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Noise Impact Assessment

Assessment of noise impacts associated with the existing Aderrig/Adamstown 110kV Substation on the proposed adjoining Aderrig phase-3 residential development

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1 Introduction

Quintain Developments Ireland Ltd has engaged iAcoustics to assess the noise impacts of an existing 110kV electrical transformer station on Phase 3 of the Aderrig residential development. The existing Aderrig/Adamstown 110kV substation consists of 2no. power transformers and 110kV switchgear; its location is shown in Figure 1-1. A 3-metre wall binds the substation compound.

Figure 1-1 Ariel view of the Adamstown SDZ showing the location of the substation in question

The primary objective of our assessment is to undertake a noise survey in the vicinity of the substation to quantify the noise levels at a set distance from the boundary. The measured noise levels are then compared against the relevant acoustic standards and guidance for sustainable residential development.

1.1 Development Description

Quintain Developments Ireland Limited intend to apply for permission for development on 2 No. sites separated by the permitted Celbridge Link Road with a total area of 6.36 Ha in the townland of Aderrig, Adamstown, Lucan, Co. Dublin. The south-western site (5.39 Ha) is generally bound to the east by Celbridge Link Road, to the south and west by undeveloped land and an electrical substation and to the north by the Tubber Lane Development Area. The northern site (0.97 Ha) is generally bound to the east by the undeveloped Primary School site and Aderrig Park Avenue, to the south by Airlie Park Road West, to the west by Celbridge Link Road and the Tubber Lane Development Area and to the north by the Tubermaclugg Development Area.

This application is being made in accordance with the Adamstown Planning Scheme 2014 (as amended) and relates to a proposed development within the Aderrig Development Area of the Adamstown Strategic Development Zone.

The proposed development will principally consist of 207 No. residential units (64 No. 2-bed, 127 No. 3-bed and 16 No. 4-bed), ranging in height from 2 No. storeys to 4 No. storeys, comprising 75 No. houses (59 No. 3-bed and 16 No. 4-bed) and 132 No. duplexes (64 No. 2-bed and 68 No. 3-bed).

The development will also include: vehicular junctions to access the development from Celbridge Link Road (2 No.) and Adamstown Way (3 No.); internal road, cycle and footpath network; 314 No. car parking spaces; cycle parking; bin storage areas; public, communal and private open space areas, with balconies and terraces facing all aspects; hard and soft landscaped areas; boundary treatments; public lighting; 2 No. sub-stations; and all associated site and development works above and below ground.

2 Assessment Criteria

2.1 World Health Organisation (WHO) Guidelines

WHO issued *Guidelines for community noise* in 1999, which includes guideline values for community noise in various settings based on the scientific evidence available:

I. For 'outdoor living areas', a daytime limit of $L_{Aeq,16hr}$ 55dB to safeguard against the likelihood of 'serious annoyance'. A second daytime limit of $L_{Aeq,16hr}$ 50dB is also given as a 'moderate annoyance' threshold.

II. For 'internal living areas', a level of $\leq L_{Aeq,16hr}$ 35dB is desirable to maintain reasonable speech intelligibility indoors and prevent moderate annoyance during day and evening times.

III. A nighttime threshold value of $L_{Aeq,8hr}$ 30dB should not be exceeded *indoors* in the interest of preventing adverse effects of sleep. It follows that an internal level of $L_{Aeq,T}$ 30dB is equivalent to a façade level of $L_{Aeq,T}$ 45dB for continuous, steady noise (assuming a partially open window provides 15 dB's of reduction).

IV. When the background noise is low, single noise events exceeding 45dB L_{AFmax} inside bedrooms at nighttime should be limited.

In 2009, the WHO European Regional Office published the 'Night Noise Guidelines for Europe'. It presents new evidence on the health damage of nighttime sound exposure and recommended threshold values. An $L_{night,outside}$ of 40 dB should be the target of the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. $L_{night,outside}$ value of 55 dB is recommended as an interim target for the countries where the NNG cannot be achieved in the short term for various reasons and where policymakers choose to adopt a stepwise approach. These guidelines are applicable to the Member States of the European Region, and may be considered as an extension to, as well as an update of, the previous WHO Guidelines for community noise (1999).

It should be noted that the WHO guideline values are neither standards nor legally binding criteria. The WHO guideline values are evidence-based public health-oriented recommendations to serve as the basis for a policy-making process. Nonetheless, the WHO guide values are usually taken on board as part of good design practice and will often be applied as an acoustic design criterion for residential projects, depending on the context.

2.2 BS 8233:2014 guidance on sound insulation and noise reduction for buildings

This British Standard provides guidance for the control of noise in buildings, which includes guidance on hotels and rooms for long-term residential purposes. The Standard mirrors the values proposed by the W.H.O. and defines upper limits for internal ambient noise levels in habitable areas of a home; these values are outlined in Table 2-1.

Activity	Location	07:00 – 23:00	23:00 – 07:00
Resting	Living Room	$L_{Aeq,16hr}$ 35dB	-
Dining	Dining Room	$L_{Aeq,16hr}$ 40dB	-
Sleeping	Bedroom	$L_{Aeq,16hr}$ 35dB	$L_{Aeq,8hr}$ 30dB

Figure 2-1 BS 8233:2014 guidance on internal ambient noise levels in dwellings

2.3 EPA Guidance NG4

In Ireland, there are no standalone noise limits for electricity infrastructure. Reference is usually made to the EPA document *'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4), Environmental Protection Agency (EPA), 2016.'*

Period	Noise Emission Limit Value
Daytime (07:00 to 19:00hrs)	55 dB $L_{Ar,T}$
Evening (19:00 to 23:00hrs)	50 dB $L_{Ar,T}$
Night-time (23:00 to 07:00hrs)	45 dB $L_{Aeq,T}$ & no tonality
Note: $L_{Ar,T}$ is the rating level as defined in BS 4142:2014.	

Figure 2-2 NG4 noise criteria

3 Noise Measurements

3.1 Method

iAcoustics carried out a field survey on the 20th July 2022. Noise levels were captured 20m from the eastern substation boundary. Due to significant ongoing construction works within the Adamstown Strategic Development Zone (SDZ), it was deemed unsuitable to undertake long-term noise surveying due to potential interference with the measurement data. A short-term survey over a 1-hour period (free from the influence of construction noise) was deemed appropriate. The noise levels from substations do not vary significantly; in the case of transformers, the core is magnetically saturated and should not produce variations in the amplitude of the noise.

The following measurement standards were referenced:

- ISO 1996-1:2016 Acoustics — Description, measurement, and assessment of environmental noise — Part 1: Basic quantities and assessment procedures.
- ISO 1996-2:2017 Acoustics — Description, measurement, and assessment of environmental noise — Part 2: Determination of sound pressure levels.

A microphone was placed on a tripod at 2m from the ground.

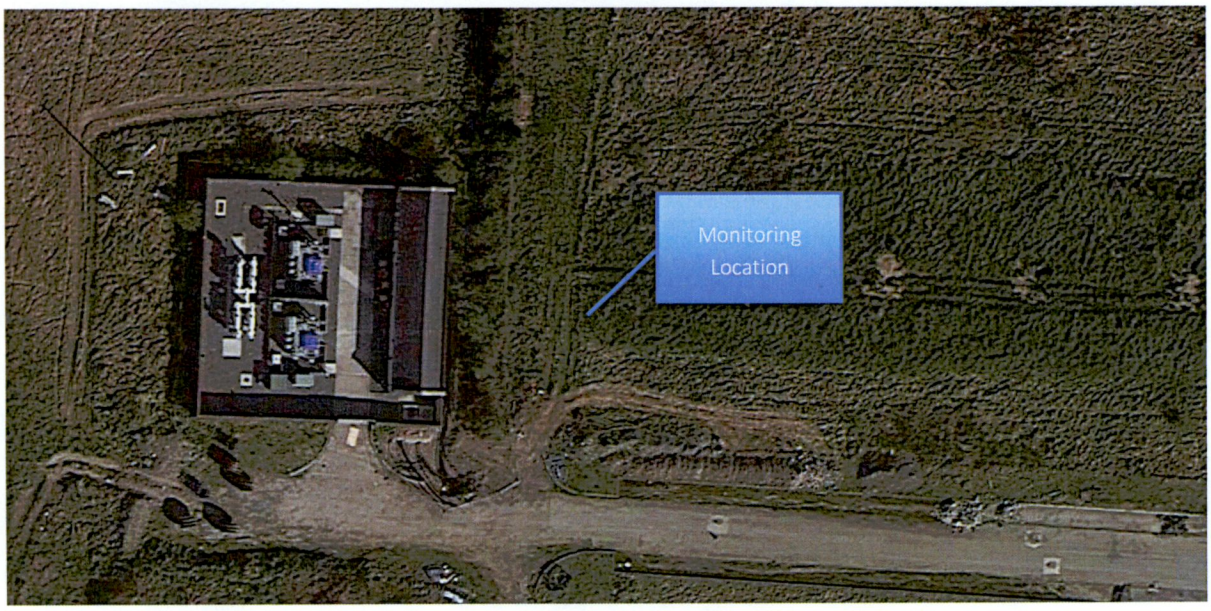


Figure 3-1 Noise Monitoring Location

Figure 3-2 Site layout showing the location of noise monitoring relative to the proposed dwellings

3.2 Measurement Equipment & Weather Conditions

The complete sound measuring system deployed conforms to BS EN 61672-1, Class 1. Sound calibrators deployed for use conform to BS EN 60942, Class 1. The microphone was fitted with an all-weather protection kit (NTI WP30) to minimise interference.

Type	Make & Model	Serial No.	Next Calibration
Sound Level Meter	*NTI XL2-TA*	*a2a-12398-EO*	*Mar-2023*
Microphone	*NTI MA220*	*6337*	*Mar-2023*
Calibrator	*Castle GA607*	*044447*	*Oct-2023*

Table 3-1 Noise Monitoring equipment. Calibration certificates are available on request.

For outdoor transmission of sound, changes in meteorological conditions may influence the sound pressure level at a receiver location. Temparatures ranged from 16°C - 18 °C with overcast conditions. Windspeeds averaged 14 km/h (3.9m/s) in a south-easterly direction which is below the 5m/s maximum value cited in ISO 1996-2.

3.3 Assessment Parameters

The selected assessment parameters are as follows: L_{Aeq} $L_{AF10\%}$ $L_{AF90\%}$ L_{AFmax}

Ambient sound level, L_{Aeq}

Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval.

Statistical Parameters $L_{AF10\%}$ & $L_{AF90\%}$

These are statistical parameters that describe the sound level that is exceeded for 10% or 90% of the measurement interval.

L_{AFmax}

The maximum Sound Level with 'A' Frequency weighting and Fast Time weighting during the measurement period.

Noise levels were also logged every 1-second.

3.4 Observations & Results

The subjective observation was that noise from the substation was ***inaudible*** at the monitoring position. The prevailing noise environment at the receiver location is dominated by distant road traffic noise, birdsong and train passings.

Assessment Parameter:	Sound Pressure Level
$L_{Aeq,1hr}$	38 dB(A)
L_{AFMax}	45 dB(A)
$L_{A10,1hr}$	39 dB(A)
$L_{A90,1hr}$	37 dB(A)

Table 3-2 Calculated L_{den} L_{night} & $L_{Aeq,16hr}$ parameters

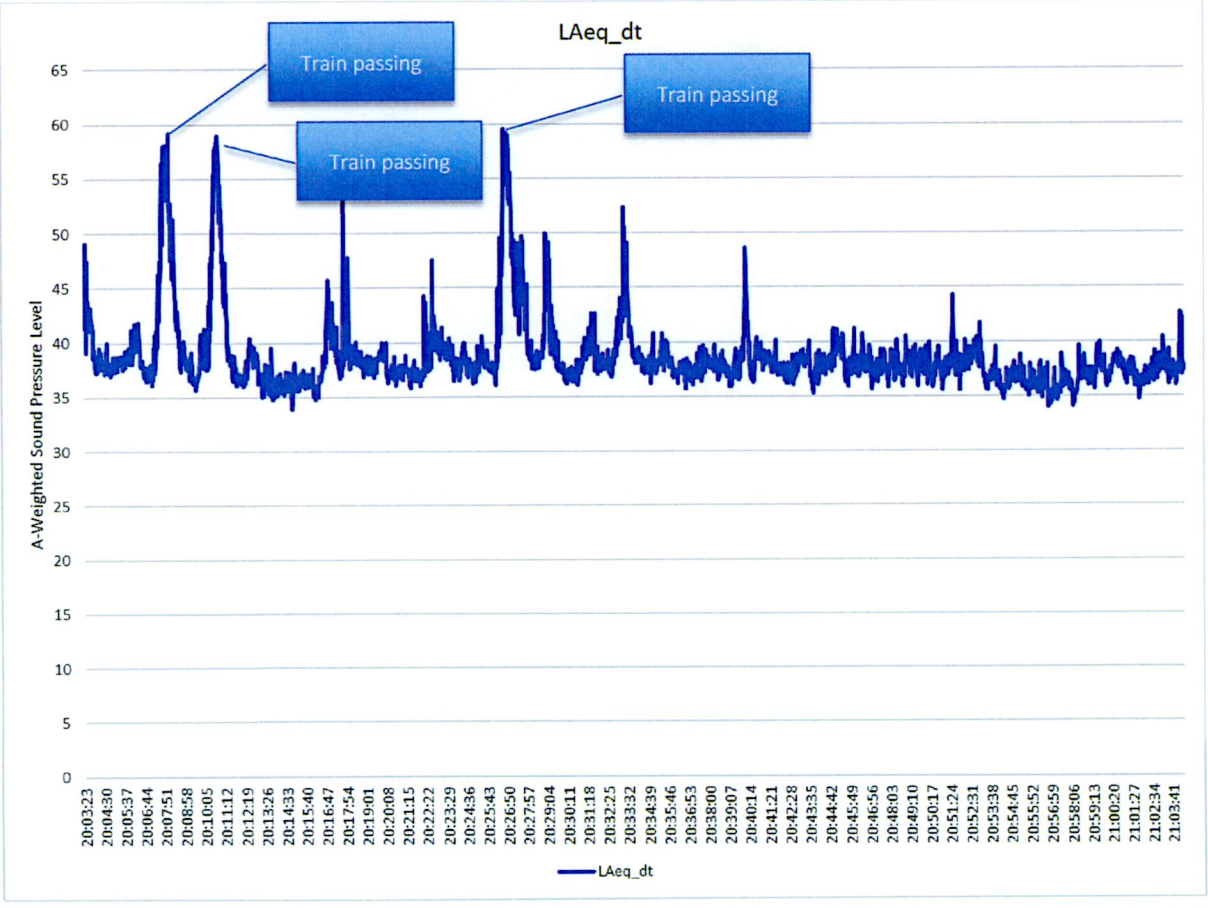


Figure 3-3 Graph showing the change in sound pressure level over a 1hr period, recorded on the 20th July 2022. Noise levels based on 1-second logging.

4 Assessment

4.1 Indoor & Outdoor Noise Levels (Residential Development)

The sound pressure level 20m from the substation boundary are significantly below the daytime WHO threshold limits for *serious annoyance* (55dB L_{Aeq}) and *moderate annoyance* (50dB L_{Aeq}) for outdoor living areas. They are also below the nighttime free-field threshold limit of 42dB (L_{Aeq}) for preventing negative effects on sleep. The nearest dwelling proposed for Aderrig Phase 3 development will be 33.8m from the substation boundary, therefore, the specific sound level from the substation would be even lower.

4.2 EirGrid Study

In 2016, EirGrid commissioned a literature review and evidence-based field study on the noise effects of high voltage transmission development. The study describes a number of ways in which noise can be generated from electricity infrastructure. Generally, these fall within four categories:

I. Noise from high voltage transmission lines generally heard as 'crackling' or 'hissing';
II. Noise associated with dirty, damaged or cracked insulators;
III. Noise associated substation equipment (i.e. transformers);
IV. Noise associated with wind blowing through electricity infrastructure – known as "Aeolian Noise".

There are no overhead lines associated with the existing substation in question. As regards substation noise, the EirGrid study cites *transformer hum* as the dominant noise generated at electricity substations; it is associated with magnetic and electrical forces within the core of an electrical transformer. Typically, the noise level does not vary with transformer load as the core is magnetically saturated and should not produce variations in the amplitude of the noise.

The report presents noise studies for 110kV, 220kV and 400kV substations. There is strong evidence that 110kV and 220kV substations are not likely to result in significant noise impacts in their vicinity. A recommendation is provided in respect of separation distances between a 110kV substation and a nearby noise-sensitive receptor:

> *"To avoid any noise impacts at sensitive receptors, it is recommended that in the design and siting of new substations: a minimum distance of 5m is maintained between a 110 kV substation and the land boundary of any noise sensitive receptor."*

We note that the nearest dwelling to the substation will be approx 33m, satisfying the suggested minimum setback distance of 5m. As a point of reference, we have appended 'section 4.4' of the EirGrid report to this document which presents noise monitoring for a similar 110kV substation showing that noise emisssions are very low.

5 Conclusions

Noise from the 110kV Adamstown/Aderrig substation is ***inaudible*** at the location of the nearest dwelling proposed as part of the adjoining Aderrig Phase 3 residential development.

The recorded sound pressure levels 20m east of substation are significantly below the daytime WHO threshold limits for *serious annoyance* (55dB L_{Aeq}) and *moderate annoyance* (50dB L_{Aeq}) for outdoor living areas. They are also below the nighttime free-field threshold limit of 42dB (L_{Aeq}) for preventing negative effects on sleep. Therefore, it is not necessary to account for noise mitigation measures within the Aderrig development.

A 2016 EirGrid study determined that noise emissions from 110kV substations are generally very low. The EirGrid report advises a minimum separation distance of 5m be maintained between a 110kV substation and the boundary of any noise-sensitive receptor to avoid unwanted noise impacts. The façade of the nearest proposed dwelling is approximately 33m from the perimeter of the substation. Therefore, the likelihood of adverse noise impacts is very low.

Appendix A – EirGrid Survey Results for Dunfirth 110kV Substation

4.4 SURVEY RESULTS FOR SUBSTATIONS

4.4.1 Dunfirth 110kV Substation

Noise monitoring was completed at four different locations in the vicinity of the Dunfirth 110kV Substation, two at alternative distances (i.e. 5m and 10m) from the southern boundary of the substation and two at alternative distances from (i.e. 5m and 10m) from the western boundary of the substation site. No measurements were taken at the northern boundary of the substation as the road would be the dominant noise source at this location. It was not possible to access the eastern boundary on account of the excessive amounts of vegetation.

Five minute measurements were completed at each location as a steady state noise was being emitted from the substation. The noise meter was paused to exclude any other noise sources (e.g. passing traffic on road etc.) during the measurement periods. For the measurements completed at the southern boundary, subjective observations were recorded that pylon corona noise was audible at low levels. On the western boundary, the subjective observations were that substation noise, pylon corona noise and noise from the T210 converter/transformer were audible.

Table 4.8 presents the noise monitoring data from the survey at the Dunfirth 110kV substation on 19th March 2013.

Table 4.8: Noise Monitoring Data for Dunfirth 110kV Substation

Boundary	Distance from Boundary (m)	Date/ Time	L_{Aeq} [dB(A)]	L_{Amax} [dB(A)]	L_{Amin} [dB(A)]	L_{A5} [dB(A)]	L_{A50} [dB(A)]	L_{A90} [dB(A)]
Southern	5	14:59	39	54	32	43	36	34
Southern	10	15:07	39	52	32	43	36	34
Western	5	15:16	37	53	31	40	35	34
Western	10	15:27	38	49	35	41	38	36

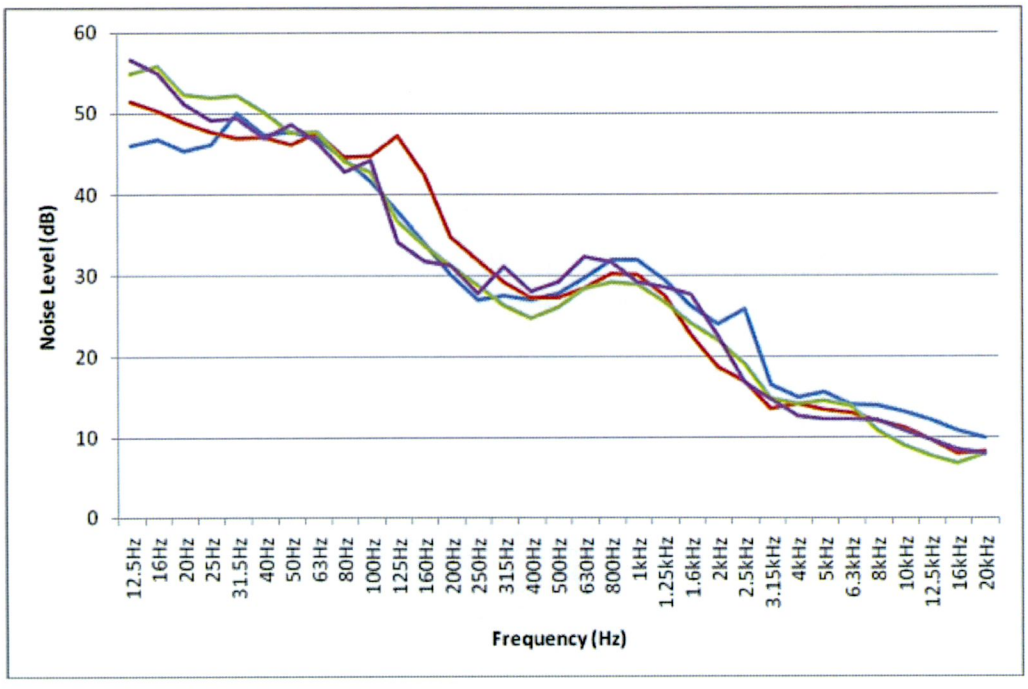
As noise propagates from a noise source, the noise energy dissipates at a constant rate as the distance from the source increases. Therefore, if a particular noise source is dominant, successive noise measurements at a greater distance from the source should show a progressive reduction in the measured noise levels as you travel away from the source.

In this instance, most parameters (i.e. L_{A50}, L_{A5}, L_{A90}) including the average noise level (i.e. L_{Aeq}) do not demonstrate any drop in the noise level at measurement locations 5m and 10m from the respective boundaries. This data indicates that the substation noise stops being the dominant noise source within a short distance of exiting the substation boundary (i.e. within the first 10m). This does not mean that the substation noise is not contributing to the ambient noise level in the vicinity of the boundary, as the subjective observations confirm that corona/substation/ transformer noise is audible. Nevertheless, it provides valuable information that noise from the 110kV substation is quite low in close proximity to the substation boundary (i.e. <40dB L_{Aeq}).

The measured noise levels at the boundary of this substation are below the daytime WHO threshold limits for serious annoyance (55dB L_{Aeq}) and moderate annoyance (50dB L_{Aeq}) for outdoor living areas. They are also below the night-time free-field threshold limit of 42dB (L_{Aeq}) for preventing negative effects on sleep.

Spectral data was recorded throughout each of the measurements completed at Dunfirth 110kV substation to determine if there were any tonal features in the recorded noise levels. Figure 4.8 illustrates the typical spectral profile recorded during all measurements at the site. The low frequency range (i.e. 12-315Hz) is dominant in all measurements, while there is very little representation in the high frequency range. Most importantly in terms of this study, there are no distinct peaks in the data that would represent a distinct tone. On the basis of this data, it can be concluded that there are no distinct tonal elements to the noise from a 110kV substation.

Figure 4.8: Typical Spectral Profile of Noise Levels at Dunfirth 110kV Substation



4.4.2 Gorman 220kV Substation

Noise monitoring was completed at eight different locations in the vicinity of the Gorman 220kV Substation, two at alternative distances (i.e. 5m and 10m) from each boundary of the substation. Five minute measurements were completed at each location as a steady state noise was being emitted from the substation. The noise meter was paused to exclude any other noise sources (e.g. passing traffic on road etc.) during the measurement periods.