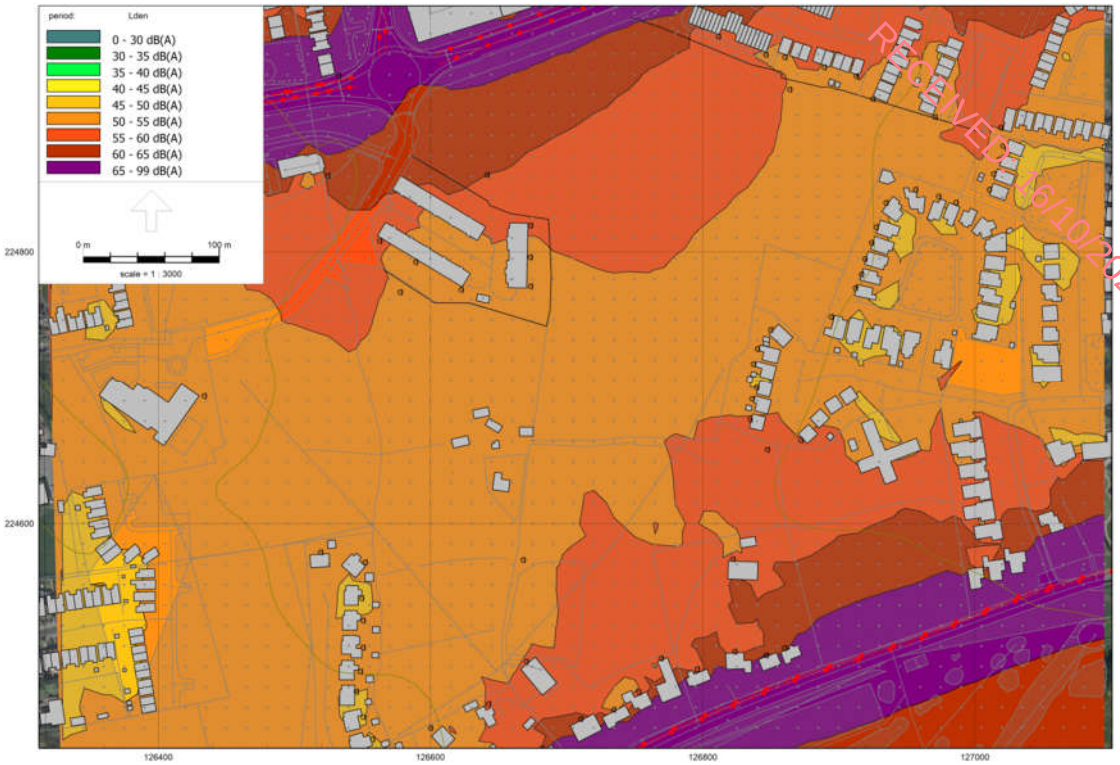

Figure 11-11 Modelled baseline traffic contours – L_{den} at 4 m.

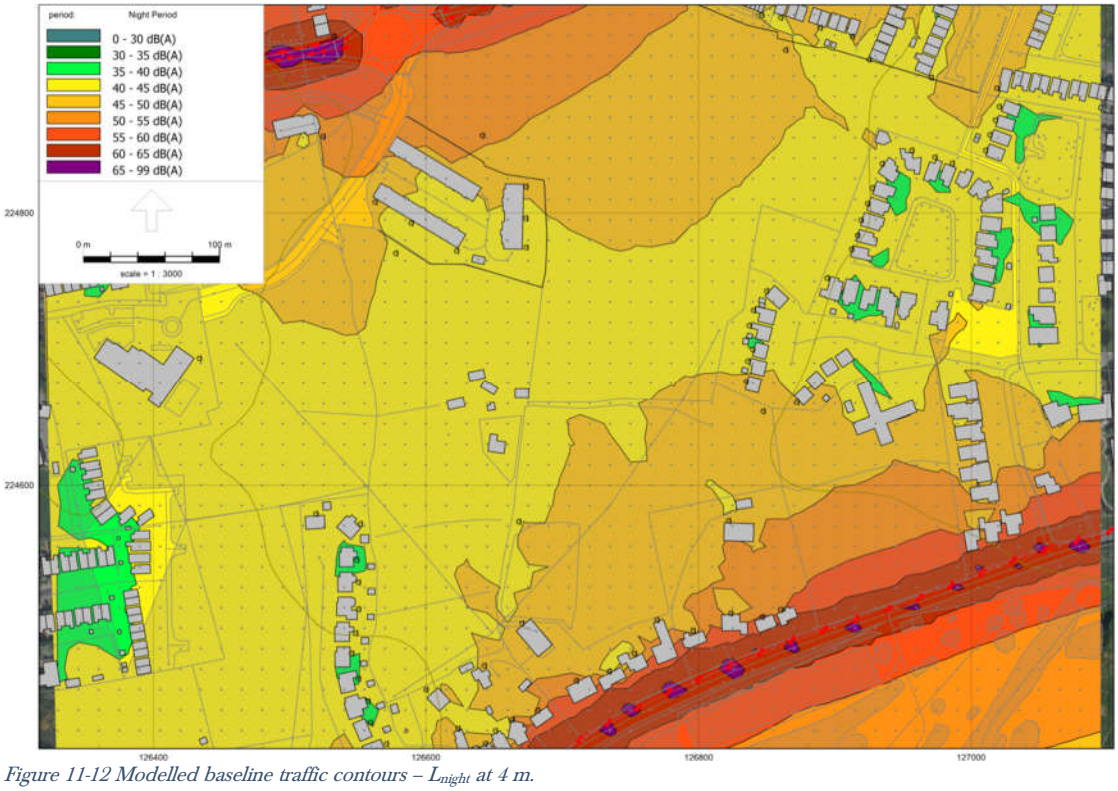

Figure 11-12 Modelled baseline traffic contours – L_{night} at 4 m.

11.4.11.5 Step 4: Addition Of Proposed Development

The Proposed Development was added to the model. Proposed house units will consist of two stories, duplex units will consist of three stories, and both apartment blocks will extend to five stories over basement. The proposed layout is shown in Figures 11-16 and 11-17.

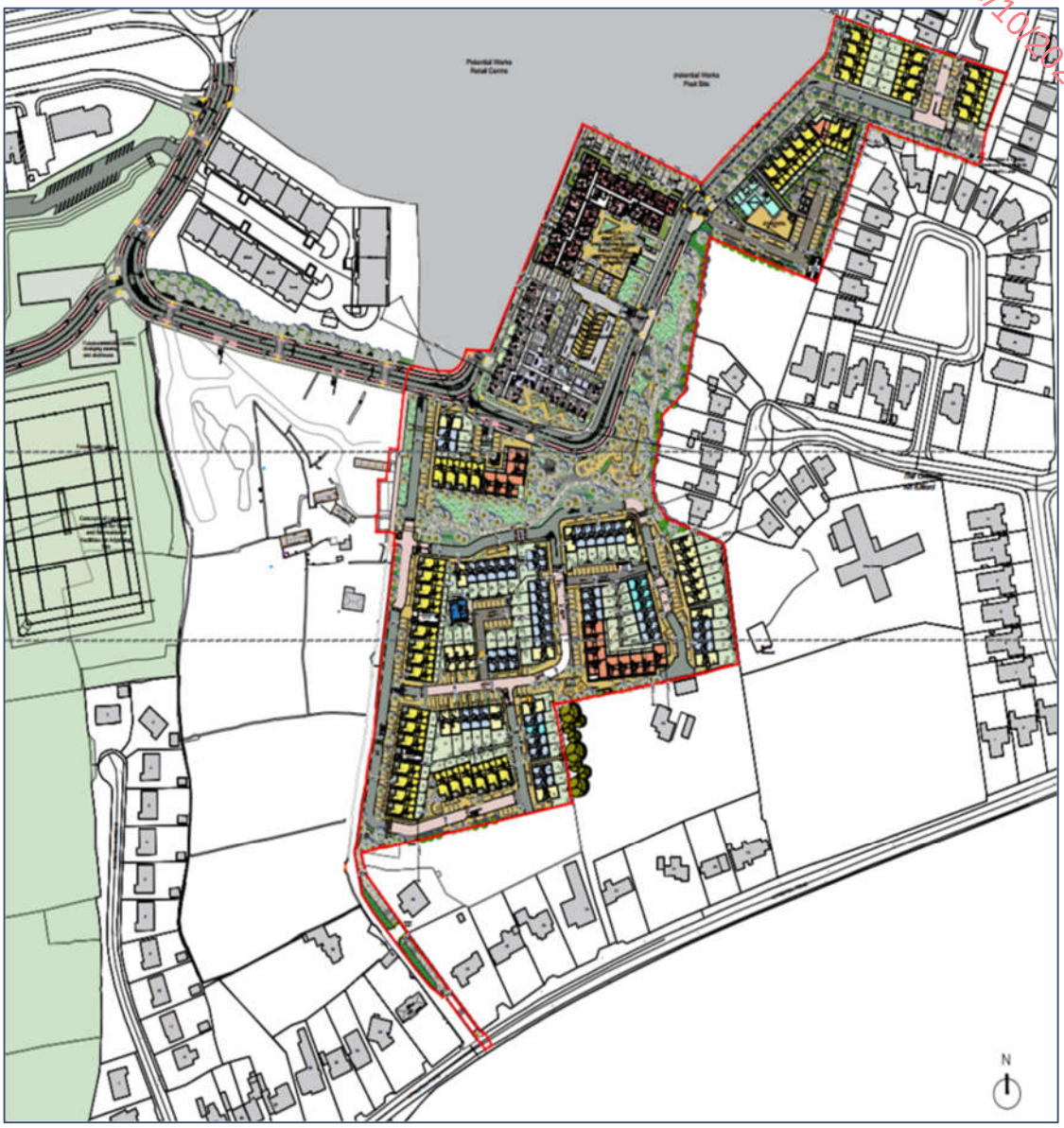

Figure 11-13 Proposed Development layout.

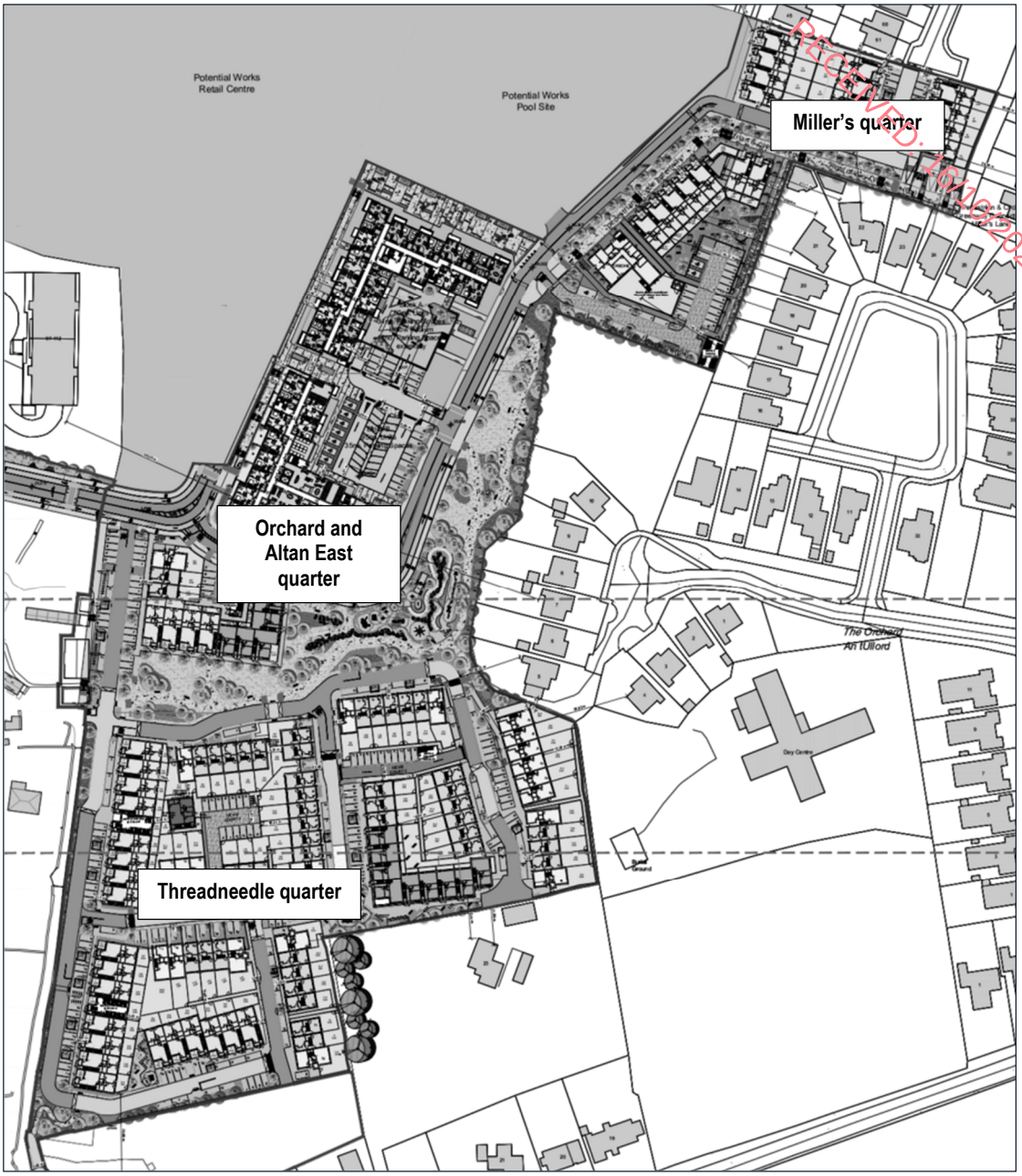

Figure 11-14 Proposed Development zones.

11.4.11.6 Step 5: Future Traffic Growth

Road network traffic noise volumes applied in the baseline model require adjustment to reflect expected growth in traffic volumes in future years. For this assessment, a design year of 2041 is applied. Given that 2041 road traffic volumes are expected to be higher than opening year volumes, modelling of the 2041 design year situation provides for a considerably more conservative assessment.

The following 2041 traffic increases are applied, taken from the traffic and transport assessment report:

- Increases arising due to the addition of Proposed Development traffic on the surrounding network.
- Increases due to the construction of other elements of the Proposed Project.
- Increases due to the proposed Knocknacarra Masterplan area retail centre, currently being assessed by the local authority.
- Increases due to the permitted aquatic centre.

- Increases due to future growth in road traffic on a wider scale.

Decreases forecast as a result of completion of the future Galway City ring road, which is expected to reduce traffic volumes on the local road network, are not factored in this assessment in order to maintain a conservative scenario.

Using predicted traffic volumes included in the traffic and transport assessment, growth factors were determined. Table 11-24 presents the growth factors determined. Calculated mean growth values were then applied to the baseline traffic data presented in Table 11-22. The revised 2041 values are given in Table 11-25.

Table 11-24 2041 traffic growth factors.

Route	AM peak	PM peak	Mean
WDR N of site	1.57	1.77	1.67
WDR NW of site	1.46	1.52	1.49
WDR NE of site	1.44	1.61	1.52
Bóthar Stiofan	1.46	1.47	1.47
Gort na Bró	1.89	2.67	2.28
R337 S of site	1.11	1.10	1.11

Table 11-25 2041 traffic volumes applied in the noise model.

Route	0700-1900		1900-2300		2300-0700	
	Cars+LGV	HGV	Cars+LGV	HGV	Cars+LGV	HGV
WDR N of site	13861	1075	2253	175	1212	94
WDR NW of site	19233	1106	3126	180	1682	97
WDR NE of site	16960	1359	2756	220	1484	119
Bóthar Stiofan	12111	892	1968	146	1060	78
Gort na Bró	3292	292	536	48	287	25
R337 S of site	12919	553	2099	90	1130	49

11.4.11.7 Step 6: Received Noise Levels

The baseline noise model was revised to include the 2041 traffic data presented above. The model was run at four heights:

- 2 m to represent ground floors and external areas.
- 4 m to represent first floors.
- 7 m to represent the top floor of duplex units, and the second floor of both apartment blocks.
- 10 m to represent the upper floors of the apartment blocks.

The model output at 4 m height is shown in Figures 11-18 to 11-20. Predicted noise levels are summarised in Table 11-26.

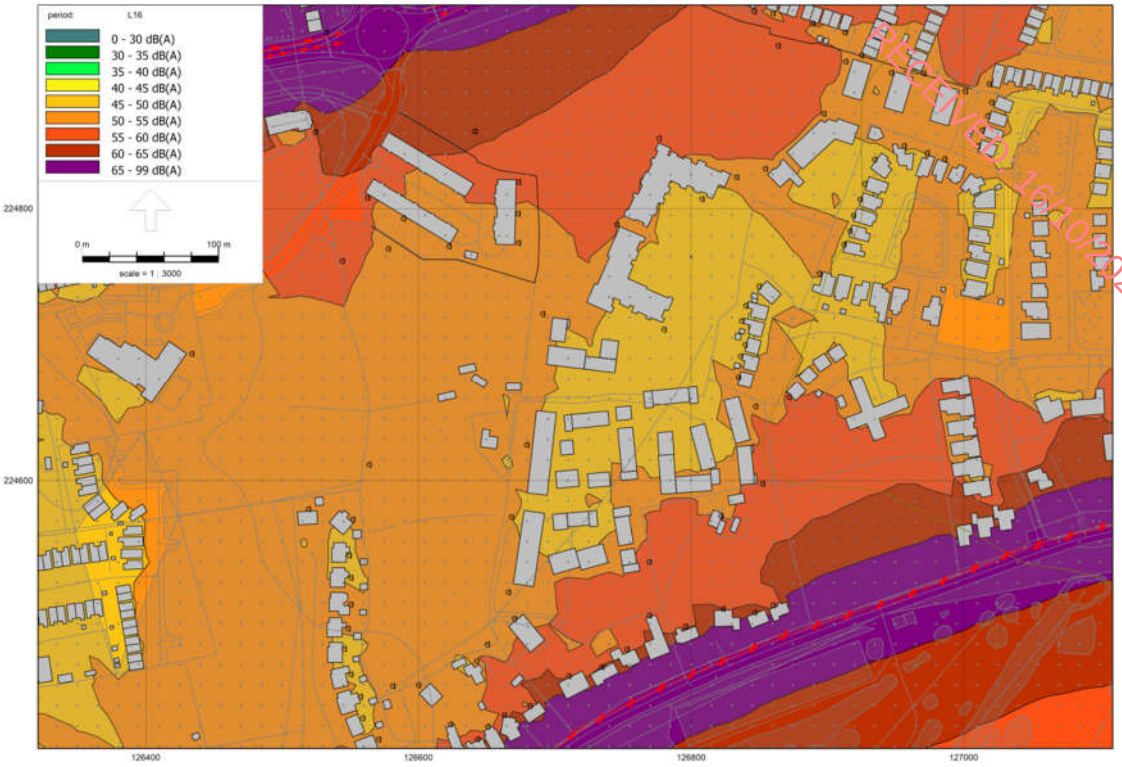

Figure 11-15 Modelled 2041 traffic contours – $L_{Aeq\ 16\ h}$ at 4 m.

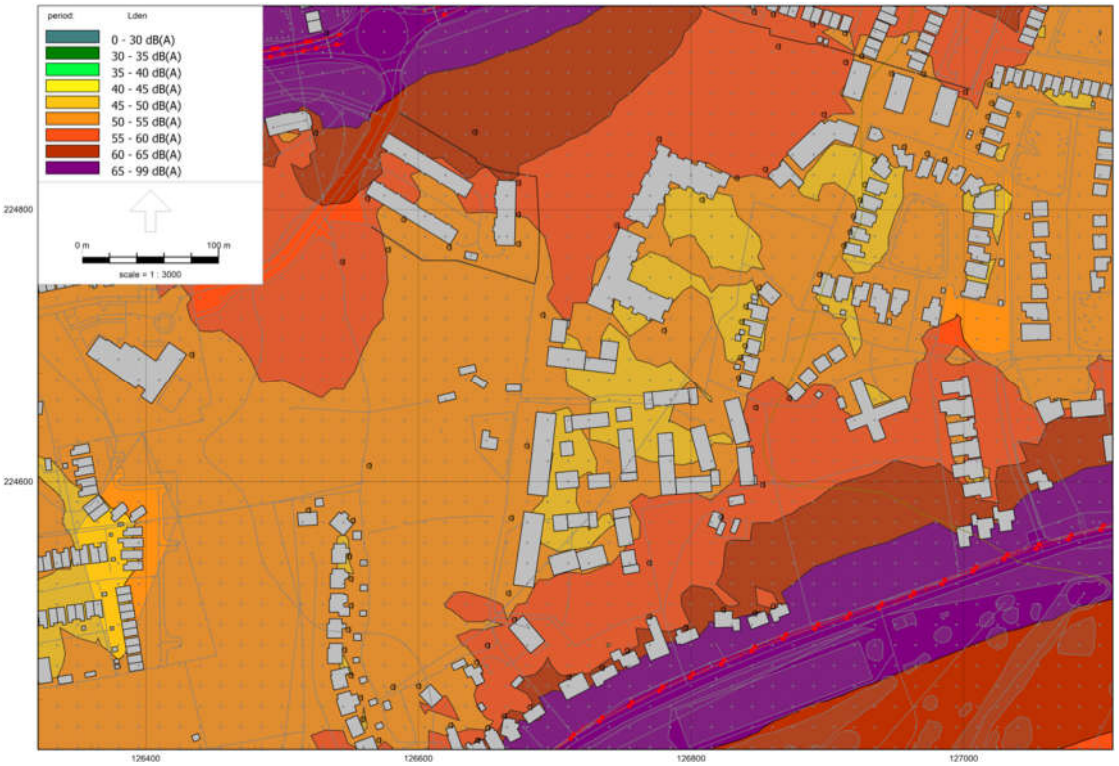

Figure 11-16 Modelled 2014 traffic contours – L_{den} at 4 m.

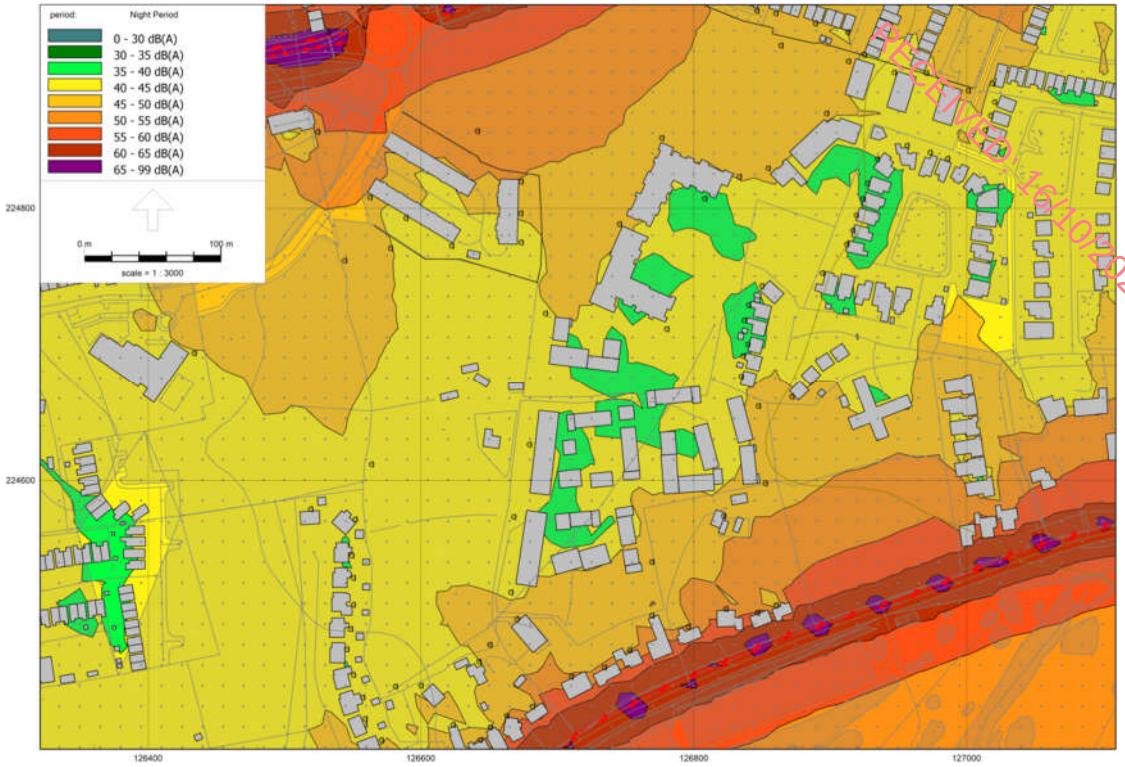

Figure 11-17 Modelled 2014 traffic contours – L_{night} at 4 m.

Table 11-26 Predicted external 2041 noise levels summary at 4 m height.

Onsite area	$L_{Aeq\ 16\ h}$	L_{den}	L_{night}
Threadneedle quarter	Levels will reach 55-57 dB across a number of units along the S side, and will fall gradually northwards to below 50 dB.	L_{den} levels will reach 58 dB at the SE corner of this area. Levels along the S side of the quarter will be 53-56 dB.	Levels along the S side of this zone will nudge 46-47 dB, rising to 48 dB at the SE corner.
Orchard and Altan East quarter	Levels will reach a maximum of 58 dB at the NW corner, falling to 53 dB along sides facing N or W. Facades facing S and E will receive considerably lower levels.	The highest onsite L_{den} levels will be received at the NW corner of this quarter, where the level will reach 59 dB. Levels will be markedly lower on the S and E sides of the apartment blocks.	L_{night} levels will reach a site maximum of 49 dB at the NW corner, and decrease to 45 dB along the NW facades. As before, levels on S and E facades will be significantly lower.
Miller's quarter	Levels here will be 46-55 dB.	Levels will be generally 48-55 dB across most of this quarter, rising to 57 dB at NW façades of duplex units.	Levels will be less than 45 dB across most of this zone, but will rise to 45-47 dB along the NW façades of duplex units.

11.4.11.8 Step 7: Assessment Of Received Noise Levels – Internal

Based on the overview of received noise levels presented in Table 11-26, and with reference to the ProPG scheme indicated in Figure 11-12 above, the Proposed Development site will continue to achieve low noise risk status in 2041.

Tables 11-27 and 11-28 present an assessment of compliance with the lower daytime 35 dB criterion and night-time 30 dB criterion recommended by ProPG and BS8233:2014 in relation to internal noise levels in bedrooms. Internal levels are assessed with reference to a windows open scenario, based on the conventionally accepted 15 dB noise reduction provided by a partially open window, drawn from guidance set out in in *NANR116: Open/Closed Window Research – Sound Insulation through*

Ventilated Domestic Windows (prepared by the Napier University Building Performance Centre for DEFRA, 2007).

Table 11-27 Internal noise level assessment – $L_{Aeq\ 16\ h}$ (35 dB daytime criterion in bedrooms), windows open scenario.

Onsite area	2 m	4 m	7 m	10 m	Assessment
Threadneedle quarter	38-42 dB along S side, highest at SE corner. <35 dB at other units.	40-42 dB along S side, highest at SE corner. 35-36 dB down W side. <35 dB at other units.	40-43 dB at S façade of duplex units.	-	Criterion exceeded by up to 8 dB at upper floors of some duplex units.
Orchard and Altan East quarter	43 dB at NW units, reducing to 39 dB at NE corner and 38 dB at SW corner. <35 dB at other facades.	Similar levels to 2 m.	Similar levels to 2 m.	Similar levels to 2 m.	Criterion exceeded by up to 8 dB at some units.
Miller's quarter	Reaching 40 dB some units, particularly facades facing NW. <35 dB at other units.	Similar levels to 2 m, although 2-3 dB higher at NE units.	Similar levels to 4 m	-	Criterion exceeded by up to 8 dB at some units.

Table 11-28 Internal noise level assessment – L_{night} (30 dB night-time criterion in bedrooms), windows open scenario.

Onsite area	2 m	4 m	7 m	10 m	Assessment
Threadneedle quarter	Nudging 31 dB along S facades, and <30 dB at other units	Nudging 31 dB along S facades, and <30 dB at other units.	Nudging 32 dB along S facades, and <30 dB at other units.	-	Criterion exceeded by up to 2 dB at upper floors of some duplex units.
Orchard and Altan East quarter	31-34 dB along NW facades, and 30-34 dB at NE façade. <30 dB at other units.	Similar levels to 2 m.	Similar levels to 2 m.	Similar levels to 2 m.	Criterion exceeded by up to 4 dB at some units.
Miller's quarter	30-31 dB at NW facades. <30 dB at other units.	31-32 dB at NW facades. <30 dB at other units.	31-33 dB at NW facades. <30 dB at other units.	–	Criterion exceeded by up to 3 dB at some units.

From Table 11-27, it is evident that the 35 dB lower $L_{Aeq\ 16\ h}$ criterion will be achieved in most bedrooms in the open window scenario. However, the criterion will be exceeded at the following units:

- At approximately 40 units along the southern side of the Threadneedle quarter, the criterion will be exceeded by up to 8 dB.
- At 68 apartments in the Orchard quarter, the criterion will be exceeded by up to 8 dB.
- At approximately 20 units at the Miller quarter, the criterion will be exceeded by up to 8 dB.

A similar scenario is evident with respect to the 30 dB night-time criterion, with the same units again affected. However, in this case, exceedances will be lower, being generally 2-4 dB in the affected bedrooms. This again applies to the open window scenario.

It follows that, where residents chose to open windows to achieve thermal comfort, internal noise criteria in some bedrooms will exceed the 35 dB daytime-evening and 30 dB night-time criteria. Daytime-exceedance will reach 8 dB in some units, while night-time exceedances will reach 4 dB.

The highest $L_{Aeq\ 16\ h}$ level received externally at any façade will be 58 dB, while the highest L_{night} level will be 49 dB. In a closed windows scenario, the transmission loss required to meet the 35 dB $L_{Aeq\ 16\ h}$ and 30 dB L_{night} criteria will be 23 and 19 dB respectively. These values will be comfortably achieved with standard thermal glazing, and enhanced glazing will not be required.

11.4.11.9 Step 8: Assessment Of Received Noise Levels – External

External $L_{Aeq\ 16\ h}$ levels at amenity areas, which include apartment balconies, duplex balconies, duplex terraces and private rear gardens, will be less than 50 dB across most of the site. The 50 dB threshold will be exceeded in several areas as follows:

- At the Threadneedle quarter, $L_{Aeq\ 16\ h}$ levels will reach 57 dB in approximately seven rear gardens. Levels will be 51-55 dB in a number of other gardens.
- At the Orchard quarter, balcony $L_{Aeq\ 16\ h}$ levels at the northwest façade of block A will reach 58 dB, arising at six balconies on each floor. On the northeast façade, levels will be 54-56 dB. Levels quoted here are incident levels. Façade levels, which include additional noise due to reflections from balcony facades, will be 2-3 dB higher.
- At the Miller quarter, rear garden $L_{Aeq\ 16\ h}$ levels will reach a maximum of 52 dB.

ProPG and BS 8233:2014 recommend that external $L_{Aeq\ 16\ h}$ levels should preferably not exceed 50-55 dB, although both documents state that this may not always be achievable, particularly in urban areas. Where the 55 dB criterion is exceeded, ProPG notes that this may be offset if residents have access to:

- A quiet façade: All units in the Threadneedle and Miller quarters will have access to quiet facades.
- A relatively quiet nearby external space for use by the residents: All residents, including those at the Orchard apartments, will have access to onsite amenity areas.

In this context, external noise levels will be satisfactory.

11.4.11.10 Step 9: Assessment of L_{AFmax} Levels

Noise data measured onsite indicate that L_{AFmax} levels due to offsite traffic do not exceed the 60 dB threshold identified by ProPG. This is expected to continue in the future, and thus offsite traffic noise levels will be satisfactory in the context of the 60 dB L_{AFmax} criterion.

The 60 dB criterion is, however, likely to be exceeded at facades overlooking onsite roadways. ProPG notes that the criterion becomes relevant where more than 10 such movements occur during the night-time. This may arise at facades overlooking the main access roadway.

While other units around the site which overlook roadways are likely to experience L_{AFmax} levels above 60 dB when onsite vehicles pass, these roadways are unlikely to see sufficient traffic volumes to exceed the threshold of 10 movements during night-time hours, as all such roadways will serve a small number of onsite units. Many of these roadways will be cul de sacs. In contrast, the main access roadway is likely to see more than 10 movements per night.

At facades directly overlooking the main access roadway, L_{AFmax} levels may reach approximately 70 dB during a typical vehicle pass, based on experience. These facades are therefore likely to receive more than 10 L_{AFmax} events above 60 dB during night-time hours. However, this will be offset by the following:

- Onsite traffic speeds will be controlled through signage and urban design methods such as constricted passageway width and varied surfaces. The 70 dB level is a worst case scenario, unlikely to arise with any degree of regularity during night-time hours. Thus the 10-movement 60 dB threshold may not be exceeded regularly.
- Onsite traffic affecting the identified facades during night-time hours will be Development-related, and will not include any offsite unrelated traffic.
- Based on a 15 dB attenuation through a partially open window, internal bedroom L_{AFmax} levels may reach 55 dB. Residents in bedrooms overlooking onsite roadways may wish to close windows to further attenuate this noise.
- With windows closed, internal L_{AFmax} levels will not exceed 45 dB, and will therefore be lower than the 45 dB criterion recommended by the WHO with respect to L_{AFmax} levels in bedrooms.
- Importantly, L_{AFmax} levels due to onsite vehicle movements will fall in future years due to the increasing proportion of electric vehicles in the national car fleet. Due to the low traffic speeds on site roadways, vehicle noise will consist of engine and transmission noise rather than tyre rolling noise. Increased electric vehicle activity will eliminate engine and transmission noise, resulting in a considerable fall in L_{AFmax} levels at units along onsite roadways. In due course, it is expected that the number of L_{AFmax} events above 60 dB will reduce towards zero.

It is therefore concluded that L_{AFmax} levels arising at Proposed Development facades will be satisfactory, and no impacts of significance will arise.

11.4.11.11 Step 10: Cumulative Impacts

Noise emissions from the proposed Knocknacarra Masterplan retail centre may impact the Proposed Development units on the western facades of the Orchard apartment blocks, while emissions from the permitted aquatic centre may impact north facing apartments on block A as well as northwest facing units at Miller's quarter. MKO carried out the noise impact assessments in relation to both projects. This assessment therefore benefits from ready access to predictive noise modelling undertaken for the projects.

At the proposed retail centre, noise emissions will arise from the following sources:

- 19 air handling units in roof spaces of two buildings.
- 12 air handling units on the roof of the main retail building.
- 8 air handling units and 3 refrigeration units in a plant compound at the rear of the main retail building.
- Deliveries – The main retail building will require two deliveries each day by HGV.
- Carpark activity – Noise emissions here will be negligible in the context of traffic noise across the surrounding area. Traffic will be confined to daytime and evening hours, and will thus not influence night-time L_{AFmax} events.

At the permitted aquatic centre, noise emissions will arise from the following sources:

- Louvred vents on the north façade of the building, serving air handling units.
- Three heat pumps adjacent to the southwest corner of the building.
- Traffic movements will again be negligible in the context of surrounding traffic volumes, and will not give rise to night-time L_{AFmax} events.

Noise sources associated with the proposed retail and permitted aquatic centres were added to the 2041 noise model in order to predict inward noise levels at the Proposed Development arising from offsite traffic and the sources listed above. The model output is shown in Figure 11-21 in relation to $L_{Aeq\ 16\ h}$ levels – this parameter is the chief parameter of relevance given that the retail centre and aquatic centre are not expected to give rise to night-time noise. Predicted noise levels are assessed in Table 11-29.

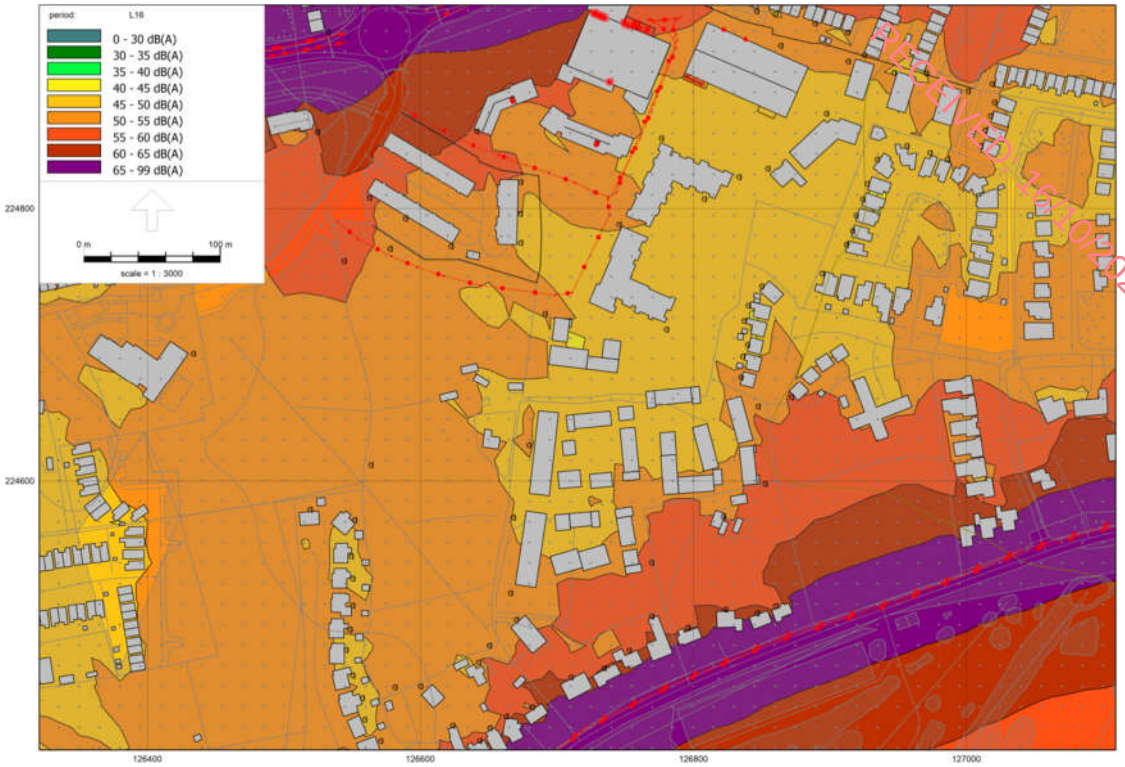

Figure 11-18 Modelled 2041 traffic noise, retail centre noise and aquatic centre noise – $L_{Aeq\ 16\,h}$ at 4 m.

Table 11-29 Predicted cumulative external 2041 $L_{Aeq\ 16\,h}$ level assessment.

Onsite area	Offsite traffic alone	Offsite traffic + retail centre sources + aquatic centre sources
Threadneedle quarter	Levels will reach 55-57 dB across a number of units along the S side, and will fall gradually northwards to below 50 dB.	Levels at the NW corner and along the N side will reduce by up 1 dB.
Orchard and Altan East quarter	Levels will reach a maximum of 58 dB at the NW corner, falling to 53 dB along sides facing N or W. Facades facing S and E will receive considerably lower levels.	Levels along the W and N sides will reduce by up to 7 dB, and by up to 9 dB at the NW corner.
Miller's quarter	Levels here will be 46-55 dB.	Levels will reduce by up to 6 dB at the NW corner.

The model indicates that total noise levels will not give rise to increased noise impacts at the Proposed Development. Indeed modelling indicates that noise levels will reduce due to partial screening of WDR traffic noise provided by the proposed retail and permitted aquatic centre buildings. In certain cases, these reductions will be considerable. It follows that the proposed retail centre and permitted aquatic centre will not give rise to increased inward impacts at the Proposed Development, and therefore the conclusions drawn above in relation to inward internal and inward external noise impacts remain unchanged.

11.4.11.12 Step 12: Consideration Of Other Relevant Issues

Other issues assessed, as recommended by ProPG, include the following:

- Compliance with relevant national and local policy: The most relevant policies are those set out in the Galway City Council noise action plan 2024-2028 as discussed above. The noise action plan refers to the 53 dB L_{den} and 45 dB L_{night} criteria recommended by the WHO. Predictive noise modelling indicates that the 53 dB L_{den} criterion will not be exceeded across most of the Proposed Development site. Around the Proposed Development perimeter, levels will exceed the criterion by several

decibels, with the highest (59 dB) arising at the northwest corner of Orchard block A. Compliance with the 45 dB L_{night} criterion will be greater, although again marginal exceedances will occur around the perimeter, with the highest level (49 dB) again occurring at block A. Future versions of the noise action plan may consider mitigation measures to be installed in relation to WDR traffic in order to reduce traffic noise levels across the Knocknacarra area. It should be noted that existing dwellings surrounding the Proposed Development site are exposed to considerably higher noise levels than the Proposed Development site itself.

- Magnitude and extent of compliance with ProPG: Internal $L_{Aeq\ 16\ h}$ and L_{night} levels, in the windows closed scenario across the entire Proposed Development, will meet identified criteria without specific acoustic mitigation measures, and standard thermal glazing will be sufficient to achieve compliance with these criteria.
- Likely occupants of the development: The Proposed Development is expected to be occupied by a typical sample of the population, and is unlikely to see a predominance of one particularly sensitive group.
- Acoustic design versus unintended negative consequences: No negative consequences have been identified.
- Acoustic design versus wider planning objectives: No issues have been identified.

One additional item requires consideration here: noise levels at the proposed onsite creche. Modelling indicates that incident L_{day} levels at the creche facades will be 48-55 dB, varying with façade orientation. It may be assumed that $L_{Aeq\ 30\ min}$ levels will be reasonably similar. Based on these noise levels, standard construction materials including thermal glazing will reduce internal $L_{Aeq\ 30\ min}$ levels in all creche rooms below the 35 dB criterion recommended by TGD-021-5.

11.4.11.13 Step 13: Mitigation Requirements For Inward Noise

In rooms on facades facing the Proposed Development site perimeter, internal $L_{Aeq\ 16\ h}$ and L_{night} levels will marginally exceed recommended criteria in the windows open scenario. In rooms overlooking the main onsite roadways, L_{AFmax} levels may also exceed the 10x60 dB threshold in the windows open scenario, although this is expected to reduce considerably due to future increased electric vehicle numbers. These levels will be readily attenuated by closing of windows. Despite exceeding criteria, residents at the Proposed Development may choose to open doors and windows to provide ventilation.

In the windows closed scenario, internal noise levels will comply with relevant criteria, assuming standard thermal glazing, and no additional mitigation is required.

11.5 Mitigation

11.5.1 Construction Phase

In most cases, construction phase noise impacts will be imperceptible to slight negative, and temporary. During certain activities, impacts will increase to temporary moderate negative at a small number of receptors in close proximity to works areas. Construction traffic and vibration impacts will be imperceptible and short term.

During ground clearance works, impacts will increase to moderate at receptors immediately adjacent to the southwest corner, and potentially to significant. These impacts will be temporary, likely to last locally 1-2 days at most. This impact may be mitigated through prior notification to residents at these receptors in advance of these works.

It is proposed to apply the following general measures throughout the construction phase:

- Construction operations will in general be confined to the periods Monday-Friday 0800-1800 h and Saturday 0900-1300 h.
- Hooting will be prohibited onsite. Drivers of plant and vehicles will be instructed to avoiding hooting 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 will be prohibited.
- Machinery not in active use will be shut down.
- A site representative will be appointed as a liaison officer with the local community.
- 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.
- Advance notification will be given to residents immediately outside the site boundary when works are proposed within 50 m of their dwellings.

While potentially significant cumulative impacts may arise at An Logán receptors during ground clearance works, these impacts will be entirely attributable to works at the proposed retail centre and permitted aquatic centre, and works at the Proposed Development site will give rise to minimal contribution to these impacts. Nonetheless, in order to minimise potential cumulative noise impacts at these receptors, it is proposed that heavy machinery (tracked excavators, dump trucks, etc.) will not be used at the northern boundary of the Proposed Development site while heavy machinery is in use at the northern boundaries of the proposed retail centre site or the permitted aquatic centre site.

11.5.2 Operational Phase

No operational phase noise impacts will arise, and mitigation is not specifically warranted. No enhanced acoustic elements are required in relation to inward noise, and standard thermal glazing will provide sufficient protection for residents.

11.6 Residual Effects

11.6.1 Residual Impacts

Residual construction impacts post-mitigation are assessed in Table 11-30. Residual operational impacts are assessed in Table 11-31.

Table 11-30 Residual construction impacts post-mitigation.

Source	Receptors	Factor	Impact
Onsite construction noise	Receptors immediately adjacent to Proposed Development perimeter	Levels	Levels may exceed the 65 dB BS 5228-1:2009 criterion at the closest receptors when works are undertaken close to the boundary, and possibly exceed the 70 dB NRA criterion. Any such exceedances will be limited in duration (likely to be several hours or days at most for any particular event), thus reducing impacts.
		Quality	Negative
		Significance	Slight to moderate
		Duration	Brief or temporary in relation to events near the boundary

Source	Receptors	Factor	Impact
Onsite construction noise	All other receptors	Levels	Levels will be lower than the 65 and 70 dB criteria throughout the construction phase, and at more distant receptors will be inaudible
		Quality	Neutral to negative
		Significance	Imperceptible to not significant, depending on construction phase
		Duration	Temporary to short term
Onsite construction vibration	All receptors	Levels	Groundborne vibration will be imperceptible offsite
		Quality	Neutral
		Significance	Imperceptible
		Duration	Short term
Offsite construction traffic noise	All receptors	Levels	Levels will be considerably lower than the 65 and 70 dB criteria, and no perceptible traffic noise increases will arise
		Quality	Neutral
		Significance	Imperceptible
		Duration	Short term

Table 11-31 Residual operational impacts post-mitigation

Source	Receptors	Factor	Impact
Onsite community noise	All offsite receptors	Levels	Noise levels will be similar to those arising at surrounding residential areas, and will be consistent with the local soundscape
		Quality	Neutral
		Significance	Imperceptible
		Duration	Long term
Onsite traffic	Altán receptors overlooking access roadway	Levels	$L_{Aeq\ T}$ increases of 2-5 dB are expected
		Quality	Neutral to negative
		Significance	Imperceptible to moderate
		Duration	Permanent
Onsite traffic	Offsite receptors removed from access roadway	Levels	The Proposed Development will not give rise to a perceptible increase in traffic noise in the soundscape
		Quality	Neutral
		Significance	Imperceptible
		Duration	Long term
Offsite traffic	All offsite receptors	Levels	The Proposed Development will not give rise to a perceptible increase in traffic noise
		Quality	Neutral
		Significance	Imperceptible
		Duration	Long term

11.6.2 Inward Impacts

Inward noise is not typically assessed in the context of the EPA assessment scale set out in Table 11-1 at the start of this chapter. The inward impact assessment indicates that:

- Internal noise levels in the windows open scenario will exceed relevant criteria at a number of peripheral units due to offsite road traffic. Residents may choose to close windows to eliminate this noise.
- Internal noise levels in the closed windows scenario will comply with relevant criteria.
- Night-time L_{AFmax} events due to vehicle passes on the main onsite access roadway will exceed the ProPG threshold at some units directly overlooking these roadways, with the windows open scenario. Compliance will be achieved with windows closed, and thus residents may choose to close windows. In due course, compliance in the open window scenario is likely to be achieved due to the increasing proportion of electric vehicles.
- External levels will comply with relevant criteria at most receptors. The 55 dB upper threshold will be marginally exceeded at a small number of peripheral units. However, residents will have access to quiet facades and/or quiet onsite areas, and this is an accepted mitigation measure.

11.6.3 Cumulative Impacts

Cumulative construction noise impacts due to simultaneous construction at the Proposed Development, the proposed retail centre and the permitted aquatic centre will give rise to impacts outside the northern boundary of the Masterplan site. To minimise these impacts, it is proposed that heavy machinery (tracked excavators, dump trucks, etc.) will not be used at the northern boundary of the Proposed Development site while heavy machinery is in use at the northern boundaries of the proposed retail centre site or the permitted aquatic centre site. This will result in a reduction in impacts at receptors outside the boundary. On this basis, impacts at these receptors will be slight to moderate negative, and temporary.

With respect to cumulative traffic volumes attributable to combined Proposed Development traffic, traffic from other elements of the Proposed Project, retail centre traffic and aquatic centre traffic, cumulative noise impacts will arise at Altán apartments overlooking the Masterplan area access roadway. Impacts will range from slight negative to significant negative, based on the current absence of Masterplan road traffic noise affecting these receptors. These impacts will be confined chiefly to daytime hours, with some evening impacts. Night-time cumulative impacts are not expected. Where impacts will arise, they will be almost entirely due to retail centre traffic, with minimal contribution from the Proposed Development.

11.6.4 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.
- With respect to short term impulsive sources, the WHO recommends a night-time L_{Amax} limit of 60 dB outside bedroom windows during night-time hours.

Impacts assessed above may be reviewed in light of the WHO recommendations, as follows:

- Following completion and occupation of the completed development, daytime and night-time WHO criteria are not expected to be exceeded at any offsite receptor as a result of onsite emissions.
- Traffic noise arising from public roads in the vicinity will increase slightly as a result of the Proposed Development. However, increases will be imperceptible.
- With respect to inward impacts, external noise levels will be generally satisfactory in the context of WHO guidance. Internal levels will also be generally satisfactory, although may require closing of windows in certain rooms at some units to fully achieve compliance during night-time hours.

On this basis, it is considered that there will be no negative noise impact on the local population or on human health.

11.6.5 Overall Residual Effects

Overall residual effects associated with the Proposed Development, once commissioned, are described in Table 11-32.

Table 11-32 Summary of residual effects.

Factor	Effect
Quality	Neutral at most receptors, increasing to negative at Altán apartments overlooking the access roadway due to Proposed Development traffic
Significance	Imperceptible at most receptors, increasing to moderate at the aforementioned Altán apartments due to Proposed Development traffic
Duration	Permanent
Extent	Localised
Context	The Proposed Development is consistent with the existing soundscape
Indirect	None identified
Cumulative	None, apart from cumulative daytime and evening traffic impacts on Altán apartments, due chiefly to the proposed retail centre, with minimal Proposed Development contribution
Worst case	None identified
Indeterminable	None identified
Irreversible	Impacts cannot be reversed
Residual	See Tables 11-30 & 11-31
Synergistic	None identified

11.7 Glossary

Ambient	Total noise environment at a location, including all sounds present.
A-weighting	Weighting or adjustment applied to sound level to approximate non-linear frequency response of human ear. Denoted by suffix A in parameters such as $L_{Aeq\ T}$, $L_{AF10\ T}$, etc.
Background level	A-weighted sound pressure level of residual noise exceeded for 90 % of time interval T. Denoted $L_{AF90\ T}$.
Broadband	Noise which contains roughly equal energy across frequency spectrum. Does not contain tones, and is generally less annoying than tonal noise.
Decibel (dB)	Unit of noise measurement scale. Based on logarithmic scale so cannot be simply added or subtracted. 3 dB difference is smallest change perceptible to human ear. 10 dB difference is perceived as doubling or halving of sound level. Examples of decibel levels are as follows: 20 dB: very quiet room; 30-35 dB: night-time rural environment; 55-65 dB: conversation; 80 dB: busy pub; 100 dB: nightclub. **Throughout this report noise levels are presented as decibels relative to 20 µPa**.
Effect	Consequence of an impact.
Emissions	Noise originating from source under consideration, spreading spherically, hemispherically or otherwise into surrounding environment.
Façade level	Noise level arising immediately in front of façade, due to sound waves received directly from sources, plus sound waves reflected by façade. Reflected contribution will reduce with increasing distance from façade.
Fast response	0.125 seconds response time of sound level meter to changing noise levels. Denoted by suffix F in parameters such as $L_{AF10\ T}$, $L_{AF90\ T}$, etc.
Free field	Measurement position removed from acoustically reflective surfaces other than ground.
Frequency	Number of cycles per second of a sound or vibration wave. Low frequency noise may be perceived as hum, while whine represents higher frequency. Range of human hearing approaches 20-20,000 Hertz.
Hertz (Hz)	Unit of frequency measurement.
Immissions	Noise received at a position due to emissions emanating from a source located nearby or in distance.
Impact	Change resulting from an action, such as implementation of a project.
Impulse	Noise which is of short duration, typically less than one second, sound pressure level of which is significantly higher than background.
Incident level	Noise level at façade or other structure which would arise if façade was absent. Thus ignores façade reflections. May be measured directly, or calculated from measurements at specified distance from façade.
Interval	Time period T over which noise parameters are measured at position. Denoted by T in $L_{Aeq\ T}$, $L_{AF90\ T}$, etc.
$L_{Aeq\ T}$	Equivalent continuous sound pressure level during interval T, effectively representing average A-weighted noise level of ambient noise environment.
$L_{AF10\ T}$	A-weighted sound pressure level exceeded for 10% of interval T, usually used to quantify traffic noise.

$L_{AF90\ T}$	A-weighted sound pressure level exceeded for 90% of interval T, usually used to quantify background noise. May also be used to describe noise level from continuous steady or almost-steady source, particularly where local noise environment fluctuates.
L_{AFmax}	Maximum A-weighted sound pressure level occurring during measurement interval.
$L_{AReq\ T}$	Rating noise level, derived from $L_{Aeq\ T}$ plus specified adjustments for tonal and impulsive characteristics. Equivalent to $L_{Ar\ T}$ used by EPA.
L_{day}	The A-weighted long term average incident sound pressure level determined over all the daytime periods of a year, where the daytime period is typically 0700-1900 h.
L_{den}	Day-evening-night noise level. Calculated from separate L_{day}, $L_{evening}$ and L_{night} levels using formula specified in *EU Directive 2002/49/EC*.
$L_{evening}$	The A-weighted long term average incident sound pressure level determined over all the evening periods of a year, where the evening period is typically 1900-2300 h.
L_{night}	The A-weighted long term average incident sound pressure level determined over all the night-time periods of a year, where the night-time period is typically 2300-0700 h.
Noise sensitive location	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.
1/3 octave band	Frequency spectrum may be divided into octave bands. Upper limit of each octave is twice lower limit. Each octave may be subdivided into thirds, allowing greater analysis of tones.
Peak particle velocity (PPV)	Rate of change of displacement of particles in solid medium due to vibration, measured as mm/s. Usually used to assess vibration in relation to activities such as blasting as correlates well with human perception of vibration and property damage.
Residual level	Noise level remaining when specific source is absent or does not contribute to ambient.
Sound pressure	Deviation over ambient atmospheric pressure due to passing sound wave. Human ear is sound pressure detector, and thus acoustic parameters ultimately relate to sound pressure. Sound pressure level is ratio of measured sound pressure to reference value.
Soundscape	Acoustic environment as perceived, experienced or understood by listeners, taking context into account.
Specific level	$L_{Aeq\ T}$ level produced by specific noise source under consideration during interval T, measured directly or by estimation or calculation.
Tone	Character of noise caused by dominance of one or more frequencies which may result in increased noise nuisance.

In this report units are generally presented using US National Institute Of Standards & Technology guidelines.