KWF Grid Connection EIA Report

Volume C2: EIAR 2023 Main Report

Chapter 10: Air

Topic Chapter Authors:

awnconsulting

Compliance Engineering Ireland Ltd.
Test & Certification Solutions

Malachy Walsh and Partners
Engineering and Environmental Consultants

EIAR Coordinator:

ECOPOWER

August 2023

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Glossary of Terms

Term	Definition
Ambient Noise	The total amount of all noise present at a particular place and time in the environment at the point of investigation
Decibel or dB	The unit of sound pressure level usually abbreviated to the dB. Any noise quantity that is expressed as a level is measured and quoted in decibels
Noise Level	For sound transmitted primarily through the air it is usually taken to be the A weighted sound pressure level
Trackout	The transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when heavy duty vehicles (HDVs) leave the construction/demolition site with dusty materials, which may then spill onto the road, and/or when HDVs transfer dust and dirt onto the road having travelled over muddy ground on site
V/m, or kV/m	Electric Field is measured in Volts per metre, V/m, or kV/m (1000 V/m)
µT	Magnetic Field is measured in micro Tesla , µT

Glossary of General Terms

Term	Definition
KWF Grid Connection (the subject development)	Underground cabling, additional plant and apparatus in the existing Woodhouse Substation, the construction a new link road, the widening of an existing forestry road and the use of the existing entrance and windfarm road network at Woodhouse Windfarm.
Authorised Knocknamona Windfarm	Not Constructed - Knocknamona Windfarm authorised in 2016 (ABP-PL 93.244006); Amendments to Knocknamona Windfarm to provide for larger turbines authorised in September 2022 (ABP-309412-21) and Junction & Bend Widening Works to facilitate turbine component access through the windfarm site entrance at Knocknaglogh Lower authorised in December 2022 (ABP-314219-22)
Whole Project	KWF Grid Connection with Authorised Knocknamona Windfarm
Sensitive Aspect	Any sensitive receptor in the local environment which could be impacted by the project.

List of Abbreviations

Abbreviation	Full Term
AIMD	Active Implantable Medical Devices, such as Pacemakers
CWA	Construction Works Area
dB	Decibel - The unit of sound pressure level
EMF	Electromagnetic Fields, Comprising of Electric and Magnetic Field.
HDV	Heavy Duty Vehicle with a gross weight greater than 3.5 tonnes
IAQM	Institute of Air Quality Management
ICNIRP	International Commission on Non-Ionising Radiation Protection
PM	Abbreviation for particulate matter suspended in the air. PM10 is airborne particulate matter with an aerodynamic diameter less than 10 microns (µm); PM2.5 is less than 2.5µm
KWF	Knocknamona Windfarm

10 Environmental Factor: Air

10.1 Introduction to the Air Chapter

10.1.1 What is Air?

In this EIAR, the evaluation of Air relates to the quality of the air we breathe in, and to the levels of noise, vibration and electromagnetic fields in the air around us.

10.1.2 Overview of Air in the Local Environment

In general terms the KWF Grid Connection is located in a predominantly rural area and away from major urban areas or centres of population. The surrounding landscape is predominantly rural, agricultural grassland and forestry. Nearby villages include Aglish and Villierstown and the town of Dungarvan. The area is sparsely populated with individual dwellings and farmsteads scattered throughout this rural area.

There is a high level of air quality in this upland area, as it is located away from busy, congested roads and industrial sources of air pollutants. The existing noise sources comprise natural and man-made noise sources. Natural noise sources include mainly wind-borne noise and birdsong. Man-made noise sources include farm machinery and milking parlours when in operation, and traffic on the local road network. The existing Woodhouse Windfarm also contribute to the existing ambient noise environment. There are few sources of vibration in the local environment.

Sources of low level EMF in the existing environment include electric equipment, and low, medium and high voltage overhead electricity lines, overhead telephone lines, signals from existing telecommunications masts and underground communication cables which run along road boundaries and across agricultural lands.

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10.1.3 SENSITIVE ASPECTS of Air

Any receptor in the local environment which could be affected by a development is a Sensitive Aspect.

10.1.3.1 Sensitive Aspects included for detailed evaluation in this Topic Chapter

The following Sensitive Aspect is **included for detailed evaluation in this topic chapter** as it is likely or there is potential, for these Sensitive Aspects to be affected by the KWF Grid Connection:

Sensitive Aspect No. 1	**Air**	Section 10.2

The above listed Sensitive Aspect is evaluated in Section 10.2 of this Chapter.

10.1.3.2 Sensitive Aspects excluded from further evaluation

The following Sensitive Aspects are **excluded from further evaluation in this topic chapter** because either there is no potential or no likelihood for KWF Grid Connection causing effects to the Air or the Sensitive Aspect is being evaluated in one of the other topic chapters within the EIAR.

The following Sensitive Aspects **are excluded from this topic chapter**:

Telecommunication Signals	Rationale for excluding this Sensitive Aspect: **No likely impact**, because: • No moving above ground structures or tall structures associated with KWF Grid Connection – only above ground structures will be the additional plant and apparatus in Woodhouse Substation, part of which will be below the level of the surrounding ground surface, therefore there is no potential for either direct or cumulative impacts (with Authorised Knocknamona Windfarm or Woodhouse Windfarm) on any airborne signals.
Ecological Receptors	Rationale for excluding this Sensitive Aspect: **Evaluated in Chapter 7: Biodiversity**. • There are no designated sites or designated habitats within 2km of the KWF Grid Connection (or Authorised Knocknamona Windfarm), and therefore as per TII guidelines biodiversity receptors do not require air quality evaluations. Biodiversity receptors are not considered sensitive to increases in ambient EMF. The potential for effects to biodiversity receptors, as a result of increases in noise or vibration, is evaluated in Chapter 7 Biodiversity.

10.1.4 The Authors of this Air Chapter

The Air chapter was written by Ciara Nolan of AWN Consulting, Peter Barry of Malachy Walsh & Partners, and Lewis Brien of CEI Engineering Ireland.

The air quality sections have been written by Ciara Nolan, BSc (Hons) in Energy Systems Engineering and Master in Applied Environmental Science, of AWN Consulting Ltd. Ciara is a Member of the Institute of Air

Quality Management and specialises in the fields of ambient and indoor air quality monitoring and EIA. AWN Consulting is a multidisciplinary environmental consultancy specialising in Acoustics, Air Quality, Climate, Waste, Water and Soil Quality, Flora and Fauna and Seveso II Major Accident Hazard Land Use Assessments.

The noise and vibration sections have been written by Peter Barry (BAgr Sc. MSc) of Malachy Walsh & Partners, consulting environmental engineers. Peter is an Environmental Scientist, Environmental Noise Specialist and Environmental Impact Assessment practitioner. Peter has 20 years-experience in the measurement, prediction, assessment and control of environmental noise. Peter is a member of the Institute of Acoustics (IOA) and has undertaken numerous wind farm and associated infrastructure noise impact assessments across the country.

The electromagnetic field sections have been written by Lewis Brien (B (Hons) in Electronics) of Compliance Engineering Ireland (CEI). CEI has carried out over 500 radiofrequency site surveys throughout Ireland and worldwide and is recognised by Comreg as one of the foremost independent authorities on the radio frequency spectrum in Ireland.

10.1.5 Sources of EIAR 2023 Information

The following sources of information were used to gather information on the baseline environment and evaluate impacts, including cumulative impacts.

Table 10-1: Sources of EIAR 2023 Information

Type	Information Source
Consultation	No Feedback was received from consultees in relation to Air See Chapter 3: The Scoping Consultations, and Appendices for further details.
Legislation, Regulation & Policy	• Air Quality Standards were established under EU Directive 2008/50/EC which sets limit values for certain air pollutants in order to protect against human health impacts. • Environmental Noise Directive (END), EC 2002/49/EC • European Commission (EC) "Electromagnetic Compatibility Directive 2014/30/EU
Guidelines	• PE-ENV-01106: Air Quality Assessment of Specified Infrastructure Projects – Overarching Technical Document (Transport Infrastructure Ireland TII, 2022) • Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2014) • Environmental Protection Agency – Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4), 2016. • NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes (2004) • Transport Infrastructure Ireland "Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes, March 2014"

Type	Information Source
	• Institute of Environmental Management and Assessment (IEMA) - Guidelines for Environmental Noise Impact Assessment, 2014. • British Standard 5228 Parts 1 & 2, Code of Practice for Noise and Vibration Control on Construction and Open Sites + A1 2014. • ISO 9613-2-1996- Acoustics – Attenuation of sound during propagation outdoors –Part 2: General method of calculation, • ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1Hz – 100 kHz) (1998) • ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1Hz – 100 kHz) (2010) • EU EMF recommendation 1999/519/EC. • European Committee for Electrotechnical Standardization (CENELEC), "EN 45502-2-1:2003 Active implantable medical devices. Particular requirements for active implantable medical devices intended to treat bradyarrhythmia (cardiac pacemakers)
Desktop	• EPA "Air Quality in Ireland 2021" (EPA, 2022), • EPA Annual Air Quality Monitoring Reports (1997 – 2020) • Review of aerial photography, and OSI and other online mapping to identify local residential properties, local community facilities and walking routes and to identify other activities in close proximity to these properties and routes • AC Field Modelling of the fields from the works • Comreg, ESB and Radiological Protection Institute of Ireland online Information In co-ordination with and by review of the other EIA Report Chapters as follows: • Chapter 12 – Material Assets (Roads & Built Services) <u>Review of Whole Project Documents</u> • Knocknamona Windfarm Revised EIS 2015; Larger Turbines Revised EIAR 2021; and Junction and Bend Widening Works Screening for EIA 2022. • Chapter 5: Description of Development: Section 5.5 Cumulative Descriptions
Fieldwork	• Site visits to establish the proximity of nearby sensitive receptors to the works areas. • Baseline Noise Measurements June 2023

10.1.6 Methodology used to Describe the Baseline Environment and to Evaluate Impacts

KWF Grid Connection has the potential to impact local air through a number of mechanisms: traffic-based

air pollutants, construction dust emissions, noise or vibration emissions, and electromagnetic field (EMF) emissions. The methodology for evaluating the effects of traffic, construction generated dust, noise and EMF emissions is provided in the Sections below.

10.1.6.1 Methodology for Evaluating Effects to Air Quality

10.1.6.1.1 Air Quality Standards

Air quality is evaluated against the Ambient Air Quality Standards which are set out by the EU under Directive 2008/50/EC. This Directive sets limit values for certain air pollutants in order to protect against human health and ecological impacts. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors, such as natural background levels, environmental conditions and socio-economic factors, may be considered. The limit values are presented in the table below. These limit values were transposed into Irish Law under S.I. No. 739 of 2022. The limit values in relation to particulate matter (PM_{10} and $PM_{2.5}$) and nitrogen dioxide (NO_2) are applicable to the proposed development.

Table 10-2: EU Air Quality Standards Regulations

Pollutant	Regulation[1]	Limit Type	Value
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3 PM_{10}
		Annual limit for protection of human health	40 µg/m^3 PM_{10}
$PM_{2.5}$	2008/50/EC	Annual limit for protection of human health	25 µg/m^3 $PM_{2.5}$
Nitrogen Dioxide	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m^3 NO_2
		Annual limit for protection of human health	40 µg/m^3 NO_2
		Critical Load for protection of vegetation	30 µg/m^3 NO + NO_2

[1] Based on EU Directive 2008/50/EC

10.1.6.1.2 Transport Infrastructure Ireland (TII) Guidance on Traffic based air pollutants

The TII guidance document PE-ENV-01106 (TII, 2022) uses the following screening criteria to determine if a detailed air modelling assessment of traffic emissions is required for a proposed development. If any road links[2] meet one or more of the following criteria it can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment of traffic emissions.

Neither the subject development nor the whole project meet any of the criteria listed in Table 10-3, and as a result a local air quality assessment of traffic emissions was not required.

Table 10-3: UK DMRB Criteria for Air Quality Assessment

TII Criteria	Criteria met?
Road alignment change of 5 meters or more	No, no change in road alignments
Annual Average Daily Traffic (AADT) flow changes by 1,000 or more	No, daily traffic substantially below 1000 Annual Average Daily Traffic (AADT)
HDVs flows changes by 200 AADT or more	No, HDV flows substantially below 200 vehicles/day
Daily average speed changes by 10 km/h or more	No, no change in average speed
Peak hour speed changes by 20 km/h or more	No, no change in peak hour speed

10.1.6.1.3 IAQM Guidance on Construction Dust Emissions

The Institute of Air Quality Management in the UK (IAQM) guidance document '*Guidance on the Assessment of Dust from Demolition and Construction*' outlines an assessment method for predicting the impact of dust emissions from earthworks, construction and haulage activities based on the scale and nature of the works and the sensitivity of the area to dust impacts. The IAQM methodology has been applied to the construction phase in order to predict the likely magnitude of the dust impacts on sensitive receptors.

10.1.6.1.4 IAQM Guidance on identifying Sensitive Receptors

The IAQM Guidance states that an assessment of dust impacts will be required where there is a 'human receptor' within 350 m of the boundary of the works or within 50 m of routes used by construction vehicles. According to the IAQM Guidance **a 'human receptor'** refers to any location where a person or property may experience the adverse effects of airborne dust or dust soiling[3], or exposure to PM_{10} over a time period relevant to the air quality objectives. The criteria for determining the sensitivity of a receptor to effects from dust is outlined in the Table below.

Table 10-4: IAQM Criteria for determining the sensitivity of a receptor to dust impacts

Sensitivity of a Human Receptor to Dust soiling	
High	locations where users can expect enjoyment of a high level of amenity
	appearance, aesthetics, value of property diminished by soiling
	people or property present either continuously or for extended periods of time
Medium	locations where users expect to enjoy a reasonable level of amenity
	appearance, aesthetics, value of property diminished by soiling
	people or property not present continuously or regularly for extended periods of time

[2] A road link is where the existing road network is broken up into sections of road with similar traffic conditions (traffic composition, speed and flow).
[3] As Per IAQM guidance 2014: Occupational settings are relevant in terms of annoyance effects.

Low	locations where enjoyment of amenity is not reasonably expected
	property not expected to be diminished in appearance, aesthetics, value by soiling
	areas of transient exposure where people or property are passing through or by an area
Sensitivity of a Human Receptor to health impacts from PM_{10}	
High	Areas where people are exposed over a time period relevant to the air quality objective for PM_{10} (Air Quality Standards established under Directive 2008/50/EC are reproduced in Table 10-12 of Appendix 10.2: Air Quality Monitoring & Standards.
Medium	locations where the people exposed are workers
Low	locations where human exposure is transient
Sensitivity of an ecological receptor to Dust Soiling	
High	locations with a national/international designation *and* the designated features may be affected by dust soiling
	locations where there is a community of dust sensitive species
Medium	locations with an important plant species whose dust sensitivity is unknown
	locations with national designation where the features may be affected by dust deposition
Low	locations with local designation where features may be affected by dust deposition

10.1.6.1.5 IAQM Guidance on Evaluating the Sensitivity of the Area

According to IAQM Guidance (2014), the sensitivity of an area to construction dust impacts from either dust soiling or health impacts from PM_{10} is assessed using the criteria outlined in Table 10-5 to Table 10-6. This is based on the sensitivity of the receptor, the number of receptors and their distance from the dust source.

With regards to the sensitivity of the area a 'worst-case' approach has been taken in this assessment whereby the area with the majority of sensitive receptors within the closest distance to the works area have been assessed. This will establish the highest possible level of risk associated with any element of the project for either dust soiling or health impacts from PM_{10}; then the appropriate level of mitigation or best practice measures can be established if necessary, based on a high, medium or low level of risk. In relation to the KWF Grid Connection, it has been established that there is a worst-case low sensitivity to dust soiling effects and health effects from PM_{10}. This is based on the highest number of receptors within closest proximity to the works area.

Table 10-5: Sensitivity of an area to dust soiling effects on people and property (in bold)

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		less than 20	less than 50	less than 100	less than 350
High	greater than 100	High	High	Medium	Low
	10 - 100	High	Medium	Low	Low
	1 - 10	Medium	Low	Low	**Low**
Medium	1 or more	Medium	Low	Low	Low
Low	1 or more	Low	Low	Low	Low

(Note: The sensitivity of the area to dust soils effects are identified in bold text)

Table 10-6: Sensitivity of an area to human health impacts

Receptor Sensitivity	Annual Mean PM_{10} concentration	Number of Receptors	Distance from the Source (m)				
			less than 20	less than 50	less than 100	less than 200	less than 350
High	less than 24 µg/m^3	greater than 100	Medium	Low	Low	Low	Low
		10 - 100	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	**Low**
Medium	less than 24 µg/m^3	greater than 10	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
Low	less than 24 µg/m^3	1 or more	Low	Low	Low	Low	Low

(Note: The sensitivity of the area to dust soils effects are identified in bold text)

10.1.6.1.6 IAQM Guidance on Evaluating the Magnitude of Dust Emissions

Earthworks will primarily involve excavating material, loading and unloading of materials, tipping and stockpiling activities. Activities such as levelling the site and landscaping works are also considered under this category. The dust emission magnitude from earthworks can be classified as small, medium or large based on the definitions from the IAQM guidance as transcribed below:

- Large: Total site area > 10,000 m^2, potentially dusty soil type (e.g. clay which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds > 8 m in height, total material moved >100,000 tonnes;
- Medium: Total site area 2,500 m^2 – 10,000 m^2, moderately dusty soil type (e.g. silt), 5 - 10 heavy earth moving vehicles active at any one time, formation of bunds 4 – 8 m in height, total material moved 20,000 – 100,000 tonnes;
- Small: Total site area < 2,500 m^2, soil type with large grain size (e.g. sand), < 5 heavy earth moving vehicles active at any one time, formation of bunds < 4 m in height, total material moved < 20,000 tonnes, earthworks during wetter months.

The worst case classification for dust emission magnitude (earthworks) can be classified as small for KWF Grid Connection alone, and medium for cumulatively with the Authorised Knocknamona Windfarm.

Construction Material: Dust emission magnitude from construction can be classified as small, medium or large based on the definitions from the IAQM guidance as transcribed below:

- Large: Total building volume > 100,000 m^3, on-site concrete batching, sandblasting;
- Medium: Total building volume 25,000 m^3 – 100,000 m^3, potentially dusty construction material (e.g. concrete), on-site concrete batching;
- Small: Total building volume < 25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

The worst case classification for dust emission magnitude (construction material) can be classified as small for KWF Grid Connection alone, and medium for cumulatively with the Authorised Knocknamona Windfarm.

Trackout: In relation to trackout, factors which determine the dust emission magnitude are vehicle size, vehicle speed, number of vehicles, road surface material and duration of movement. Dust emission magnitude from trackout can be classified as small, medium or large based on the definitions from the IAQM guidance as transcribed below:

- Large: > 50 HDV (> 3.5 t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length > 100 m;
- Medium: 10 - 50 HDV (> 3.5 t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 - 100 m;
- Small: < 10 HDV (> 3.5 t) outward movements in any one day, surface material with low potential for dust release, unpaved road length < 50 m.

The worst case classification for dust emission magnitude (trackout) can be classified as small for KWF Grid Connection alone, and small for cumulatively with the Authorised Knocknamona Windfarm.

10.1.6.1.7 IAQM Guidance on Evaluating the Risk of Dust Impacts

The sensitivity of the area is combined with the dust emission magnitude to define the risk of dust impacts in the absence of mitigation, as outlined in Table 10-7.

Table 10-7: Risk of Dust Impacts in relation to earthworks, construction works and trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk – earthworks/construction *or* Low Risk - trackout	Low Risk – earthworks/construction *or* Negligible - trackout
Low	Low Risk	Low Risk	Negligible

The worst case risks of dust impacts in relation to earthworks, construction materials and trackout can be classified as negligible in relation to the KWF Grid Connection site, and low in relation to cumulative effects with the Authorised Knocknamona Windfarm.

Relevant Appendix (at the end of this chapter)
Appendix 10.2: Air Quality Monitoring & Standards

10.1.6.2 Methodology for Evaluating Noise & Vibration Effects

10.1.6.2.1 Identifying Noise Sensitive Receptors

A noise sensitive receptor is defined by the Environmental Protection Agency as, *any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.*

10.1.6.2.2 Scope of the Noise Assessment

The scope of the assessment has been defined by industry standard best practice and guidance used in Ireland for assessing environmental noise. In general, this includes:

- Establishing the existing or baseline noise conditions at representative noise sensitive receptors.
- Establishing noise limits based on the measured baseline noise levels in accordance with best practice and guidance.
- Using computer software and/ or calculations, predict the noise emissions from the proposed development at the nearest noise sensitive receptors.
- Comparing the predicted noise emissions against the noise limit criteria. The predicted noise emissions must not exceed the noise limit criteria.
- Specifying mitigation measures if required.

There will be no significant sources of vibration during the construction phase because no blasting or piling is required. There are no sources of vibration during the operational phase. Therefore vibration is scoped out from further assessment.

10.1.6.2.3 Construction Phase Noise Assessment- Best Practice and Guidance

The most recent revision of *British Standard 5228-1:2009+A1:2014, Code of practice for noise and vibration control on construction and open site* outlines noise thresholds for significant impacts (Refer to Appendix 10.3 Noise Impact Assessment).

NRA Guidelines on Construction Noise

There are no mandatory noise limits for construction noise in Ireland. The Irish National Roads Authority (NRA) - *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes*, March 2014 was consulted for noise and vibration related impact nuisance thresholds.

The Authority (NRA) considered that the noise levels, included in the table below, are typically deemed acceptable, with the comment that more stringent levels might be appropriate in areas where pre-existing noise levels are low.

Table 10-8: Construction Stage Noise Level Thresholds at the façade of dwellings

Period	Working Hours	$LAeq_{(1\ hour)}$ dB[4]	$LpA_{(Max)slow}$[5] dB
Monday to Friday	07:00 to 19:00hrs	70	80
Monday to Friday	19.00 to 22.00hrs[6]	60*	65*
Saturday	08:00 to 16:30hrs	65	75

*The lower threshold level of 65dB has been applied to the KWF Grid Connection project. It should be noted that the 60dB level is not applied because works will not take place beyond 7pm.

10.1.6.2.4 Operational Phase Noise Assessment Criteria

In the absence of specific noise limits for this type of development, the most appropriate criteria are set out in the Environmental Protection Agency (EPA) Guidance Note for Noise: Licence Applications, Surveys and

[4] $LAeq_{)}$: An indication of the average level of noise heard
[5] $LpA_{(Max)}$: An indication of the maximum sound level heard
[6] As stated in both the NRA Guidelines (2004) construction at these times or outside the times indicated in the table, except for emergency work, will require the explicit permission of the relevant local authority.

Assessments in Relation to Scheduled Activities (NG4) (Environmental Protection Agency, 2016). The guidelines require that noise sensitive receptors locations are screened to determine whether they are a in a 'quiet area'; an area of 'low background noise' or an 'all other Areas'. This screening is required to determine the most applicable recommended noise limits for licenced sites.

Evaluating Operational Phase Noise from additional plant at Woodhouse Substation

A baseline noise survey was undertaken in June 2023 at two locations. The first location at the nearest dwelling to Woodhouse Substation (Location H1 – 330m west). The second location at a distance from Woodhouse Substation to give a representative result for houses in the vicinity (Location H8 – 817m east).

The survey was conducted in general accordance with ISO 1996-2: 2017 *"Acoustics -- Description, measurement and assessment of environmental noise -- Part 2: Determination of sound pressure levels"*.

The sound level meter was set up at both locations (H1 and H8) to record unattended measurements over two day and night periods logging 15-minute concurrent measurements. The microphone was mounted at 1.5m above ground level, located away from reflective surfaces, such as fences and walls. A weather station was also set up to monitor rainfall and wind speed over the same monitoring period. Weather conditions were recorded as dry and calm with average wind speeds generally not exceeding 5 m/s.

The more detailed Noise Impact Assessment methodology, figures and location reports are set-out in Appendix 10.3 Noise Impact Assessment: Section 2 Methodology.

Noise Monitoring Equipment

Manufacturer	Equipment Model	Serial Number	Type	Calibration Date
PCB	377B02	314623	Microphone	21st February 2023
Larson Davis	LxT1	000592B	Sound Level Meter	22nd February 2023
Larson Davis	PRMLxT1L	055776	Preamplifier	22nd February 2023
Larson Davis	CAL200	16931	Calibration	20th February 2023

Measurement Parameters

The noise survey results are presented in terms of the following parameters:

LAeq is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period. This parameter is representative of the specific noise from plant when plant is the dominant noise source, i.e. there is no extraneous noise from sources such as traffic.

LA90 is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise. This parameter is representative of the specific noise from plant when there is extraneous noise from intermittent noise sources such as intermittent traffic.

LAmax is the instantaneous maximum sound level measured during the sample period.

LAmin is the instantaneous minimum sound level measured during the sample period.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB)

relative to $2x10^{-5}$ Pa.

Decibels Levels Post the KWF Grid Connection Works: To demonstrate the decibel levels at the Woodhouse Substation from the proposed KWF Grid Connection additional transformer at Woodhouse Substation, two noise modelling scenarios were run. These included;

- Scenario 1: Noise propagation from existing Woodhouse Substation infrastructure.
- Scenario 2*:* Noise propagation from existing Woodhouse Substation and additional transformer at Woodhouse Substation associated with the KWF Grid Connection.

A series of measurements were undertaken in the vicinity of the existing Woodhouse Substation. From these measurements it was possible to calculate the sound power levels for the existing Woodhouse Substation electrical transformer and any other noise emitting infrastructure. These were then input into the noise model. The proposed KWF Grid Connection electrical transformer is given the same sound power level as the existing and input into the model for *Scenario 2*.

Evaluation of the Magnitude of Noise Impacts

The Institute of Environmental Management and Assessment (IEMA) Guidelines for Environmental Noise Impact Assessment, November 2014, were used to evaluate the magnitude of impacts, the sensitivity of receptors and the level of significance of any effects during operation. The criteria outlined in Tables 10-9 to 10-11 have been sourced from these Guidelines.

Table 10-9: IEMA (2014) Guidelines for Evaluating the Magnitude of Noise Impact

EPA Terminology	Description	Receptor Perception of Effects
Negligible	No discernible change in the baseline environmental conditions, within margins of error of measurement	Not Noticeable
Small	Impact resulting in a discernible change in baseline environmental conditions with undesirable/desirable conditions that can be tolerated	Noticeable and not intrusive
Medium	Impact resulting in a discernible change in baseline environmental conditions predicted either to cause statutory objectives to be marginally exceeded or to result in undesirable/desirable consequences on the receiving environment.	Noticeable and intrusive
Large	Impact resulting in a considerable change in baseline environmental conditions predicted either to cause statutory objectives to be significantly exceeded or to result in severe undesirable/desirable consequences on the receiving environment.	Noticeable and disruptive

Table 10-10 IEMA (2014) Guidelines for Evaluating the Sensitivity of Receptor

EPA Terminology	Description
Negligible	Receptor/ resource is not sensitive to noise.
Low	Receptor/resource is tolerant of change without detriment to its character or is of low or local importance. For example industrial estates
Medium/ Moderate	Receptors/resource has moderate capacity to absorb change without significantly altering its present character. For example residential dwellings, offices, schools, and play areas.

	Locally designated nature conservation sites which are also known to contain noise sensitive species (i.e. noise may change breeding habits or threaten species in some other way).
High	Receptor/resource has little ability to absorb change without fundamentally altering its present character, or is of international or national importance. For example hospitals, residential care homes, and internationally and nationally designated nature conservation sites which are also known to contain noise sensitive species (i.e. noise may change breeding habits or threaten species in some other way).

Table 10-11: IEMA (2014) Guidelines for Evaluating the Impact Significance Matrix

Magnitude	Sensitivity of Receptor			
	Negligible	Low	Medium/ Moderate	High
Negligible	None	None	None	None
Small	None	Slight	Moderate	Moderate
Medium	None	Moderate	Substantial	Substantial
Large	None	Moderate	Substantial	Very Substantial

10.1.6.3 Methodology for Evaluating Electromagnetic Fields Effects

10.1.6.3.1 Treatment of the Existing Electricity and Communication **Networks**

The contribution to EMF levels from the internal Knocknamona Windfarm Substation and underground cabling; the internal Woodhouse Windfarm underground cabling; the existing 110kV overhead lines at Woodhouse Substation and the existing electrical equipment at Woodhouse Substation is considered in the evaluation of cumulative impacts. The local electricity and communications (eir) networks, on the other hand, are considered as part of the existing environment.

10.1.6.3.2 Treatment of Naturally Occurring Electric and Magnetic Fields

Naturally occurring electric and magnetic fields differ from the electromagnetic Fields (EMF) which are produced by the power system as naturally occurring EMF do not change direction and are, therefore, referred to as static or direct current (DC) fields, whereas EMF from power systems fluctuates at a fixed frequency and are referred to as alternating current (AC) fields.

Because EMF from the two sources (i.e natural and power systems) differ from each other, naturally occurring electric and magnetic fields are not included in the baseline environment.

10.1.6.3.3 Authors Methodology for Modelling Theoretical Worst-Case Effects

In order to categorically demonstrate that the maximum possible power load of the electric cables and equipment associated with the whole project, will comply with the EU EMF Exposure Recommendations and the International Commission on Non-Ionising Radiation Protection (ICNIRP) limits, the theoretical worst-case contribution of the operational Woodhouse Windfarm, Woodhouse Substation, Knocknamona Windfarm and KWF Grid Connection, to EMF levels in the environment is evaluated in this report. The criteria for modelling the worst-case levels of EMF are outlined in Appendix 10.4: Explanation and Modelling of EMF.

Relevant Appendix (at the end of this chapter)

Appendix 10.4 Examination and Modelling of EMF

10.1.6.3.4 ICNIRP General Public Reference levels

In this EIA Report chapter, the compliance of the KWF Grid Connection and Knockamona Windfarm has been evaluated against the directives and legislation listed in the section above, and against the 1998 guidelines on limiting exposures to electromagnetic fields as published by the ICNIRP. The European Union and the Irish Government have adopted the ICNIRP 1998 guidelines which are more conservative than the 2010 guidelines, which are outlined in Table 10-12 below.

Table 10-12: ICNIRP EMF Limits

Exposure Characteristics ICNIRP	Electric Field Strength V/m	Magnetic Field Strength µT
1998 General Public Reference Level	5000	100
2010 General Public Reference Level	5000	200

The Irish Government Department of Communications, Marine and Natural Resources, have stated "No adverse health effects have been established below the limits suggested by international guidelines".

10.1.6.3.5 Authors Methodology for Evaluating the Magnitude and Significance of Impacts

The significance of the impact for each identified sensitive receptor will be assessed according to the impact magnitude according to Table 10-13 and Table 10-14.

Table 10-13: Determining magnitude and significance of effects in relation to Electric Fields

Magnitude		**Significance of Effects**		
Magnitude Rating	**Field Strength**	**Local Residents & Community**	**Transient People**	**Electronic Equipment**
Very Low (1)	< 1 V/m	Imperceptible Similar to existing ambient levels	Imperceptible Similar to existing ambient levels	Imperceptible Similar to existing ambient levels
Low (2)	1V/m - 1000 V/m	Slight Similar to existing ambient levels from residential electric equipment	Imperceptible Higher than existing ambient levels	Imperceptible Similar to existing ambient levels from Electric Equipment
Medium (3)	1000 V/m-5000 V/m	Slight Under EU EMF limits Under HSA Low Action limit	Slight Significantly higher than existing ambient levels but length of exposure is momentary or brief	Slight to moderate Above existing ambient levels from Electric Equipment

High (4)	5000 V/m - 10000 V/m	Moderate Above EU EMF limits Above HSA Low Action limit	Moderate Above EMF limits although not applicable	Significant Above EU AIMD[7] Device Immunity Test levels
Very High (5)	>10000 V/m	Profound Above EU EMF limits Above HSA High Action limit	Significant to Profound Significantly above AIMD Immunity Test Level	Profound Significantly above electrical device test levels

Table 10-14: Determining magnitude and significance of effects in relation to Magnetic Fields

Magnitude		**Significance of Effects**		
Magnitude Rating	**Field Strength**	**Local Residents & Community**	**Transient People**	**Electronic Equipment**
Very Low (1)	< 0.1 to 1.26 µT (micro Tesla)	Imperceptible Similar levels to existing ambient levels	Imperceptible Similar to existing ambient levels	Imperceptible Similar to existing ambient levels Below EU Residential and Light Industrial Electronic device Immunity limit (1.26 µT)
Low (2)	1.26-38 µT	Imperceptible Higher than existing ambient levels Under EU EMF limits Under HSA public limit	Imperceptible Higher than existing ambient levels	Imperceptible to Slight Above EU Residential and Light Industrial Electronic device Immunity limit (1.26 µT)
Medium (3)	38-100 µT	Slight Under EU EMF limits Under HSA public limit	Imperceptible to Slight Significantly Higher than existing ambient levels but exposure not long term	Slight Above EU Industrial Electronic device Immunity limit (38 µT)
High (4)	100-1000 µT	Moderate EU EMF limits exceeded HSA Low Action Level	Moderate Above EU EMF limits although not applicable	Moderate to Significant Above EU AIMD Device test levels

[7] AIMD is the abbreviation for 'Artificial Implantable Medical Devices' such as pacemakers and defibrillators

Magnitude		**Significance of Effects**		
Magnitude Rating	**Field Strength**	**Local Residents & Community**	**Transient People**	**Electronic Equipment**
		reached		
Very High (5)	>1000 µT	Significant EU EMF and HSA levels breached	Significant to Profound EU EMF and HSA levels breached but not applicable to transient people Above Test Levels for AIMD Devices	Profound Significantly above All Electrical Device test levels
		Profound > 6000 µT HSA High Action Level reached		

10.1.7 Certainty and Sufficiency of the Evaluated Information

The information used to compile the air quality sections of this chapter is collated from reports and documents generated by local authorities and statutory agencies, including the European Commission; the Environmental Protection Agency; Transport Infrastructure Ireland; and the UK Institute of Air Quality Management (IAQM)[8]. The most recent publications have been relied upon, with references detailed as footnotes where required. The UK guidance has been used in the absence of equivalent Irish guidance as is considered best practice. The most recent monitoring data provided by the EPA was used to inform the baseline conditions. See Appendix 10.2: Air Quality Monitoring & Standards.

The information used to compile the noise sections of this chapter was based on best practice and guidance as described throughout this chapter and appendix. The baseline information used for the purpose of this assessment has been acquired through a combination of site visits, visual observations, mapping and baseline noise measurements. Noise levels documented in industry standard best practice and guidance documentation, BS 5228 Noise and Vibration from Open and Construction Sites, 2014, has been used in determining the potential impact of the KWF Grid Connection construction works. Calculations undertaken err on the side of caution and overestimation.

The information used to compile the Electromagnetic Fields sections of this chapter is collated from reports and documents generated by national and international authorities and statutory agencies, including the Commission for Communication Regulation (Comreg); International Commission for Non-Ionizing Radiation Protection (ICNIRP); the Transmission System Operator Eirgrid and a selection of published and accessible scientific studies. Where possible the most recent publications are relied upon, with references detailed as footnotes throughout the chapter.

The Knocknamona Windfarm Revised EIS (2015); Larger Turbines Revised EIAR 2021; and the Junction & Bends Widening Works Screening for EIA 2022 were reviewed in order to inform the whole project and cumulative impact assessment.

[8] IAQM (2014) Guidance on the Assessment of Dust from Demolition and Construction

10.2 Sensitive Aspect No.1: Air

This Section 10.2 provides a description of the baseline environment and an evaluation of the likely impacts of KWF Grid Connection, both alone and cumulatively, on **Air**.

10.2.1 Description of the BASELINE ENVIRONMENT for Air

This Section 10.2.1 comprises the identification of the Study Area for direct or indirect effects and for cumulative effects, and a description of the context, character, importance and sensitivity of the Air in the area. Trends or changes in the baseline environment and expected receiving environment are also identified.

10.2.1.1 STUDY AREA for Air

Study areas relate to areas which could be affected by impacts from KWF Grid Connection, whether direct impacts from the KWF Grid Connection on its own or cumulative impacts from KWF Grid Connection and other projects or activities.

The KWF Grid Connection study areas are described in the table below and on relevant figures.

Relevant Figures (at the end of this chapter)
Figure 10.2.1: Study Area for Air (Construction Stage)
Figure 10.2.2: Study Area for Air (Operational Stage Noise)
Figure 10.2.3: Study Area for Air (Operational Stage EMF)

Table 10-15: Study Area for Air Quality

KWF Grid Connection Study Area (direct or indirect effects)	Cumulative Study Area (cumulative effects)
Study Area Extent: *Construction Dust, Noise and Vibration*: Houses within 350m of construction works areas & within 50m of the Local Roads L60741 and L6074 as far as Woodhouse Windfarm Site Entrance and the Woodhouse Windfarm access roads to be used for delivery of construction materials and turbine component loads. *Operational Noise:* Houses within 1km of KWF Grid Connection. *Operational EMF:* 100m from KWF Grid Connection cabling and additional plant in Woodhouse Substation.	Study Area Extent: *Construction Dust, Noise and Vibration*: Houses within 700m from KWF Grid Connection construction works, 50m from Local Roads L60741 and L6074 as far as Woodhouse Windfarm Site Entrance and the Woodhouse Windfarm access roads to be used for delivery of construction materials and turbine component loads. *Operational Noise:* Houses within 1km of KWF Grid Connection. *Operational EMF:* 200m from KWF Grid Connection cabling and additional plant in Woodhouse Substation.
Justification for Study Area Extent: *Construction Dust, Noise & Vibration*: Based on the criteria outlined in Guidance on the	Justification for Study Area Extent: *Construction Dust, Noise & Vibration:* The distance from KWF Grid Connection is

Assessment of Dust from Demolition and Construction (IAQM, 2014). The L2018 and L2019 at Cappagh Quarry have been excluded because quarry traffic forms the normal baseline traffic for these roads and KWF Grid Connection quarry materials traffic is minimal in that context. *Construction Noise and Vibration:* Based on the Guidelines for the Treatment of Noise and Vibration in National Road Schemes, the Guidelines recommend that receptors within 300m of a route be identified, however in order to capture the nearest house, the wider Air Quality study area of 350m from construction works is used in the appraisal. *Operational Noise:* In order to assess all houses in the vicinity. *Operational EMF:* Based on professional judgement, EMF Field emissions can extend to this distance.	doubled from that used for direct impacts in order to evaluate whether any sensitive receptors within the KWF Grid Connection zone of impact could also be affected by dust, noise & vibration sources from different directions either at the same time or sequentially. *Operational Noise:* In order to assess all houses in the vicinity. The cumulative assessment comprises the existing noise from Woodhouse Substation cumulatively with the additional electrical infrastructure associated with KWF Grid Connection. *Operational EMF*: The distance from KWF Grid Connection is doubled to evaluate whether any sensitive receptors within the KWF Grid Connection zone of impact could also be affected by EMF from other sources in the vicinity such as from Knocknamona Windfarm (when constructed); Woodhouse Windfarm and Woodhouse Substation (existing); and overhead lines.
Relevant development stage Construction and operation Justification: Dust, noise and vibration may be emitted during the construction of the KWF Grid Connection through excavating materials, loading/unloading of materials and movement of vehicles, use of machinery and the movement of machinery/vehicles to and from site on unpaved roads, and on the local road network in the vicinity of the site entrance. During operation, noise and EMF will be emitted.	Relevant development stage Construction and operation Justification: There is potential for cumulative dust, noise and vibration impacts should the construction of the KWF Grid Connection and Authorised Knocknamona Windfarm occur during the same period. During operation, noise and EMF will be emitted.

10.2.1.2 Description of the BASELINE CONTEXT and CHARACTER of Air

The baseline context includes a description of the KWF Grid Connection Study Area and also the wider area which includes the Cumulative Study Area; Knocknamona Windfarm project area; Woodhouse Substation and Woodhouse Windfarm project areas.

10.2.1.2.1 Baseline for KWF Grid Connection Study Area (Air)

Survey Results: The nearest house is c.330m from Woodhouse Substation. There are no other dwellings within 350m of the KWF Grid Connection Construction Works Area (CWA). The next nearest house is 460m from the CWA and adjacent to the nearest house. These houses are owned by landowners involved in the development. The nearest 3rd party dwelling from KWF Grid Connection CWA is c.550m distant at the nearest point which is the cabling, as it enters Woodhouse Substation. All houses within 1km of KWF Grid Connection CWA and the Access Road through Woodhouse Windfarm Entrance are marked on Figures at

the end of this chapter.

Air Quality: The KWF Grid Connection is within EPA Air Quality Monitoring Zone D. Overall, there is a good air quality baseline for the area. Background concentrations of air pollutants (NO_2, PM_{10} and $PM_{2.5}$) are very low in this area and are substantially below the EU limit values. Further details on the the limit values and on baseline air quality are included in Appendix 10.2: Air Quality Monitoring & Standards at the end of this chapter.

Noise and Vibration

The area is rural in nature with agriculture, forestry and renewable energy, the main land uses. Noise sources which contributed to the existing noise environment included some wind-borne noise and noise from existing Woodhouse wind turbines. It was noted that during the installation and removal of the noise monitoring station at the nearest house (H1 – 330m west), that existing noise from the Woodhouse Substation was not audible. Other intermittent noise sources in the area include agricultural machinery using the farmyard and surrounding fields and milking parlours when operational.

Baseline Noise Survey Locations

Two noise survey locations were chosen. The first location at the nearest dwelling to Woodhouse Substation (Location H1 – 330m west). The second location at a distance from Woodhouse Substation and Woodhouse Windfarm to give a representative result for houses in the vicinity (Location H8 – 817m east).

Existing Noise Levels at the nearest dwelling house to KWF Grid Connection Construction Works Area CWA (identified as H1 in Chapter Figures and Appendix 10.3 Noise Impact Assessment)

A baseline noise survey was undertaken at H1 from the 17th to 19th of April 2023. The survey results indicate that the daytime LAeq or ambient noise levels ranged from an average of 51 to 53 dB(A). The night-time LAeq or ambient noise levels averaged 49 dB(A). The main contributing noise sources at H1 are the resident's own milking parlour when operating, neighbouring Woodhouse Windfarm turbines and wind through surrounding vegetation. Based on the criteria set out in the Environmental Protection Agency (EPA) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA 2016), the measured background noise levels at H1 exceed the NG4 criteria of "Area of Low Background noise ". This location is deemed to be in an area of "All other Areas".

Existing Noise Levels at a remove from Woodhouse Windfarm and Woodhouse Substation (identified as H8 in Chapter Figures and Appendix 10.3 Noise Impact Assessment)

A baseline noise survey was undertaken at H8 from the 14th to 16th of June 2023. The survey results indicate that the daytime LAeq or ambient noise levels ranged from an average of 39 to 45 dB(A). The night-time LAeq or ambient noise levels ranged from an average of 32 to 33 dB(A). The main contributing noise sources at H8 are intermittent noise from agricultural activity i.e. milking parlours and agricultural vehicles and the wind through surrounding vegetation. Based on the criteria set out in NG4, H8 is deemed to be in an "Area of Low Background noise".

Existing Noise Levels at other Houses in the vicinity (within 1km of KWF Grid Connection)

The more conservative noise limits associated with "Areas of Low Background Noise" above have been applied to all the Houses within the Study Area (1km), notwithstanding that H1 and H2 are classified as being in an "All other Areas".

Existing Noise Levels at Woodhouse Substation Perimeter Fence

The Woodhouse Substation emits a steady and continuous noise which is audible within the substation

compound and at the perimeter fence and diminishes as one moves further away from the substation compound perimeter fence. The sound power level associated with a typical substation that would support a development of this nature is in the order of 93 dB(A). This has been validated by boundary measurements at the existing substation in April 2023.

Relevant Appendix (at the end of this chapter)

See Appendix 10.3 Noise Impact Assessment for full details of the Baseline Noise Surveys carried out in April and June 2023.

Existing EMF Levels in the vicinity

Electrical objects and anything connected to them produce two types of fields - electric fields and magnetic fields. Electric and magnetic fields are produced in all residential and working environments as a result of nearby electrical wiring, appliances, power lines and telecommunication masts, among other things. Electric fields are measured in volts per meter (V/m), and magnetic fields measured in microtesla (µT). The ICNIRP guideline levels in relation to the general public for exposure to frequency EMF associated with electrical power systems, is 5000V/m for electric fields exposure and 100µT for magnetic field exposure. Studies of homes in the UK show that most homes had average electric field exposures of less than 10 V/m (Bracken et al, 1990) and that most homes had magnetic field levels in the range 0.2µT to 0.4µT which were attributed to low voltage sources (i.e. wiring, appliances, and distribution circuits) (Mastanyi et al, 2007). It is assumed in this report that the existing electric field and magnetic field levels, at local residential dwellings, are similar. These assumed levels are substantially under the ICNIRP guideline levels.

Relevant Appendix (at the end of this chapter)

Appendix 10.4 Examination and Modelling of EMF

10.2.1.2.2 Baseline for the Cumulative Study Area (Air)

There are no additional Context or Characteristics of Air in the Cumulative Study Area. Both the Authorised Knocknamona Windfarm and the operational Woodhouse Windfarm are partially located within the Cumulative Evaluation Study area, while all of the footprint of Woodhouse Substation is included in the Study Area.

10.2.1.2.3 Consideration of the Passage of time

KWF Grid Connection is one element of the whole Knocknamona Windfarm project and therefore the passage of time since the main element (Knocknamona Windfarm) was granted planning permission in 2016 with modifications to the size of the turbines in 2022, has been considered. Knocknamona Windfarm Revised EIS 2015 and the Larger Turbines Revised EIAR 2021 were reviewed in the context of the current baseline conditions.

Levels of air quality have not changed significantly since 2015. Concentrations of particulate matter and nitrogen dioxide have fluctuated somewhat but overall average levels remain significantly below the ambient air quality standards in rural locations. It is considered that, the changes in air quality do not affect the findings of the Knocknamona Windfarm Revised EIS 2015 on the significance of the effects of dust and vehicles emissions, on air quality during construction.

EMF was not specifically evaluated in the Revised Knocknamona Windfarm EIS 2015, however EMF was considered in the evaluations for the Larger Turbines Revised EIAR 2021, which included a cumulative evaluation of the whole Knocknamona Windfarm Project together with Woodhouse Windfarm and

Woodhouse Substation. No changes to the levels of EMF have occurred in the baseline environment in the intervening period.

Noise and shadow flicker from Operational Woodhouse Windfarm turbines were taken into account in the Revised EIAR 2021. There have been no changes or additions to the Woodhouse Windfarm turbines since then.

A survey was carried out in February 2023 to ascertain if any new houses or other sensitive properties have been constructed within 1km of the authorised wind turbines. This survey confirmed that no new houses or other sensitive properties i.e community facilities, have been constructed within 1km of the authorised Knocknamona Windfarm turbines since the Revised EIAR 2021 was prepared.

10.2.1.3 IMPORTANCE of Air

The low number of residential properties is common in rural, upland areas of Ireland, as is their distribution with the majority of properties centred around small rural villages.

In general there is a reasonable expectation for a good quality of air in these upland areas which are remote from busy, congested roads and industrial sources of air pollutants.

The area has no statutory or other designations regarding noise or vibration.

In relation to EMF levels in the Air, the ICNIRP guidelines form the basis of the EU guidelines for human exposure to EMF (EC Council Recommendation 1999/519/EC[9]). These exposure guidelines apply only where members of the public could be expected to spend significant periods of time (EC, 1999). Artificial Implantable Medical Devices (AIMDs), such as pacemakers are tested to higher EMF Immunity levels to safeguard operation according to EU regulations (CENELEC 50527-1:2010). A limit of 100 µT applies to 50 Hz magnetic fields and 5000 V/m to 50 Hz electric fields. It should be noted that these are the same limits as the ICNIRP limits adopted by the EU for the general public and used in this evaluation.

10.2.1.3.1 Importance of Air in the Cumulative Study Area

Noise and Vibration: Residential amenity will be protected from intrusive noise from the Authorised Knocknamona Windfarm by noise limits imposed as conditions of planning.

10.2.1.4 SENSITIVITY of Air

All local residences are high sensitivity locations. There is only one dwelling within the 350m study area, this dwelling is c.330m from the Woodhouse Substation and is occupied by a landowner involved in the development.

Air Quality: People in the area could be sensitive to health effects such as respiratory illnesses as a result of breathing polluted air. Based on the high sensitivity, but very low number (1 local residence within 350m of construction works), and the high level of existing air quality, it is considered that sensitivity of the local residences to dust soiling is '**low'** and to human health effects is '**negligible'** under the IAQM assessment guidance.

People passing through are not considered to be sensitive to dust impacts.

[9] https://op.europa.eu/en/publication-detail/-/publication/9509b04f-1df0-4221-bfa2-c7af77975556/language-en

Noise and Vibration: Local residents are sensitive to noise as a distraction or disturbance preventing enjoyment of their property or local outdoor amenity during the day. At night, noise that is too loud can lead to sleep disturbance. Local residents can be very sensitive to any new permanent source of noise introduced to their environment, depending on the level and characteristics of the noise that is audible.

EMF: Local Residents and members of the community could raise health concerns if the levels of EMF Exposure within their residences and premises are deemed to breech the ICNIRP limits. A substantial increase in EMF levels above EU electric and electronic equipment Immunity test levels could cause the malfunction of equipment. **Note**: Electronic Equipment in machinery and vehicles are not commonly susceptible to 50 Hz magnetic fields, and are excluded from further consideration in this EIA Report.

10.2.1.5 TRENDS for Air in the Baseline Environment

Air Quality: There are no specific future trends in relation to air quality. Air quality is likely to improve in future years with a reduction in the use of diesel and petrol vehicles and increased usage of renewable sources of electricity. However, it is assumed for the purposes of this assessment that future levels of NO_2, PM_{10} and $PM_{2.5}$ will be similar to the baseline conditions.

Operational noise: There has been a trend of renewable energy development in the area, with Woodhouse Windfarm and Woodhouse Substation becoming operational in 2015. The addition of further wind energy development, for example the Authorised Knocknamona windfarm will mean additional noise sources in the area and an increase in ambient noise levels albeit within the bounds of the noise limits as imposed by conditions of planning.

Operational EMF: There has been a trend of renewable energy development in the area, with Woodhouse Windfarm and Woodhouse Substation becoming operational in 2015. The addition of further wind energy development, for example the Authorised Knocknamona windfarm will mean additional EMF sources in the area.

10.2.1.6 The 'Do Nothing Scenario' (the Environment if the Development is not carried out)

If the KWF Grid Connection does not proceed, the effects on the environment will not occur, and the baseline environment will only change in line with the trends identified above.

Air Quality: The baseline levels of dust including PM_{10} and $PM_{2.5}$ are likely to remain at existing levels. In Ireland the primary sources of Particulate Matter (PM_{10} and $PM_{2.5}$) are vehicular emissions and burning of solid fuels for heating. Due to the nature of the area (remotely populated with no congested roads) PM emissions are unlikely to change dramatically in future years. Small fluctuations are likely in line with previous trends.

Noise: The baseline levels will increase in line with the trends identified above.

EMF: Electrical and Users of Electronic Equipment and radio frequency technology will increasingly become more present in everyday life; the expansion of the power infrastructure in the country is also expected albeit at a much slower rate; however government regulations will ensure EMF levels remain significantly lower than the ICNIRP standard limits.

10.2.1.7 Description of the RECEIVING ENVIRONMENT for Air

The receiving environment is the likely state of the baseline environment at the time of construction/operation/decommissioning as relevant i.e. baseline + trends.

Air Quality: There are no specific future trends for construction dust emissions in the area of the KWF Grid Connection. It is assumed in this report that the baseline environment identified above will be the receiving environment.

Noise and Vibration: As there is potential for KWF Grid Connection to be built during the same period as Authorised Knocknamona Windfarm, it is assumed that the receiving environment will include construction works for Knocknamona Windfarm.

EMF: A continued adoption of electrical and electronic infrastructure and equipment, will increase the background level of EMF at a very slow rate over time. It is not expected that EMF levels will increase significantly above existing average levels of 10V/m or 0.2µT in local residents and the receiving environment during the operational stage is assumed to be similar to the baseline environment identified above.

Relevant Figure (at the end of this chapter)

Figure 10.1: Location of KWF Grid Connection in relation to Air
Figure 10.2.1: Study Area for Air (Construction Stage)
Figure 10.2.2: Study Area for Air (Operational Stage Noise)
Figure 10.2.3: Study Area for Air (Operational Stage EMF)

10.2.2 EVALUATION OF IMPACTS to Air

In this Section, the direct or indirect impacts and the cumulative impacts of KWF Grid Connection on Air are described.

10.2.2.1 Potential Impacts Evaluated for Air

A conceptual site model exercise was carried out to identify potential impacts through the examination of the specific pathways between the project (source) and the sensitive aspect (receptor).

The potential for impacts was **examined in the absence of mitigation measures**, and **based on the description of development, standard construction methodologies, construction activities and operational activities as described in Chapter 5**: **Description of the Development**.

The potential impacts which were evaluated are listed in the 1st column of the table below. As summarised in the table below, **no significant effects are likely to occur**.

Table 10-16 Conclusion of the Evaluation of Potential Impacts to Air

Potential Impacts which were evaluated	Relevant Stage of KWF Grid Connection	Direct Impact of KWF Grid Connection	Cumulative Impact with the Authorised Knocknamona Windfarm	Impact with Woodhouse Windfarm and Woodhouse Substation	Cumulative Whole Knocknamona Windfarm Project Impact
Increase in Airborne Dust	Construction	**Imperceptible**	Imperceptible	No potential for cumulative impact	**Not Significant**
Deterioration in Ambient Air Quality due to traffic derived pollutants	Construction	**Neutral**	Neutral	Neutral	**Not Significant**
Increase in Ambient Noise Levels	Construction	**Imperceptible**	No potential for Impact	No potential for cumulative impact	**Not Significant**
Increase in Ambient Noise Levels	Operational	**Imperceptible**	No Impact	No potential for cumulative impact	**Not Significant**
Increase in Ambient EMF	Operational	**No Direct Impact**	No Impact	No potential for cumulative	**Not Significant**

Levels at Local Residences				impact	
Increase in Ambient EMF Levels on roads and lands & Interference with AIMDs	Operational	**Imperceptible**	Imperceptible to Slight	Imperceptible to Slight	**Not Significant**
Vibration damage to buildings or internal nuisance to residents	Construction	**Neutral**	No Impact	Neutral	**Not Significant**
Vibration damage to buildings or internal nuisance to residents	Operational	**Neutral**	Neutral	Neutral	**Not Significant**
Shadow Flicker Occurrence	Operational	**No Impact**	No Impact	Neutral	**Not Significant**

In order to keep this EIA Report concise and focused on potential significant impacts, where the evaluation of potential impacts found no significant impacts from the development, the evaluation tables are presented in the appendix to the chapter. Because no significant impacts to Air are likely to occur, the Impact Evaluation Tables for the potential impacts listed in the table above are in Appendix 10.1.

Relevant Appendix (at the end of this chapter)

Appendix 10.1 Evaluation of Potential Impacts to Air
Appendix 10.2: Air Quality Monitoring & Standards
Appendix 10.3: Noise Impact Assessment
Appendix 10.4 Explanation & Modelling of EMF

10.2.2.2 Summary of the Significance of the Potential Impacts to Air

As outlined in the table above, negative **impacts to Air as a direct result of KWF Grid Connection, where there is potential for impact, will be no greater than Imperceptible**. The background levels of particulate matter in the area, are significantly below the air quality standards limit values. There is a negligible potential for dust soiling or human health impacts as a result of earthworks, construction or trackout activities. All works will be short-term and temporary in nature. Due to the linear nature of the KWF Grid Connection, any properties or people will be affected for only part of the construction period. There are no residences within 100m of the construction works area, the nearest property is 330m distance. No works are required for the delivery of abnormal loads through the Woodhouse Windfarm main entrance. Construction traffic from KWF Grid Connection will make a negligible contribution to local traffic. There will be a temporary increase in ambient noise levels in proximity to the construction works. The noise emissions from the additional plant at Woodhouse Substation will not be discernible at the nearest dwelling during operation. The intensity of vibrations due to construction works and traffic will be low-level. The levels of EMF from KWF Grid Connection will be substantially below the limits suggested by international guidelines and there are no houses within 100m of the operating cables or electrical equipment to be installed. Any people (Transient People) passing close to construction works or the operational KWF Grid Connection will only be briefly or momentarily exposed to increased dust, noise, vibration or EMF.

Cumulative impacts if any, of KWF Grid Connection with Authorised Knocknamona Windfarm will not be greater than Imperceptible to Slight; this is generally due to the limited extent of overlap of KWF Grid Connection works with Authorised Knocknamona Windfarm works; the temporary duration of construction works; the small level of increases in cumulative construction dust, noise, vibration and EMF; the imperceptible increase in ambient noise from Woodhouse Substation during operation due to the additional equipment proposed therein; there is no blasting or piling required for the construction of Knocknamona Windfarm and operational windfarms are not a significance source of vibration; and the absence of any local residents or community facilities within 100m of both KWF Grid Connection and Knocknamona Windfarm. Regarding effects of EMF on Transient People, the whole project effect will be Imperceptible, based on the low magnitude of emissions at any point within 100m of KWF Grid Connection and Knocknamona Windfarm (including where these two projects overlap) and substantially below the ICNIRP threshold values. And no potential for cumulative impacts from shadow flicker occurrence as there are no turbines proposed for KWF Grid Connection. **Overall the 'whole project' effect will not be significant.**

When Woodhouse Windfarm and Woodhouse Substation are also taken into account, cumulative impacts will not be greater than Imperceptible to Slight, this is generally due to operational status of Woodhouse Substation and Woodhouse Windfarm, and therefore will not contribute to any construction dust, construction noise or vibration. The operational noise from the additional plant in Woodhouse Substation will not be discernible at the nearest dwelling and, as there is no impact from KWF Grid Connection at this dwelling, there can be no cumulative impact with Woodhouse Windfarm or Woodhouse Substation. Worst case levels of EMF from operational turbines, Substation and underground cables will be imperceptible and substantially below the ICNIRP guideline threshold. There are no residences or community facilities within 100m of KWF Grid Connection and Woodhouse Windfarm or Woodhouse Substation.

10.3 Summary of the Air Chapter

The Air chapter examines the effects of KWF Grid Connection development on the environmental topic Air.

The following aspects of Air were considered during scoping for this topic chapter: Air (air quality, levels of noise, vibration and EMF), Telecommunication Signals and Sensitive Ecological Receptors.

Air (air quality, levels of noise, vibration and EMF) was deemed to be sensitive to the development and was scoped in for detailed examination.

The other aspects were scoped out because the effects would be No Likely Impact (Telecommunication Signals) or the aspect is examined elsewhere in the EIAR (Sensitive Ecological Receptors - See Chapter 7: Biodiversity). (Rationale for scoping out Section 10.1.3.2)

In relation to the sensitive aspect Air which were scoped in, impacts were evaluated (in Section 10.2) as follows:

- **Air** : potential negative impacts were evaluated as follows
    - Air Quality – ranges from Neutral to Imperceptible
    - Noise & Vibration – ranges from No Impact to Imperceptible
    - EMF – ranges from No Impact to Imperceptible to Slight
    - Vibration – No impact to Neutral
    - Shadow Flicker Occurrence – No Impact

Related Documents
Non-Technical Summary of Chapter 10 in Volume C1: Non-Technical Summary: Section 10

Figures for Air chapter

Figure 10.1	Location of KWF Grid Connection in relation to Air
Figure 10.2.1	Study Area for Air (construction stage)
Figure 10.2.2	Study Area for Air (Operational Stage Noise)
Figure 10.2.3	Study Area for Air (Operational Stage EMF)

Appendices for Air chapter

Appendix 10.1	Evaluation of Potential Impacts to Air
Appendix 10.2	Air Quality Monitoring & Standards
Appendix 10.3	Noise Impact Assessment
Appendix 10.4	Explanation and Modelling of EMF

10.4 Reference List

Transport Infrastructure Ireland (TII) (2022) PE-ENV-01106: Air Quality Assessment of Specified Infrastructure Projects – Overarching Technical Document

Institute of Air Quality Management (IAQM) (2014) Guidance on the Assessment of Dust from Demolition and Construction

Environmental Protection Agency (EPA) (2022) Air Quality in Ireland 2021 (and previous reports 2012 – 2020)

The Institute of Environmental Management and Assessment (2014) 'Guidelines for Environmental Noise Impact Assessment', IEMA UK.

Transport Infrastructure Ireland (2014) Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes. Dublin.

British Standard 5228 (2014) 'Noise and Vibration Control on Construction and Open Sites Parts 1& 2'

ISO 9613-2 (1996) Attenuation of sound during propagation outdoors.

ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1Hz – 100 kHz) (2010)

ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1Hz – 100 kHz) (1998)

Figure 10.1 - Location of KWF Grid Connection in relation to Air

Legend:

- KWF Grid Connection Construction Works Area
- Access Road through Woodhouse Windfarm Entrance
- House within 1km of KWF Grid Connection
- Aglish Village — Town/Village

Villierstown Village

Aglish Village

KWF Grid Connection Construction Works Area

N

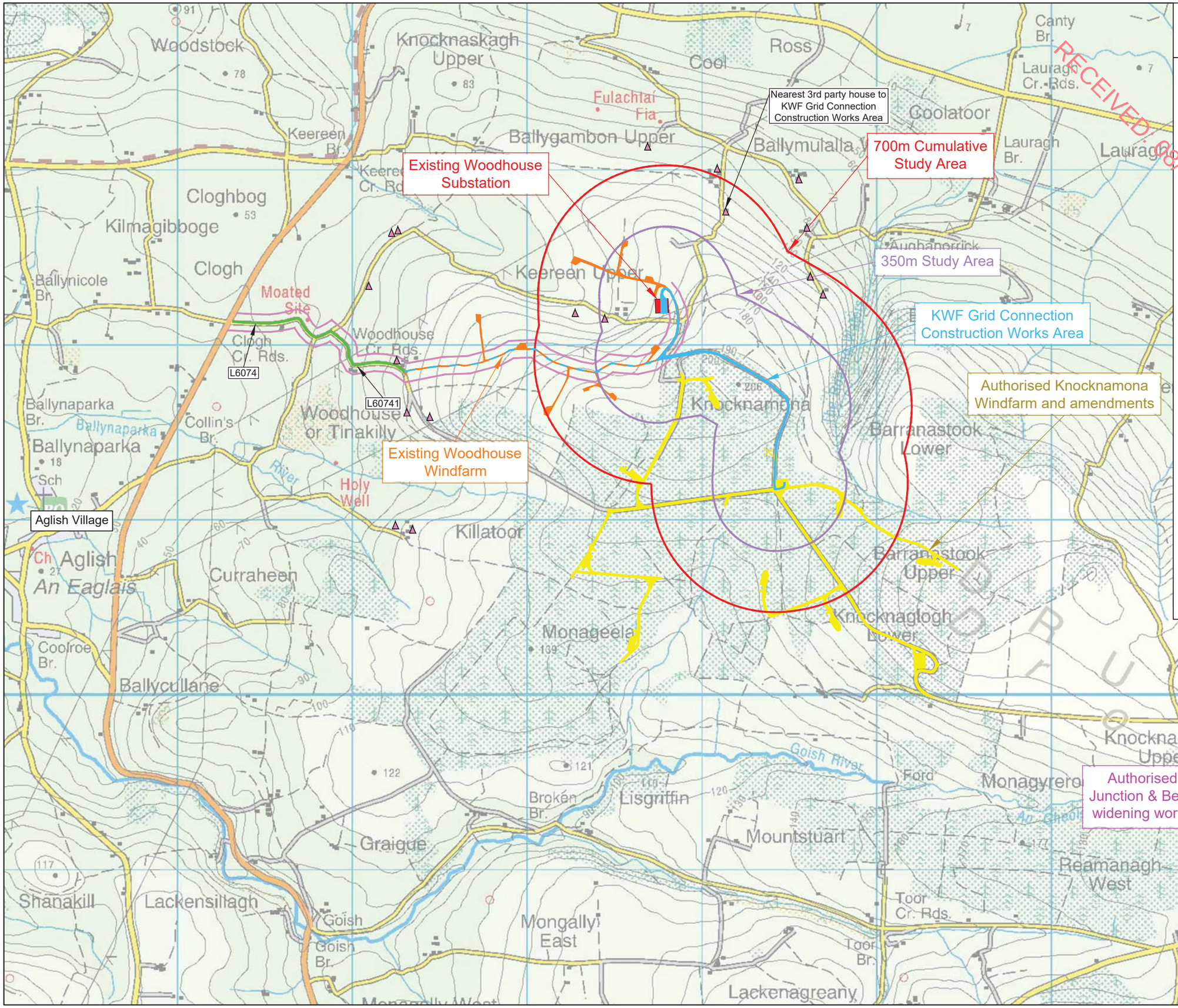


Figure 10.2.1 - Study Area for Air (Construction Stage)

Legend:

KWF Grid Connection:

- KWF Grid Connection Construction Works Area
- Access Road through Woodhouse Windfarm Entrance

Study Area Extents:

- KWF Grid Connection Construction Dust, Noise & Vibration: 350m
- Cumulative Construction Dust, Noise & Vibration: 700m
- 50m from the Local Roads L60741 and L6074 and Woodhouse Windfarm access roads to be used for delivery of construction materials and turbine component loads

Whole Project:

- Authorised Knocknamona Windfarm and amendments
- Authorised Junction & Bend widening works

Other Projects:

- Existing Woodhouse Substation
- Existing Woodhouse Windfarm

Map Features:

- Houses within 1km of KWF Grid Connection
- Local Haul Routes on Local Roads
- L6074 Road Identification Number

Figure 10.2.2 - Study Area for Air (Operational Stage Noise)

Legend:

KWF Grid Connection :

- KWF Grid Connection Construction Works Area
- Access Road through Woodhouse Windfarm Entrance

Study Area Extents:

- Houses within 1 km of KWF Grid Connection

Whole Project:

- Authorised Knocknamona Windfarm and amendments

Other Projects:

- Existing Woodhouse Substation
- Existing Woodhouse Windfarm

Map Features:

- Noise Survey Locations
- H9 House ID

Existing Woodhouse Substation

Nearest 3rd party house to Woodhouse Substation

Existing Woodhouse Windfarm

KWF Grid Connection Construction Works Area

Authorised Knocknamona Windfarm and amendments

H1 H2 H3 H4 H5 H6 H7 H8 H9 H10 H11 H12 H13 H14 H15 H16 H17

Fulachtaí Fia

Ballygambon Upper

Ballymulalla West

Keereen Br.

Keereen Cr. Rds

Keereen Lower

Keereen Upper

Moated Site

Clogh Cr. Rds.

Woodhouse or Tinakilly

Holy Well

River

Killatoor

Curraheen

Monageela

Knocknamona

Barranastook Lower

Barranastook Upper

Knocknaglogh Lower

Aughano Br.

N

Figure 10.2.3 - Study Area for Air (Operational Stage EMF)

Legend:

KWF Grid Connection:

- KWF Grid Connection Construction Works Area
- Access Road through Woodhouse Windfarm Entrance

Study Area Extents:

- KWF Grid Connection EMF: 100m from KWF Grid Connection cabling and additional plant in Woodhouse Substation.
- Cumulative EMF: 200m from KWF Grid Connection cabling and additional plant in Woodhouse Substation.

Whole Project:

- Authorised Knocknamona Windfarm and amendments
- Knocknamona Windfarm Cabling

Other Projects:

- Existing Woodhouse Substation
- Existing Woodhouse Windfarm
- Woodhouse Windfarm Internal Cabling

Map Features:

- Houses within 1km of KWF Grid Connection
- Overhead Transmission Lines

Existing Woodhouse Substation

Existing Woodhouse Windfarm

200m Cumulative Study Area

100m Study Area

KWF Grid Connection Construction Works Area

Authorised Knocknamona Windfarm and amendments

220kV Overhead Transmission Line

110kV Overhead Transmission Line

Keereen Br.

Keereen Cr. Rds

Keereen Lower

Ballygambon Upper

Ballymulalla West

Keereen Upper

Moated Site

Woodhouse Cr. Rds.

Knocknamona

Holy Well

Killatoor

Monageela

Barranastook Upper

Knocknaglogh Lower

N

Appendix 10.1: Evaluation of Potential Impacts to Air

This Appendix contains Impact Evaluation Table for the following Sensitive Aspect:

Sensitive Aspect Details as per Main EIA Report		Relevant Section of Main EIA Report:
Sensitive Aspect No. 1	Air	Section 10.2 of the Main EIA Report

Evaluation of Potential Impacts to AIR

In relation to **Air**, the following potential impacts were evaluated:

Potential Impacts which were evaluated	**Relevant Stage of KWF Grid Connection**	**Evaluated in this Appendix in Table:**
Increase in Airborne Dust	Construction	A10.1, Table 1
Deterioration in Ambient Air Quality due to traffic derived pollutants	Construction	A10.1, Table 2
Increase in Ambient Noise Levels	Construction	A10.1, Table 3
Increase in Ambient Noise Levels	Operational	A10.1, Table 4
Increase in Ambient EMF Levels at Local Residences	Operational	A10.1, Table 5
Increase in Ambient EMF Levels on roads and lands & Interference with AIMDs	Operational	A10.1, Table 6
Vibration damage to buildings or internal nuisance to residents (construction stage)	Construction	A10.1, Table 7
Vibration damage to buildings or internal nuisance to residents (operational stage)	Operational	A10.1, Table 8
Shadow Flicker Occurrence	Operational	A10.1, Table 9

A10.1 Table 1 Air - Increase in Airborne Dust

Impact Source	**Delivery of construction materials to works area, excavation and storage of materials.**
Impact Pathway (between Source and Sensitive Aspect)	Air/Wind
Brief Impact Description	During dry and windy weather conditions, construction dust emissions will arise from construction activities such as excavations, earth moving and backfilling. Vehicles transporting potentially dusty material to and from the site also have the potential to cause dust generation along the concentrated haul routes from the construction areas. Dust deposition rates will be greatest within 50 m of the source. An increase in airborne dust can cause dust soiling effects at property and increase the risk of health impacts to local residents and members of the local community.
Project Stage:	Construction
A: Direct/Indirect Impacts of KWF Grid Connection	The **Direct Impact will be Imperceptible** because: There is a negligible potential for dust soiling or human health impacts as a result of earthworks, construction or trackout activities according to criteria set out in Section 10.1.6.1 of Chapter 10. • All works will be short-term and temporary in nature. Due to the linear nature of the KWF Grid Connection, any properties or people will be affected for only part of the construction period. In addition, only one property is within 350m of the works area, at 330m distance, all other properties are further than 350m from the works areas (where the highest potential for dust emissions will be). • No works required for the delivery of abnormal loads through the Woodhouse Windfarm main entrance. • The background levels of particulate matter are significantly below the air quality standards limit values.
B: Cumulative Impact of the Whole Project - KWF Grid Connection with the authorised Knocknamona Windfarm i.e. the windfarm; amendments to the windfarm to provide for larger turbines and Junction & Bend Widening Works to facilitate turbine component	**Imperceptible Whole Project Impact** because: • There is a low potential for dust soiling or human health impacts as a result of earthworks, construction or trackout activities as per the criteria set out in Section 10.1.6.1 of Chapter 10. • no properties nearer than 330m of both KWF Grid Connection and Authorised Knocknamona Windfarm. • The background levels of particulate matter are significantly below the air quality standards limit values. • Implementation of the Environmental Management Plan for the Authorised Knocknamona Windfarm, which includes dust control measures will minimise potential dust impacts. • The Larger Turbines at the Authorised Knocknamona Windfarm do not require additional groundworks, contracts or construction activity.

access through the windfarm site entrance at Knocknaglogh Lower	• The Junction & Bend Widening Works impact is Imperceptible because the works are very small scale; with minimal nearby receptors and the works will be of very short duration. • Impacts to Air as a result of the Authorised Knocknamona Windfarm were previously assessed by An Bord Pleanála in 2016 and 2021 as not significant. When the additional effects of KWF Grid Connection are taken into account, the combined whole project effect remains not significant.
Cumulative Impact with Woodhouse Substation and Woodhouse Windfarm	**No Potential for Cumulative Impact** because: • As the Woodhouse Substation and Woodhouse Windfarm are already constructed there is no potential for additional cumulative impacts. Cumulative impacts are confined to those associated with the Knocknamona Windfarm and KWF Grid Connection as described above.

A10.1 Table 2 Air - Deterioration in Ambient Air Quality due to traffic derived pollutants

Impact Source	Delivery of construction materials to works area, excavation and storage of materials.
Impact Pathway (between Source and Sensitive Aspect)	Air/Wind
Brief Impact Description	There is potential for a deterioration in ambient air quality as a result of traffic derived pollutants (NO_2, PM_{10}, $PM_{2.5}$).
Project Stage:	Construction
A: Direct/Indirect Impacts of KWF Grid Connection	The **Direct Impact will be Neutral** because: • The traffic levels associated with the KWF Grid Connection do not reach the criteria outlined in Section 10.1.6.1 of the Main Report (TII Criteria for Air Quality Assessment) for carrying out an air modelling assessment for traffic based pollutants as the increase in traffic levels will be substantially less than 1,000 Annual Average Daily Traffic (AADT) – In total 39 loads of stone and 4 loads of concrete, 23 loads of other construction materials will be delivered over a 4 month period, up to 25 construction personnel may travel to site daily. c.72 loads (including abnormal loads) carrying turbine components will use the roads periodically over the construction period for Knocknamona Windfarm over a 3 month period. Therefore any increase in local traffic will be negligible and consequently any potential increases in traffic derived pollutants will have a negligible effect in the context of the high level of baseline air quality (see also Appendix 10.2).
B: Cumulative Impact of the Whole Project - KWF Grid Connection with the authorised Knocknamona Windfarm i.e. the windfarm; amendments to the windfarm to provide for larger turbines and Junction & Bend Widening Works to facilitate turbine component access through the windfarm site entrance at	The **Whole Project Impact will be Neutral** because: • The traffic levels associated with the KWF Grid Connection and the Authorised Knocknamona Windfarm do not reach the criteria outlined in Section 10.1.6.1 of the Main Report, (TII Criteria for Air Quality Assessment) for carrying out an air modelling assessment for traffic based pollutants as the increase in traffic levels will be substantially less than 1,000 AADT (in total 131 over a 9 to 12 month period, with a the highest level being on the turbine foundation concrete pour days which will have c.50 loads of concrete per turbine being delivered along with construction worker transportation). Any potential increases in traffic derived pollutants will have a negligible effect in the context of the high level of baseline air quality. • No increase in construction traffic required for the Larger Turbines at Knocknamona Windfarm • The low number of traffic movements required for Junction & Bend Widening Works. • Impacts to Air as a result of Knocknamona Windfarm were previously assessed by An Bord Pleanála in 2016 and 2022 as not significant. When the additional

Knocknaglogh Lower	effects of KWF Grid Connection are taken into account, the combined whole project effect remains not significant.
C: Cumulative Impact with Woodhouse Substation and Woodhouse Windfarm	The **Cumulative Impact will be Neutral** because: • As the Woodhouse Substation and Woodhouse Windfarm are already constructed, and operational traffic associated with these two projects will be negligible, any contribution to cumulative traffic related pollutants will be negligible. • Cumulative impacts are confined to those associated with the Knocknamona Windfarm and KWF Grid Connection as described above.

A10.1 Table 3 Air - Increase in Ambient Noise Levels (Construction)

Impact Source	**Working plant and moving machinery and excavation activities**
Impact Pathway (between Source and Sensitive Aspect)	Air
Brief Impact Description	Temporary increase in ambient noise levels in proximity of the works (350m) for the duration of the works. A guidance threshold level of 65dB at distances of 320m is indicated.
Project Stage:	Construction
A: Direct/Indirect Impacts of KWF Grid Connection	**Direct Impact will be Imperceptible** because: • the very temporary duration, • relatively low noise levels, • It is expected that the guidance 65dB threshold will not be exceeded at distances of 120m and 60m, under worst-case and realistic scenarios, respectively. There are no properties nearer than 330m of a proposed works area, therefore the noise thresholds will not be exceeded. • The works will be limited to normal working hours with no night time works. • No works required for the delivery of turbine component loads through Woodhouse Windfarm. • Reversibility of the impact - Once completed there will be no further construction noise impact. See Section 4 of Appendix 10.3 Noise Impact Assessment
B: Cumulative Impact of the Whole Project - KWF Grid Connection with the authorised Knocknamona Windfarm i.e. the windfarm; amendments to the windfarm to provide for larger turbines and Junction & Bend Widening Works to facilitate turbine component access through the windfarm site entrance at Knocknaglogh Lower	**No potential** for **Whole Project Impact** because**:** • due to temporary nature of the KWF Grid Connection and Authorised Knocknamona Windfarm construction works periods. • no sensitive receptors within 350m of both KWF Grid Connection and Authorised Knocknamona Windfarm • As per Knocknamona Windfarm EIS 2015, it has been demonstrated that the construction phase of the wind farm will not exceed the relevant construction noise limit criteria at any noise sensitive location. • Reversibility of the impact - Once completed there will be no further construction noise impact. • The Larger Turbines for Knocknamona Windfarm do not require extra excavations or extra construction activities. • The Junction & Bend Widening Works are minor in scale, temporary and of short duration. • Noise related impacts as a result of Authorised Knocknamona Windfarm were previously assessed by An Bord Pleanála in 2016 and 2022 as not significant. When the additional effects of KWF Grid Connection are taken into account, the combined whole project effect remains not significant.

C: Cumulative Impact with Woodhouse Substation and Woodhouse Windfarm	**No potential** for **Cumulative Impact** because**:** As Woodhouse Windfarm and Woodhouse Substation are both constructed and operational, these projects will not contribute to construction noise sources. Any contribution of operational noise from turbines or the operating substation will not be significant given the temporary duration (2 months) of KWF Grid Connection works, and the absence of noise sensitive receptors in the Cumulative Study Area.

A10.1 Table 4 Air - Increase in Ambient Noise Levels (Operational)

Impact Source	**Operational additional plant in Woodhouse Substation**
Impact Pathway (between Source and Sensitive Aspect)	Air
Brief Impact Description	Increase in noise emissions from the additional plant in Woodhouse Substation at houses in the vicinity (within 1km of KWF Grid Connection Construction Works Area (CWA) and Access Road through Woodhouse Windfarm Site Entrance). There are 17 residential dwellings within 1km of KWF Grid Connection. In general dwellings are at a remove from the proposed KWF Grid Connection. H1 and H2 are the nearest to the substation, 330m and 460m respectively. H1 and H2 are landowners on which Woodhouse wind turbines and substation are located. The next nearest dwelling (H5) is 550m from the Construction Works Area and is the nearest 3rd party dwelling to the Woodhouse Substation.
Project Stage:	Operational
A: Direct/Indirect Impacts of KWF Grid Connection	**Imperceptible Direct Impact** because <u>Existing Ambient Noise</u> A baseline survey was conducted in April and June 2023. Two noise survey locations were chosen. The first location at the nearest dwelling to Woodhouse Substation (Location H1 – 330m west). The second location at a distance from Woodhouse Substation to give a representative result for houses in the vicinity (Location H8 – 817m east). <u>Results of the baseline survey for H1</u> - The daytime LAeq or ambient noise levels ranged from an average of 51 to 53dB(A). The night-time LAeq or ambient noise levels averaged 49dB(A). The main contributing noise sources at H1 are the resident's own milking parlour when operating, neighbouring Woodhouse Windfarm Turbines and wind through surrounding vegetation. Based on the criteria set out in EPA guidance document NG4, the measured background noise levels at H1 exceed the NG4 criteria of "Area of Low Background noise ". This location is deemed to be in an area of "All other Areas". <u>Results for H8</u> - The daytime LAeq or ambient noise levels ranged from an average of 39 to 45dB(A). The night-time LAeq or ambient noise levels ranged from an average of 32 to 33dB(A). The main contributing noise sources at H8 are the wind through surrounding vegetation and intermittent noise from agricultural activity i.e. milking parlour and agricultural vehicles. Based on the criteria set out in EPA guidance document NG4 the measured background noise levels at H8 fit the criteria for an "Area of Low Background noise ".

	Noise limit criteria – Based on the results of the background noise survey at H8, the more conservative noise limits associated with "Areas of Low Background Noise", have been applied to all the 17 residential dwellings in the vicinity, notwithstanding that H1 and H2 are in an "All other Areas". The EPA Noise threshold limits for Low Noise Environments is 45dB(A) during the Daytime period; 40dB(A) during the Evening period and 35dB(A) during the Night. Predicted Cumulative Operational Noise - Noise propagation from existing Woodhouse Substation and additional transformer at Woodhouse Substation associated with the KWF Grid Connection will result in noise levels not exceeding 31dB(A) at H1 (the nearest house). At H3, H4 and H5, the nearest 3rd party dwellings to Woodhouse Substation, the predicted noise levels from the Substation cumulatively with the additional electrical infrastructure associated with KWF Grid Connection will not exceed 21dB(A), 20dB(A) and 18dBA respectively. These noise levels are very low, in and around the threshold of detection for sound level meters, and unlikely to be audible above existing ambient noise levels. These levels are below the EPA noise limit criteria for Areas of Low Background Noise. The results of the cumulative operational noise assessment show that at all 17 No. houses the predicted substation noise emissions are below any of the EPA noise limit criteria for Areas of Low Background Noise. Further, there is a predicted maximum increase in noise levels at any of the houses, of 3dB(A) between the noise from the existing Woodhouse Substation alone and the existing Substation with the additional KWF Grid Connection equipment operating. A change of 3dB is just discernible by the human ear and very unlikely to be noticeable at such low emission levels. See Section 4 of Appendix 10.3 Noise Impact Assessment. Full details on Methodology; Baseline and Results can be found in Appendix 10.3 Noise Impact Assessment.
B: Cumulative Impact of the Whole Project - KWF Grid Connection with the authorised Knocknamona Windfarm i.e. the windfarm; amendments to the windfarm to provide for larger turbines and Junction & Bend Widening Works to facilitate turbine component access through the windfarm	**No Whole Project Impact** because: • No potential for cumulative impacts - the additional noise from the additional plant in Woodhouse Substation will be imperceptible at the nearest house and other houses surveyed and, because there is no impact from KWF Grid Connection at this dwelling, there can be no cumulative impact with Authorised Knocknamona Windfarm. • With regard to the Larger Turbines, the larger modern turbines have similar noise levels to the previously authorised turbines, these turbines can be controlled, via reduced noise operating modes, to stay within the authorised noise limits, there is no change to the location of the turbines, no increase in the number of turbines and no change required to the windfarm substation. • With regard to the Junction & Bend Widening Works there is no impact due to the scale and temporary nature of the works. • In relation to the whole project effect, the Authorised Knocknamona Windfarm was assessed by An Bord Pleanála in 2016 and 2022 as having an acceptable level of noise emissions in relation to effects to local residents. As KWF Grid Connection will not cause any discernible additional noise, the whole project effect during operation, remains not significant.

site entrance at Knocknaglogh Lower	
C: Cumulative Impact with Woodhouse Substation and Woodhouse Windfarm	**No Cumulative Impact because**: No potential for cumulative impacts- the additional noise from the additional plant in Woodhouse Substation will not be discernible at the nearest dwelling and, as there is no impact from KWF Grid Connection at this dwelling, there can be no cumulative impact with Woodhouse Windfarm or Woodhouse Substation.

A10.1 Table 5 Air - Increase in Ambient EMF Levels at local residences (Operational)

Impact Source	**Underground Cabling and additional plant in Woodhouse Substation**
Impact Pathway (between Source and Sensitive Aspect)	Air/Ground
Brief Impact Description	There will be some increase in ambient electromagnetic field levels within 100m of electrical or communication parts. There are no houses or community facilities within 100m. Details of the modelling of worst-case EMF emissions are included in Appendix 10.4 Explanation and Modelling of EMF
Project Stage:	Operational
A: Direct/Indirect Impacts of KWF Grid Connection	**No Direct Impact** because: • There are no houses or community facilities within 100m. The nearest house is 330m from the works in Woodhouse Substation.
B: Cumulative Impact of the Whole Project - KWF Grid Connection with the authorised Knocknamona Windfarm i.e. the windfarm; amendments to the windfarm to provide for larger turbines and Junction & Bend Widening Works to facilitate turbine component access through the windfarm site entrance at Knocknaglogh Lower	**No Whole Project Impact** because: • There are no houses within 100m of either KWF Grid Connection or Authorised Knocknamona Windfarm. • The Larger Turbines amendment effect is also 'No Impact' because there is no change to the location, number of turbines, rated capacity of the cabling and no notable difference in EMF levels emitted from the electrical equipment in the larger turbines, including the turbine transformer. • There is no potential for impact from the Junction and Bend Widening Works.
C: Cumulative Impact with Woodhouse Substation and Woodhouse Windfarm	**No Cumulative Impact** because: • There are no houses or community facilities within 100m of KWF Grid Connection and Woodhouse Windfarm or Woodhouse Substation, and as stated in the row above, no houses or community facility within 100m of both KWF Grid Connection and Authorised Knocknamona Windfarm.

A10.1 Table 6 Air - Increase in Ambient EMF Levels on roads and lands & Interference with AIMDs (Operational)

Impact Source	**Underground Cabling and additional plant in Woodhouse Substation**
Impact Pathway (between Source and Sensitive Aspect)	Air/Ground
Brief Impact Description	There will be some increase in ambient electromagnetic field levels within 100m of electrical or communication parts. People passing through the area or working in the area (called Transient People in Chapter 6 Population & Human Health) may be present on the public road at Woodhouse Substation or along forestry/farm/windfarm roads or lands within 100m of electrical cabling, plant and apparatus. AIMDs worn by people also has potential to be affected by increased EMF. Details of the modelling of worst-case EMF emissions are included in Appendix 10.4 Explanation and Modelling of EMF
Project Stage:	Operational
A: Direct/Indirect Impacts of KWF Grid Connection	The **Direct Impact will be Imperceptible** because: • The number of transient people passing through the study area is expected to be low. • Transient people have the potential to be affected by increased EMF when standing at the Woodhouse Substation perimeter fence, walking along the forestry or farm access roads along which the underground cables are routed and public road users on the L6074 local road in the vicinity of Woodhouse Substation where underground cables cross under the public road L6074. • Levels from the Woodhouse Substation additional equipment at the Woodhouse Substation perimeter fence: electric field levels will be 40V/m - the guideline limit is 5000V/m, and magnetic field levels will be 1µT - the guideline limit is 100µT. • Levels from the Underground Cabling standing directly over the cable: there are no electric field levels from the Underground Cabling due to the complete screening of these fields by both the metallic sheath surrounding the cables and the earth (backfill) materials above the cables. Magnetic field levels will be 3.8µT - the guideline limit is 100µT. • The levels of EMF from KWF Grid Connection will be substantially below the ICNIRP threshold levels, and the Irish Government Department of Communications, Marine and Natural Resources, have stated "No adverse health effects have been established below the limits suggested by international guidelines". Therefore, it is evaluated that neither Transient People nor any AIMD worn by them will be affected by the development; • the momentary to brief exposure of any transient people (and any fitted AIMDs); • the occasional nature of any exposure;

	• the reversibility of the exposure as transient person (and any AIMD fitted) move away from the location of the underground cables or away from the Woodhouse Substation; • Levels of EMF drop off quickly with distance and at 30m of the Underground Cabling, the worst case magnetic field levels will be 0.02 µT.
B: Cumulative Impact of the Whole Project - KWF Grid Connection with the authorised Knocknamona Windfarm i.e. the windfarm; amendments to the windfarm to provide for larger turbines and Junction & Bend Widening Works to facilitate turbine component access through the windfarm site entrance at Knocknaglogh Lower	The **Whole Project Impact will be Imperceptible to Slight** significance because: • Transient people have the potential to be affected by a cumulative increase EMF along/near to the forestry roads underneath which the KWF Grid Connection underground cables or Authorised Knocknamona Windfarm underground cables are routed. Slightly higher levels of EMF will occur in proximity to Knocknamona Substation due to the convergence of internal windfarm cables and KWF Grid Connection underground cabling, in proximity to the electrical plant and apparatus at Knocknamona Windfarm Substation. • Cumulative levels from the Underground Cables and adjacent Knocknamona Internal Windfarm Cables, standing directly over the cables along the existing forestry roads at the Knocknamona Windfarm Substation: there are no electric field levels from the Underground Cablings due to the complete screening of these fields by both the metallic sheath surrounding the cables and the earth (backfill) materials above the cables. Magnetic field levels will be 7.7µT - the guideline limit is 100µT. However levels of EMF drop off quickly with distance and at 30m of the Underground Cabling, the worst case magnetic field levels will be 0.036 µT. This is equivalent to a low magnitude, as per Section 10.1.6.3 of Chapter 10. This is considered to have imperceptible significance. • The worst case EMF levels right beside a turbines, there are no electric field levels from the turbines as the electric field generated by the transformer, generator and cables are screened internally by the housing over the transformer and generator, and by the steel turbine tower. The turbine's transformer and generator are also at a substantial height above ground level. Magnetic fields will be very low due to the shielding which will be provided by the extensive metalwork within the wind turbine, which will include turbine housings and steelwork. Right beside the turbine, worst case EMF are expected to be 0.2µT. Based on this Low magnitude, is considered to have imperceptible significance. • There is no change to the location, number of turbines, rated capacity of the cabling and no notable difference in EMF levels emitted from the electrical equipment in the larger turbines, including the turbine transformer. Also there is no potential for impact from the Junction and Bend Widening Works. • Overall the whole project effect will be Imperceptible, based on the Low magnitude of emissions at any point within 100m of KWF Grid Connection and Knocknamona Windfarm (including where these two projects overlap) and substantially below the ICNIRP threshold values. • the momentary to brief exposure of any transient equipment present. • the occasional nature of any exposure.

	• the reversibility of the exposure as the machine or person wearing an AIMD moves away from the location of the underground cables. Levels of EMF drop off quickly with distance and at 30m of the Underground Cabling, the worst case magnetic field levels will be 0.036 µT.
C: Cumulative Impact with Woodhouse Substation and Woodhouse Windfarm	The **Cumulative Impact will be Imperceptible to Slight** because: • Transient people have the potential to be affected by a cumulative increase in EMF when near the KWF Grid Connection underground cable which are routed adjacent to internal windfarm cables for Woodhouse Windfarm along the farm roads and the public road crossing leading to the Woodhouse Substation, and in proximity to the Woodhouse Substation. • There is no potential for cumulative impacts of Knocknamona Windfarm with either Woodhouse Windfarm or Woodhouse Substation due to the separation distances between the projects (i.e. greater than 200m); • Cumulative levels from the Underground Cables standing directly over the cables along windfarm/farm roads or at the public road crossing: there are no electric field levels from the Underground Cabling due to the complete screening of these fields by both the metallic sheath surrounding the cables and the earth (backfill) materials above the cables. Magnetic field levels will be 7.7µT – the guideline limit is 100µT. However levels of EMF drop off quickly with distance and at 30m of the Underground Cabling, the worst case magnetic field levels will be 0.036 µT. • At the Woodhouse Substation fence, close to the point where Woodhouse Windfarm internal windfarm cables and KWF Grid Connection underground cabling will be routed, the worst case electric and magnetic fields will be 40V/m and 4.9µT. This is equivalent to a low magnitude, as per Section 10.1.6.3 of Chapter 10. This is considered to have imperceptible significance. • Close to the existing 110kV overhead line, north of the L6074 public road cable crossing location, where both Woodhouse Windfarm and KWF Grid Connection underground cabling will be located, the worst case electric and magnetic fields will be 1230V/m and 22.2µT. This is equivalent to a low magnitude, as per Section 10.1.6.3 of Chapter 10. This is considered to be imperceptible to slight and will be substantially below the ICNIRP threshold values. • the momentary to brief exposure of any transient equipment present. • the occasional nature of any exposure. • the reversibility of the exposure as the machine or person wearing an AIMD moves away from the location of the underground cables or away from the Woodhouse Substation. Levels of EMF drop off quickly with distance and at 30m of the Underground Cabling, the worst case magnetic field levels will be 1.156 µT.

A10.1 Table 7 Air - Vibration Damage to Buildings or Internal Nuisance to Residents

Impact Source	**Road opening, rock breaking, earthmoving, operation of machinery and movement of construction traffic along access roads**
Impact Pathway (between Source and Sensitive Aspect)	Air, Ground
Brief Impact Description	Potential nuisance and structural damage.
Project Stage:	Construction
A: Direct/Indirect Impacts of KWF Grid Connection	The **Direct Impact will be Neutral** because of: • the minor scale and magnitude of the KWF Grid Connection works, • the low-level intensity of any vibrations and • the separation distance between and works areas and dwellings (closest dwelling 330m).
B: Cumulative Impact of the Whole Project - KWF Grid Connection with the authorised Knocknamona Windfarm i.e. the windfarm; amendments to the windfarm to provide for larger turbines and Junction & Bend Widening Works to facilitate turbine component access through the windfarm site entrance at Knocknaglogh Lower	**No Whole Project Impact** because: • no residential dwellings or any other property within 350m of both the KWF Grid Connection and Knocknamona Windfarm construction works area boundaries. • Vibration related impacts as a result of Knocknamona Windfarm were previously assessed by An Bord Pleanála in 2016 and 2022 as not significant. When the neutral effects of KWF Grid Connection are taken into account, the whole project effect will also not be significant. • There is no blasting or piling requirements for the turbine installation; No change to rock breaking requirements; No change to the delivery of construction materials; No change to the operation of machinery or movement of construction traffic and no change in extent, duration or level of construction works due to the Larger Turbines. • There are no vibration impacts from the Junction & Bend Widening Works.
C: Cumulative Impact with Woodhouse Substation and Woodhouse Windfarm	**Cumulative Impact will be Neutral** because: • Woodhouse Windfarm and Woodhouse Substation are both operational, and therefore will not contribute to cumulative sources of vibration during the construction stage of KWF Grid Connection; • There are no sources of discernible vibration effects from either operational underground cabling or operational substations or from operational windfarms.

A10.1 Table 8 Air - Vibration damage to buildings or internal nuisance to residents (operational stage)

Impact Source	**Operational additional plant in Woodhouse Substation, operational underground cabling**
Impact Pathway (between Source and Sensitive Aspect)	Ground
Brief Impact Description	Potential nuisance and/ or structural damage
Project Stage:	Operational
A: Direct/Indirect Impacts of KWF Grid Connection	The **Direct Impact will be Neutral** because: • There are no sources of discernible vibration effects from either the operational underground cabling or from the operational additional plant in Woodhouse Substation • The separation to the nearest residence (330m)
B: Cumulative Impact of the Whole Project - KWF Grid Connection with the authorised Knocknamona Windfarm i.e. the windfarm; amendments to the windfarm to provide for larger turbines and Junction & Bend Widening Works to facilitate turbine component access through the windfarm site entrance at Knocknaglogh Lower	**Whole Project Impact will be Neutral** because: • There are no sources of discernible vibration effects from the operational underground cabling, • Operational windfarms are not a significance source of vibration • Vibration related impacts as a result of Authorised Knocknamona Windfarm were previously assessed by An Bord Pleanála in 2015 and 2022 as not significant. When the neutral effects of KWF Grid Connection are taken into account, the whole project effect will also not be significant.
C: Cumulative Impact with Woodhouse Substation and Woodhouse Windfarm	The **Cumulative Impact will be Neutral** because: • There are no sources of discernible vibration effects from either operational underground cabling or operational substations or from operational windfarms, • The separation distances to local residents, with just one residence (330m) within 350m of the KWF Grid Connection.

A10.1 Table 9 Air - Shadow Flicker Occurrence (Operational)

Impact Source	**Operational turbines (cumulative source only)**
Impact Pathway (between Source and Sensitive Aspect)	Air
Brief Impact Description	Potential nuisance
Project Stage:	Operational
A: Direct/Indirect Impacts of KWF Grid Connection	**No Direct Impact** because: • No turbines proposed for KWF Grid Connection project, the only above ground structures relate to additional apparatus and plant at Woodhouse Substation.
B: Cumulative Impact of the Whole Project - KWF Grid Connection with the authorised Knocknamona Windfarm i.e. the windfarm; amendments to the windfarm to provide for larger turbines and Junction & Bend Widening Works to facilitate turbine component access through the windfarm site entrance at Knocknaglogh Lower	**No Whole Project Impact** because: • No sources of shadow flicker from KWF Grid Connection, therefore no potential for cumulative impacts with Authorised Knocknamona Windfarm turbines. • Shadow flicker related impacts as a result of Authorised Knocknamona Windfarm were previously assessed by An Bord Pleanála as not significant. In relation to the amendment to provide for Larger Turbines, while they have a larger swept area and higher tower, and therefore have the potential to cause more shadow flicker, the larger turbines will be fitted with a shadow flicker control module (mitigation). The Shadow Flicker Control Modules will be set to eliminate shadow flicker completely and the developer has already committed to using this setting at the relevant turbine/s to eliminate shadow flicker at sensitive receptors during that element planning process.
C: Cumulative Impact with Woodhouse Substation and Woodhouse Windfarm	The **Cumulative Impact will be Neutral** because: • No sources of shadow flicker from KWF Grid Connection, therefore no potential for cumulative impacts with either Woodhouse Windfarm turbines.

Appendix 10.2: Air Quality Monitoring & Standards

The data and descriptions in this appendix have informed Chapter 10: Air of the EIA Report, in relation to air quality levels in the existing environment.

CONTENTS

A10.2.1 EPA Monitoring Programme Results

The EPA and Local Authorities have undertaken air quality monitoring programmes in recent years. For air quality monitoring and assessment purposes under the requirements of S.I. No. 739 of 2022 the EPA have divided the country into various Air Quality Zones[1]. Zone A is defined as Dublin and its environs, Zone B is defined as Cork City, Zone C is defined as 23 urban areas with a population greater than 15,000 and Zone D is defined as the remainder of the country. The KWF Grid Connection is within Zone D. The most recent annual report on air quality "*Air Quality in Ireland 2021*[2], details the range and scope of monitoring undertaken throughout Ireland.

Long-term PM_{10} monitoring was carried out at two rural Zone D locations, Killkitt and Claremorris[2]. The annual average concentration measured at these sites from 2012 - 2021 ranged from 7 - 13 µg/m^3. The average result for both locations indicates an upper average annual mean concentration of no more than 11 µg/m^3. The long term results for both locations show that levels of PM_{10} are well below the annual mean limit value of 40 µg/m^3. There was at most one exceedance of the 24-hour PM_{10} concentration of 50 µg/m^3 at either station in recent years, albeit 35 exceedances are permitted per year before the standard is deemed to have been breached. Based on the above information a conservative estimate of the current 2023 background PM_{10} concentration for the region of the KWF Grid Connection is 11 µg/m^3.

Long-term monitoring for both PM_{10} and $PM_{2.5}$ was carried out at the station in Claremorris; this allows the $PM_{2.5}/PM_{10}$ ratio to be calculated. The results of $PM_{2.5}$ monitoring at a Zone D site of Claremorris over the period 2012 – 2021 show an annual mean result ranging from 4 – 8 µg/m^3. This indicated an average $PM_{2.5}/PM_{10}$ ratio ranging from 0.36 – 0.80[2]. Long-term average $PM_{2.5}$ concentrations measured at these locations were significantly lower than the annual average limit value of 25 µg/m^3. Based on this information, the conservative ratio of 0.8 was used to generate a rural background $PM_{2.5}$ concentration in 2023 of 8.8 µg/m^3.

Long-term NO_2 monitoring was carried out at the three rural Zone D locations of Castlebar, Kilkitt and Emo[2]. The NO_2 annual average in 2021 across all three sites ranged from 2 - 6 µg/m^3. The NO_2 annual average result for the Zone D sites over the period 2012 – 2022 ranged from 2 - 11 µg/m^3. Hence long-term average concentrations measured at these locations were substantially lower than the annual average limit value of 40 µg/m^3. Data for the rural background stations in Kilkitt and Emo are most representative of the project location. Long-term data over the period 2012 – 2021 indicates an annual mean concentration ranging from 2 - 5 µg/m^3. Based on the above information, a conservative estimate of the background NO_2 concentration, for the region of the KWF Grid Connection is 5 µg/m^3.

In summary, existing baseline levels of PM_{10}, $PM_{2.5}$ and NO_2 based on extensive long-term data from the EPA are well below ambient air quality limit values in the study area. There is no monitoring of baseline dust concentrations (PM greater than 10 microns) but these are also predicted to be low due to the nature of the area.

[1] EPA (2023) https://airquality.ie/

[2] EPA (2022) Air Quality in Ireland 2021 (& previous annual reports 2012 - 2020)

A10.2.2 Air Quality Standards

Ambient Air Quality Standards were established under EU Directive 2008/50/EC which sets limit values for certain air pollutants in order to protect against human health and ecological impacts. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors, such as natural background levels, environmental conditions and socio-economic factors, may be considered. These limit values were transposed into Irish Law under S.I. No. 739 of 2022.

The limit values are presented in Table 1 below.

Table 1: Air Quality Standards Regulations 2011

Pollutant	Regulation[3]	Limit Type	Value
Particulate Matter (as PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3 PM_{10}
		Annual limit for protection of human health	40 µg/m^3 PM_{10}
Particulate Matter (as $PM_{2.5}$)	2008/50/EC	Annual limit for protection of human health	25 µg/m^3 $PM_{2.5}$
Nitrogen Dioxide (NO_2)	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m^3 NO_2
		Annual limit for protection of human health	40 µg/m^3 NO_2
		Critical Load for protection of vegetation	30 µg/m^3 NO + NO_2

[3] Based on EU Directive 2008/50/EC

Appendix 10.3: Noise Impact Assessment

The data and descriptions in this appendix have informed Chapter 10: Air of the EIA Report

MWP

Noise Impact Assessment Report

Knocknamona Windfarm Grid Connection

June 2023

Project No.	Doc. No.	Rev.	Date	Prepared By	Checked By	Approved By	Status
23919	6001	A	21/06/2023	**PB**	**PB**	**PB**	**FINAL**

MWP, Engineering and Environmental Consultants
Address: Reen Point, Blennerville, Tralee, Kerry, V92 X2TK
www.mwp.ie

Contents

1. Introduction

This report considers the potential effects on noise and vibration sensitive receptors arising from the proposed development. A full description of the proposed development is provided in **Chapter 5** of this EIAR.

The data and descriptions in this Appendix have informed **Chapter 10**: Air of the EIA Report, in relation to noise emissions.

The nature and probability of effects on noise and vibration sensitive receptors arising from the proposed development has been assessed herein. The assessment comprises:

- Prediction and characterisation of likely impacts of the construction and operational phases of the proposed KWF Grid Connection,
- Evaluation of effects significance as a standalone project and cumulatively with other projects; and
- Consideration of mitigation measures, where appropriate.

1.1 Project description

The subject application, KWF (Knocknamona Windfarm) Grid Connection is the grid connection element of the Authorised Knocknamona Windfarm Project which is not yet constructed (refer to **Figure 2**).

The KWF Grid Connection proposal consists of underground cabling, additional plant and apparatus in an existing substation, the construction a new link road and the widening of an existing forestry road.

The underground cabling (1940m in length) comprises cables, ducts and other apparatus installed in a trench. The cables will be routed through lands comprising; felled forestry, forestry road; scrub; farm track; Woodhouse Windfarm roads; Public Road crossing via directional drill; and grassland and will finish at the cable chair located in the existing Woodhouse Substation compound. The underground cabling will join the Authorised Knocknamona Windfarm substation to the existing Woodhouse Substation.

The additional electrical plant and apparatus in Woodhouse Substation comprises a new control building; main 110kV transformer; 110kV transformer bay; two lightening masts; and ancillary electrical equipment. Works will also include a new access track and an internal palisade gateway and fencing within the compound and two new gateways in the existing perimeter fence.

For full details of the proposed development refer to **Chapter 5.**

1.2 Noise and Vibration Characteristics of the Proposed Development

1.2.1 Grid Connection

There is potential for noise nuisance during the construction of the grid connection because of the noise generated by the plant and machinery employed to carry out the works. The noise emission each will be exposed to, will depend on its proximity to the works area. There is one receptor within 350m of the works area (Refer to Figure 2). This is the nearest house to Woodhouse Substation (separation distance 330m) and is occupied by the landowner involved in the project.

Once operational there will be no further noise emissions associated with the grid connection cabling as it will be buried underground and has no inherent noise generating capacity. There may be service and maintenance requirements, but these noise and vibration effects will not be significant.

1.2.2 Substation Works

Works within Woodhouse Substation compound will comprise a new control building; main electrical transformer with associated plinth and bund; transformer bay and ancillary electrical equipment; 2 No. lightening masts; gateway and palisade fencing and short new access track inside the compound and 2 No. gateways in the existing perimeter fence.

There are several ways in which noise can be generated from electricity infrastructure. Continuously radiated noise is the most noticeable to neighbours and this is associated primarily with transformers. This is acknowledged in the 2016 EirGrid research report (*EirGrid Evidence Based Environmental Studies Study 8: Noise. Literature review and evidence based filed study on the noise effects of high voltage transmission development*) on noise from electrical infrastructure which states: "there is strong evidence that the only relevant noise sources are the power transformers and associated cooling systems. Generally, modern transformers are manufactured with a specified and guaranteed emission level. Improvements in the manufacture of transformers have reduced the associated level of noise emission and hence modern transformers are typically quieter than equivalent capacity older transformers. Therefore, there will be noise emissions during the construction of these elements and once operational, primarily from the main electrical transformer".

1.2.3 Link Road and Forestry Road Works

The development also includes the use of the existing entrance and windfarm road network at Woodhouse Windfarm; the construction of a new Link Road joining the Woodhouse Windfarm Road network to the Knocknamona Windfarm road network; and the widening of a forestry road at Knocknamona to provide access for the delivery of turbine components and electrical equipment and apparatus to Knocknamona Windfarm. There will be noise emissions from the construction plant and machinery employed to carry out these works.

2. Methodology

This Noise Impact Assessment was prepared by Peter Barry (BAgr Sc. MSc) of Malachy Walsh & Partners, consulting environmental engineers. Peter is a Chartered Environmental Scientist with over 20 years' experience in the measurement, prediction, assessment, and control of Environmental Noise.

2.1 Fundamentals of Environmental Noise

Fundamentally, noise is vibrations of the air which are detectable by the ear. Sound waves radiate out spherically from a sound source in three dimensions. The human ear can detect a very wide range of pressure variations. In order to cope with this wide range, a logarithmic scale (decibel (dB) scale) is used to translate pressure values into manageable numbers from 0 dB to 140 dB. 0 dB is the threshold of hearing, and 120 dB is the threshold of pain. Measuring in decibels means that a 3 dB increase is equivalent to a doubling of the sound energy and a 10 dB increase in a tenfold increase in sound energy. For broadband sounds which are very similar in all but magnitude, a change or difference in noise level of 1 dB is just perceptible under laboratory conditions, 3 dB is perceptible under most normal conditions and a 10 dB increase generally appears twice as loud. A healthy human ear is also sensitive to a large range of frequencies (approximately 20 Hz to 20,000 Hz) and varies in sensitivity depending on the frequency. The human ear is not equally sensitive to sound at all frequencies and is less sensitive to sound at low frequencies and high frequencies. A -weighting (dB A) is the main way of adjusting measured sound pressure levels (noise) to take account of the uneven human response to frequencies. **Figure 1** illustrates some everyday sounds on the dB(A) scale. A quiet bedroom is around 35 dB(A), a busy office around 60dB(A) and a rock concert around 100 dB(A).

Figure 1 The Level of Typical Common Sounds on the dB(A) Scale

2.3 Scope of assessment

The scope of the assessment has been defined by industry standard best practice and guidance used in Ireland for assessing environmental noise. In general, this includes:

- Establishing the existing or baseline noise conditions at representative noise sensitive receptors.
- Establishing noise limits based on the measured baseline noise levels in accordance with best practice and guidance.
- Using computer software and/ or calculations, predict the noise emissions from the proposed development at the nearest noise sensitive receptors.
- Comparing the predicted noise emissions against the noise limit criteria. The predicted noise emissions must not exceed the noise limit criteria.
- Specifying mitigation measures if required.

There will be no significant sources of vibration during either the construction or operational phases, therefore vibration is scoped out from further assessment.

2.4 Construction Phase Impact Assessment- Best Practice and Guidance

There are no mandatory noise limits for construction noise in Ireland. The most recent revision of *British Standard 5228-1:2009+A1:2014, Code of practice for noise and vibration control on construction and open site* outlines noise thresholds for significant impacts (Section 2.5.1).

The Irish National Roads Authority (NRA) - *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes*, March 2014 was also consulted for noise and vibration related impact nuisance thresholds.

2.5 Criteria for Evaluating Construction and Decommissioning Noise Effects

2.5.1 Construction Noise

There is no statutory guidance in Ireland relating to the maximum noise levels permitted during construction works, and in the absence of statutory guidance or other specific limits prescribed by local authorities, the thresholds outlined in Table 1 are from the NRA *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (2004) has been adopted in this appraisal. The Authority (NRA) considered that the noise levels, included in the table below, are typically deemed acceptable, with the comment that more stringent levels might be appropriate in areas where pre-existing noise levels are low.

Table 1 Construction Nosie Thresholds

Period	Working Hours	$LAeq_{(1\ hour)}$ dB[1]	$LpA_{(Max)slow}$[2] dB
Monday to Friday	07:00 to 19:00hrs	70	80
Monday to Friday	19.00 to 22.00hrs[3]	60*	65*
Saturday	08:00 to 16:30hrs	65	75

*The lower threshold level of 65dB has been applied to the KWF Grid Connection project. It should be noted that the 60dB level is not applied because works will not take place beyond 7pm.

2.6 Criteria for Evaluating Operational Noise Effects

2.6.1 Operational Noise

2.6.1.1 EPA Noise Limit Criteria for Industrial Noise Sources

In the absence of specific noise limits for this type of development, the most appropriate criteria are set out in The Environmental Protection Agency (EPA) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (Environmental Protection Agency, 2016). The aforementioned guidelines requires that sites are screened to determine whether they are a 'quiet area' in accordance with the EPA publication Environmental Quality Objectives – Noise in Quiet Areas (2003). This screening is required to determine the most applicable recommended noise limits for licenced sites. Page 20 of the NG4 document referenced above defines the criteria an area must meet to be considered a "Quite Area". The site does not meet the defined criteria of a 'Quiet Area'. These criteria are:

- At least 3 km from urban areas with a population >1,000 people;
- At least 10 km from any urban areas with a population >5,000 people; **(Dungarvan within 10 km)**
- At least 15 km from any urban areas with a population >10,000 people;
- At least 3 km from any local industry; **(Woodhouse windfarm adjacent)**
- At least 10 km from any major industry centre; **(Dungarvan within 10 km)**
- At least 5 km from any National Primary Route, and; **(N72 < 5km)**
- At least 7.5 km from any Motorway or Dual Carriageway

Next the NG4 guidance requires the site to be screened to determine if the site is in an 'area of low background noise'. Background noise levels are examined to see if they satisfy the following criteria:

[1] $LAeq_{1}$: An indication of the average level of noise heard
[2] $LpA_{(Max)}$: An indication of the maximum sound level heard
[3] As stated in both the NRA Guidelines (2004) construction at these times or outside the times indicated in the table, except for emergency work, will require the explicit permission of the relevant local authority.

- Average Daytime Background Noise Level ≤40dB LAF90, and
- Average Evening Background Noise Level ≤35dB LAF90, and
- Average Night-time Background Noise Level ≤30dB LAF90.

In order for a site to be considered an 'area of low background noise', all three criteria above must be satisfied. Based on measured noise levels in the study area (refer to Section 3.2) the result of the screening shows that Location H8 (refer to Figure 2) is in an "Area of Low Background noise". Therefore, the in order to study the worst case scenario, the noise limits associated with "Areas of Low Background Noise" as detailed in Table 2 below have been applied to all the 17 residential dwellings within the study area.

Table 2 Recommended Noise Limit Criteria (Source: NG4 EPA Guidance Note for Noise)

Period	Daytime Noise Criterion, dB LAr,T (07:00 to 19:00hrs)	Evening Noise Criterion, dB LAr,T (19:00 to 23:00hrs)	Night-time Noise Criterion, dB LAeq,T (23:00 to 07:00hrs)
Quiet Area	Noise from the licensed site to be at least 10dB below the average evening background noise level measured during the baseline noise survey.	Noise from the licensed site to be at least 10dB below the average evening background noise level measured during the baseline noise survey.	Noise from the licensed site to be at least 10dB below the average night-time background noise level measured during the baseline noise survey.
Areas of Low Background Noise	45dB	40dB	35dB
All other Areas	55dB	50dB	45dB

2.6.1.2 Authorised Knocknamona Windfarm Noise Limit Criteria

Knocknamona Windfarm is authorised under Planning Ref. 14/600109. Under this authorisation the Windfarm noise emissions are controlled through Condition 7 as follows:

Wind turbine noise *arising from the proposed development, by itself or in combination with any other permitted wind energy development in the vicinity, shall not exceed the greater of:*

(a) 5 dB(A) above background noise levels or,
(b) 43 dB(A) L90,10min when measured externally at dwellings or other sensitive receptors

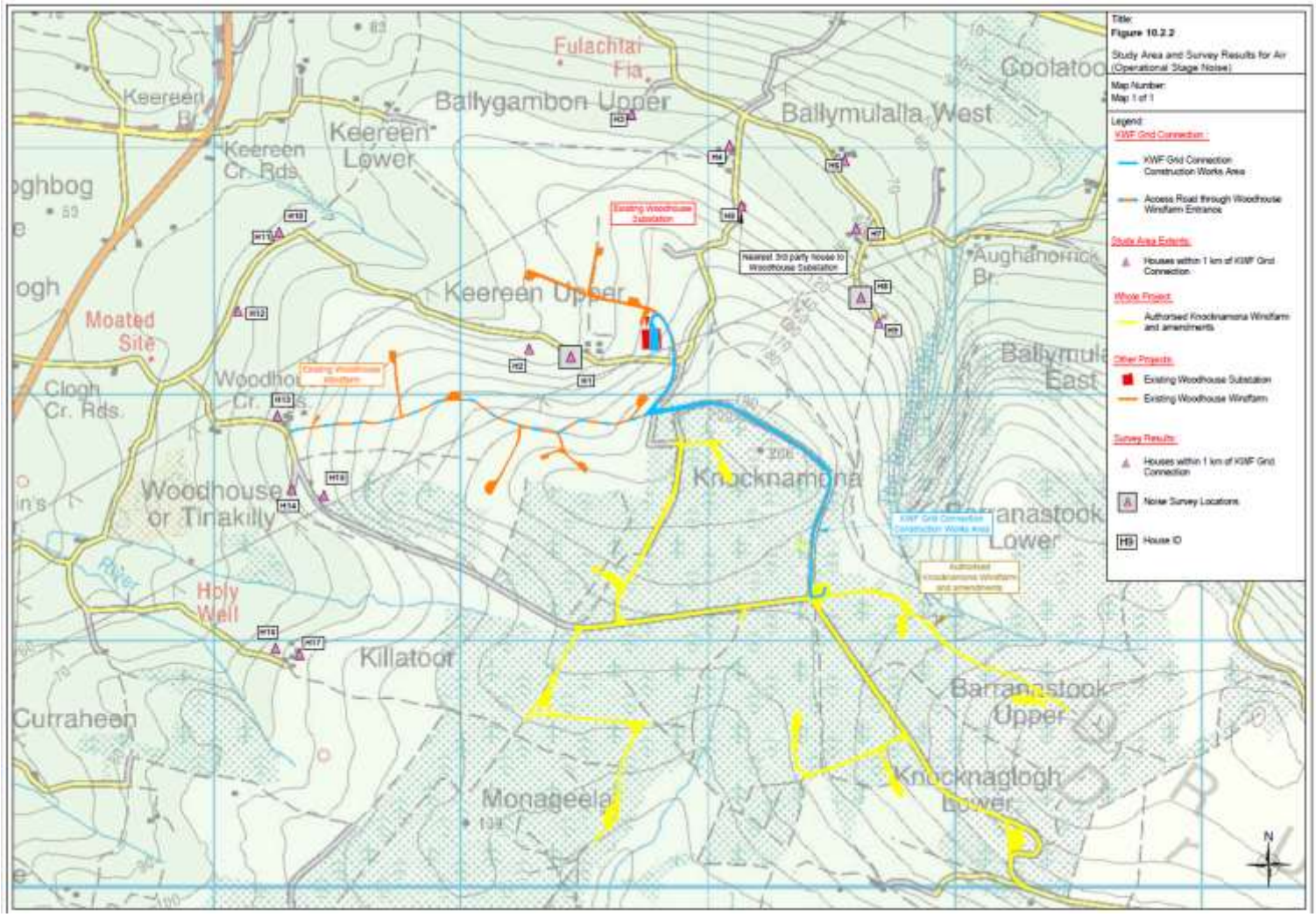
Amendments to Knocknamona Windfarm to provide for larger turbines were authorised in September 2022 (ABP-309412-21). The allowable wind turbine noise as set out in Condition 7 above is also applicable to the larger turbines authorisation.

3. Existing Environment

3.1 Nearest Noise Sensitive Locations

There are 17 residential dwellings in the study area, refer to **Figure 2** below. It can be seen on **Figure 2** that in general dwellings are at a remove from proposed works area. H1 and H2 are the nearest to the substation, 330m and 460m respectively. H1 and H2 are landowners on which Woodhouse wind turbines and substation are located. The next nearest dwelling (H5) is 550m from any potential works area and the operational substation, and is the nearest 3rd party dwelling to the Woodhouse Substation.

Figure 2 Layout, study area and sensitive receptors



3.2 Baseline Noise Survey

3.2.1 Survey Personnel

The baseline noise survey was undertaken by Ecopower personnel under the supervision of the Author at H1 from the 17th to 19th of April 2023 and at H8 from the 14th to 16th of June 2023. The installation report was prepared by Conor Brett of Ecopower. Refer to **Appendix A**.

3.2.2 Instrumentation and Set Up

The sound level meter was located away from reflective surfaces, in open ground. The microphone was at a height of 1.5 m above the ground. The measurements were performed using the following equipment:

Table 3 Noise Monitoring Equipment

Manufacturer	Equipment Model	Serial Number	Type	Calibration Date
PCB	377B02	314623	Microphone	21st February 2023
Larson Davis	LxT1	000592B	Sound Level Meter	22nd February 2023
Larson Davis	PRMLxT1L	055776	Preamplifier	22nd February 2023
Larson Davis	CAL200	16931	Calibration	20th February 2023

The microphone was protected using a proprietary Larson Davis windshield. Before and after the survey the measurement apparatus was check calibrated using a Larson Davis CAL200 Sound Level Calibrator Serial Number 16931 that produces a sound level of 93.96dB re. 2x10-5 Pa, at a frequency of 1k Hz.

The calibration certificates are attached as **Appendix B** to this report. Weather conditions were recorded as dry and calm with average wind speeds generally not exceeding 5 m/s.

3.2.3 Procedure

The sound level meter was set up at both locations (H1 and H8) to record unattended measurements over two day and night periods logging 15-minute concurrent measurements. A weather station was also set up to monitor rainfall and wind speed over the same monitoring period.

The survey results were noted onto a survey record sheet and were also saved to the instrument memory for download and later analysis. The primary sources contributing to noise build-up were noted during the survey.

An installation report including location photographs is attached as **Appendix A** to this report.

3.2.4 Measurement Parameters

The noise survey results are presented in terms of the following parameters:

L_{Aeq} is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period. This parameter is representative of the specific noise from plant when plant is the dominant noise source, i.e. there is no extraneous noise from sources such as traffic.

L_{A90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise. This parameter is representative of the specific noise from plant when there is extraneous noise from intermittent noise sources such as intermittent traffic.

L_{A10} is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.

L_{Amin} is the instantaneous minimum sound level measured during the sample period.

L_{Amax} is the instantaneous maximum sound level measured during the sample period.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pa. A glossary of the acoustic terminology used in this report is included in Appendix D.

3.2.5 Noise Survey Locations

Two noise survey locations were chosen. The first location at the nearest dwelling to Woodhouse Substation (Location H1 – 330m west). The second location at a distance from Woodhouse Substation to give a representative result for houses in the vicinity (Location H8 – 817m east). Figure 2 illustrates the noise monitoring locations.

3.2.6 Results

The noise levels measured at H1 and H8 are presented in Tables 4 and 5 below. The complete set data is presented in Appendix C to this report.

Table 4 Summary of Noise Survey Results at H1

Date	Time	Run Duration	Average L_{Aeq}	Average L_{AFmin}	Average L_{AFmax}	Average L_{AF10}	Average L_{AF90}
17/04/2023 Daytime	4pm to 7pm	15-min concurrent measurements	51	44	67	53	46
17/04/2023 Evening	7pm to 11pm		49	43	62	51	45
17/04/2023 Night-time	11pm to 7am		48	45	56	49	47
18/04/2023 Daytime	7am to 7pm		52	46	69	54	47
18/04/2023 Evening	7pm to 11pm		49	43	62	51	44
18/04/2023 Night-time	11pm to 7am		49	44	58	50	46
19/04/2023 Daytime	7am to 7pm		53	46	69	56	48

Table 5 Summary of Noise Survey Results at H8

Date	Time	Run Duration	Average L_{Aeq}	Average L_{AFmin}	Average L_{AFmax}	Average L_{AF10}	Average L_{AF90}
14/06/2023 Daytime	11:15am to 7pm	15-min concurrent measurements	42	36	57	44	38
14/06/2023 Evening	7pm to 11pm		29	21	47	31	23
14/06/2023 Night-time	11pm to 7am		33	26	48	34	28
15/06/2023 Daytime	7am to 7pm		39	28	57	41	30
15/06/2023 Evening	7pm to 11pm		35	25	56	34	27
15/06/2023 Night-time	11pm to 7am		32	26	46	34	28
16/06/2023 Daytime	7am to 10am		45	30	64	45	34

3.2.7 Discussion of Results

3.2.7.1 Results at H1

The daytime L_{Aeq} or ambient noise levels ranged from an average of 51 to 53 dB(A). The night-time L_{Aeq} or ambient noise levels averaged 49 dB(A). The main contributing noise sources at H1 are the resident's own milking parlour when operating, wind through surrounding vegetation and neighbouring Woodhouse Windfarm Turbines.

Based on the criteria set out in Section 2.6.1.1 above, the measured background noise levels at H1 exceed the NG4 criteria of "Area of Low Background noise ". This location is deemed to be in an area of "All other Areas".

3.2.7.2 Results at H8

The daytime L_{Aeq} or ambient noise levels ranged from an average of 39 to 45 dB(A). The night-time L_{Aeq} or ambient noise levels ranged from an average of 32 to 33 dB(A). The main contributing noise sources at H8 are the wind through surrounding vegetation, birdsong and intermittent noise from agricultural activity i.e. milking parlour and agricultural vehicles.

Based on the criteria set out in Section 2.6.1.1 above the measured background noise levels at H8 do not exceed the NG4 criteria of "Area of Low Background noise " and therefore this location is deemed to be and "Area of Low Background noise".

3.2.7.3 Noise limit criteria for the purposes of this study

The more conservative noise limits associated with "Areas of Low Background Noise", as detailed in Table 2, above have been applied to all the 17 residential dwellings in the vicinity, notwithstanding that H1 and H2 are in an "All other Areas".

4. Potential Impacts

4.1 Construction Phase Noise

There are no extraordinary sources of noise amongst the equipment to be used. The works will proceed quickly and during normal working hours.

The main item of plant which will be used for the excavation of the trench will be a tracked or wheeled excavator. This is a piece of machinery with similar noise emissions to an agricultural tractor, which are commonplace in the area. Noise emissions for a 30 to 50 tonne tracked excavator is 79dB at 10m.

Table 6 below is a typical list of plant and machinery involved in substation construction activities, cable trench excavations and new road construction. The noise levels from the construction equipment have been sourced from BS5228 Noise Database for Noise and Vibration Control on Construction and Open Site 1& 2: 2014+A1.

Table 3 Typical Construction Plant and Machinery which will be used during the Construction Stage

Plant and Machinery	Octave Banding (Hz)								Sound Power Level dB(A)	Sound Pressure Level @10mdB(A)
	63	125	250	500	1k	2k	4k	8k		
Telescopic Handler	86.8	86.9	85.4	92.8	98	96.2	88	78.9	102	71
Mobile Crane	84.8	90.9	93.4	90.8	95.0	95.2	88.0	79.9	101	70
30-50T Excavator	89.8	92.9	99.4	104.8	104	103.2	100	92.9	110	79
15-30T Excavator	99.8	98.9	104.1	100.8	101	100.2	96	86.9	109	78
12T Roller	94.8	98.9	99.4	108.8	104	100.2	97	90.9	111	80
Dump truck	89.8	94.9	99.4	98.8	105	102.2	97	87.9	109	78
Tractor & Trailer	97.8	100.9	98.4	103.8	104	104.2	96	88.9	110	79
15-20T Rubber Tired Excavator	78.8	80.9	86.4	91.8	94	92.2	91	79.9	99	68
3-10T mini digger	85.8	86.9	90.4	90	95.0	90	92	84.9	100	69
Diesel Generator	84.8	88.9	79.4	81.8	84	80.2	77	66.9	92	61

The decibel sum of all of the items of plant listed above totals 86 dBA at 10 metres. The construction works will be sequenced, and all the noise sources presented in Table 6 will not be in operation continuously or simultaneously for the duration of the construction phase, and likely noise levels will be in the order of the excavator, i.e. 79dB at 10m.

Using the inverse square law rule (In decibel terms a doubling (or halving) of sound intensity corresponds to an increase (or reduction) of 6dB), the sound pressure level, or magnitude of noise impact for both the Worst-Case Noise levels (all plant in operation in the same location at the same time) and the Realistic Noise Levels, can be determined. The results are presented in **Table 7**, at increasing distances from the works. The appropriate construction noise threshold levels are also included in **Table 7**.

Table 7 Determining Worst-Case and Realistic-Case Noise Levels

Distance from noise source	Worst Case Scenario	Realistic Scenario	Guidance Levels
10m	86 dB	79 dB	65 dB
20m	80 dB	73 dB	65 dB
40m	74 dB	67 dB	65 dB
80m	68 dB	61 dB	65 dB
160m	62 dB	55 dB	65 dB
320m	56 dB	49 dB	65 dB

It is expected that the 65dB threshold will not be exceeded at distances of 120m and 60m, under worst-case and realistic scenarios, respectively. There are no properties nearer than 330m of a proposed works area, therefore the noise thresholds will not be exceeded.

4.2 Operational Phase

4.2.1 Noise Prediction Methodology

Noise prediction computer software was used to quantify the impact of the proposed additional substation transformer. The noise predictions were undertaken using noise prediction software, specifically Bruel & Kjaer's Predictor software (iNoise 2023 V1).

The software calculations are based on ISO 9613, Attenuation of sound during propagation outdoors, Part 2, General Method of Calculation. The ISO 9613-2 model can take account of the following factors that influence sound propagation outdoors:

- The magnitude of the noise sources in terms of A weighted sound power levels (LwA)
- The distance between the source and the receiver
- Geometric divergence
- Air Absorption
- Reflecting obstacles
- Screening
- Vegetation; and
- Ground reflections

Table 4 Model Input Data

Item	Description
Noise Source Locations	Planning Drawings
House Locations	Aerial Imagery
Acoustic Emission	On Site Measurement
Source Height	variable (m)
Landform	Flat
Ground Factor	0.5 Note 1
Receptor Height	4m at the residential receptor and 1.5m at the substation boundary
Wind Direction	Downwind
Relative Humidity	70%
Temperature	10^{o}C

Note 1: Ground Factor is a value between 0 and 1, where 0 represents hard/ reflective surfaces and 1, represents soft absorbent surfaces.

4.2.2 Noise Prediction Scenarios

To demonstrate the decibel levels at the Woodhouse Substation from the proposed KWF Grid Connection additional transformer at Woodhouse Substation, two noise modelling scenarios were run. These included;

Scenario 1: Noise propagation from existing Woodhouse Substation infrastructure.

Scenario 2: Noise propagation from existing Woodhouse Substation and additional transformer at Woodhouse Substation associated with the KWF Grid Connection.

A series of measurements were undertaken in the vicinity of the existing Woodhouse Substation. From these measurements it was possible to calculate the sound power levels for the existing Woodhouse Substation electrical transformer and any other noise emitting infrastructure. These were then input into the noise model. The proposed KWF Grid Connection electrical transformer is given the same sound power level as the existing and input into the model for *Scenario 2*.

4.2.3 Noise Sources

The substation will be operational on a continuous basis. The sound power level associated with a typical substation that would support a development of this nature is in the order of 93 dB(A). This has been validated by boundary measurements at the existing substation in April 2023.

Assumed frequency spectrum data relied upon within the noise model is included within Table 9.

Table 9 Modelled Sound Power Levels

Source	Octave Band Sound Power Level dB(Lin) Hz									Sound Power Level dB(A)
	31	63	125	250	500	1000	2000	4000	8000	
Existing Substation	82	82	85	86	87	85	83	79	78	93
Additional Transformer (KWF Grid Connection)	82	82	85	86	87	85	83	79	78	93

4.2.4 Predicted Noise Levels - Residential Receptors within the study area.

The predicted noise levels from Woodhouse Substation with the additional equipment for KWF Grid Connection at the houses studied are presented in **Table 9** and illustrated on **Figures 3 & 4**. The predicted levels are for the worst case scenario in this landscape context where the model input represents flat landform without attenuation from topography and with a Ground Factor of 0.5 where 0 represents hard/ reflective surfaces and 1, represents soft absorbent surfaces (refer to Table 8 Model Input Data above). The predicted noise levels are presented for two scenarios, i.e.

Scenario 1: Noise propagation from existing Woodhouse Substation infrastructure.

Scenario 2: Noise propagation from existing Woodhouse Substation and additional transformer at Woodhouse Substation associated with the KWF Grid Connection.

The more conservative noise limits associated with "Areas of Low Background Noise", as detailed in **Table 2**, above have been applied to all the 17 residential dwellings in the vicinity, notwithstanding that H1 and H2 are in an "All other Areas".

Table 10 Substation Noise Levels at all houses in the study area

Assessment Location	Distance from Woodhouse Substation (meters)	Period	Predicted Noise Levels dB(A)		EPA Noise Thresholds dB(A)	EPA Compliance
			Scenario 1	Scenario 2		
H 1	330	Day	28	31	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 2	460	Day	28	30	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 3	863	Day	18	21	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 4	783	Day	17	20	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 5	550	Day	15	18	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 6	1010	Day	13	16	45	Yes
		Evening			40	Yes

Assessment Location	Distance from Woodhouse Substation (meters)	Period	Predicted Noise Levels dB(A)		EPA Noise Thresholds dB(A)	EPA Compliance
			Scenario 1	Scenario 2		
		Night			35	Yes
H 7	875	Day	9	12	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 8	817	Day	8	11	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 9	866	Day	9	12	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 10	1520	Day	17	20	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 11	1550	Day	17	20	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 12	1636	Day	12	15	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 13	1510	Day	13	16	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 14	1530	Day	12	15	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 15	1420	Day	11	14	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 16	1910	Day	11	13	45	Yes
		Evening			40	Yes
		Night			35	Yes
H 17	1870	Day	10	13	45	Yes
		Evening			40	Yes
		Night			35	Yes

Figure 3 Scenario 1 Noise Emission Contours - existing Woodhouse Substation alone

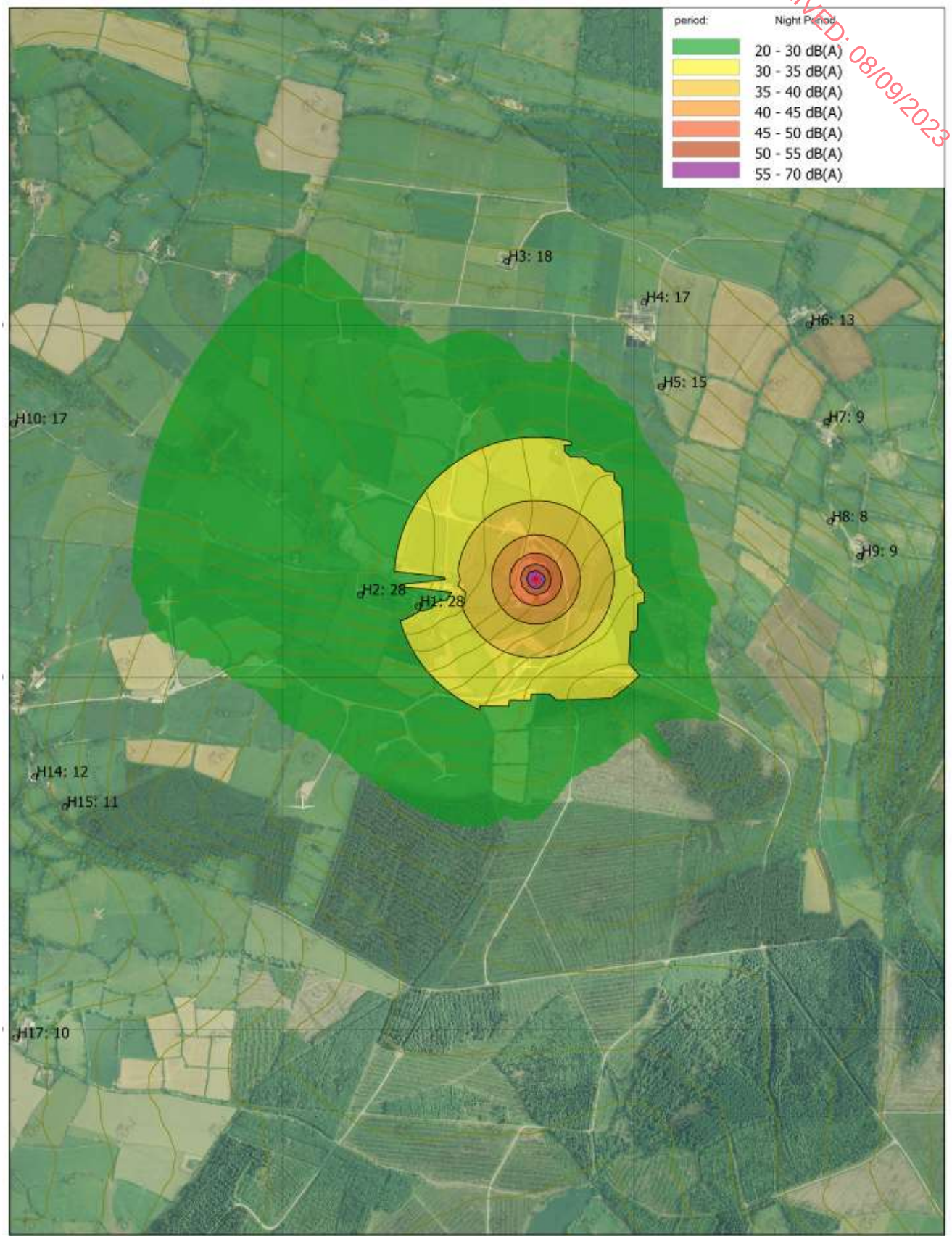
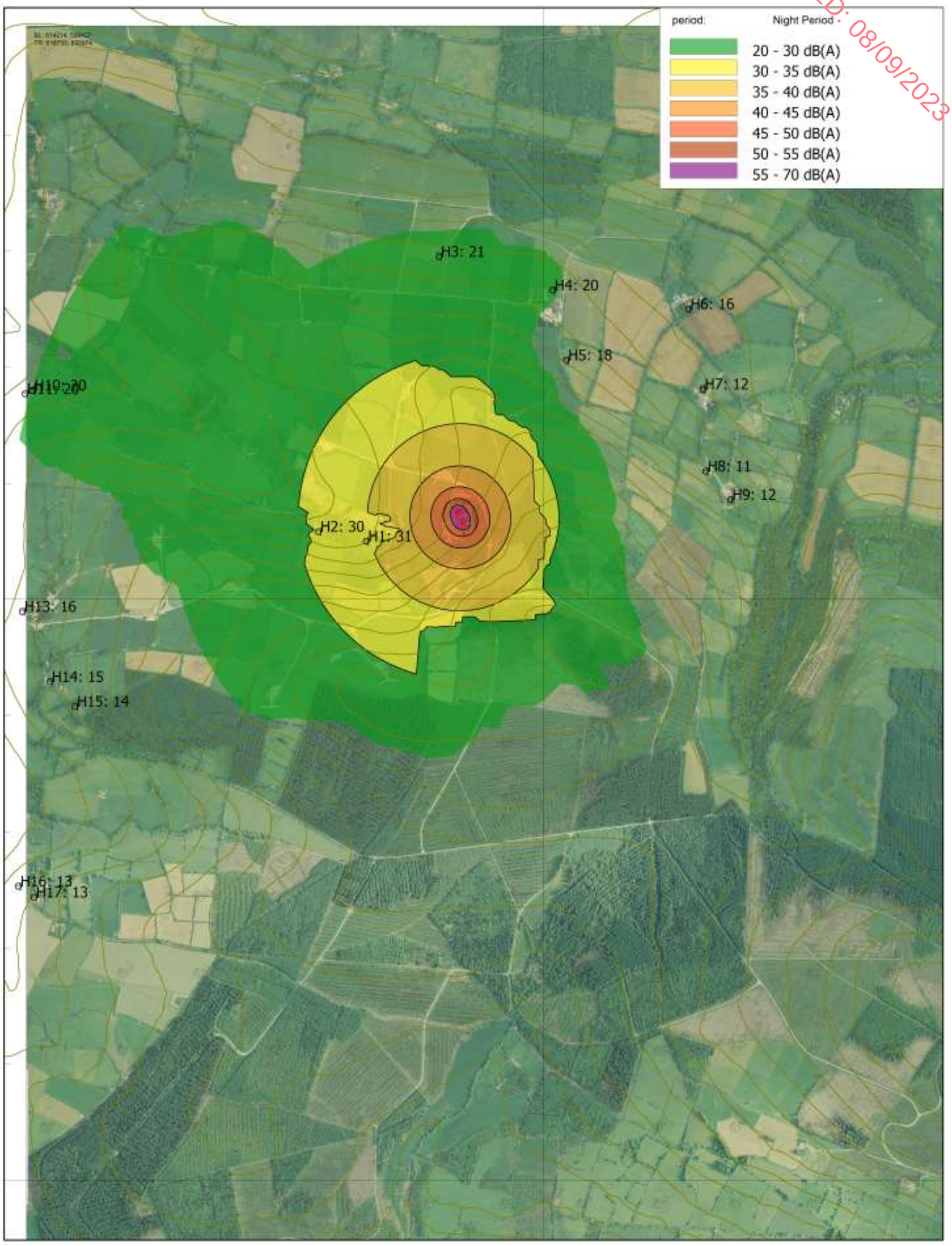


Figure 4 Scenario 2 Noise Emission Contours - existing Woodhouse Substation cumulatively with KWF Grid Connection equipment



4.2.4.1 Discussion of Results

The operational noise emissions from the substation (including the additional transformer noise) were predicted at dwellings in the vicinity. The results in **Table 9** and illustrated in **Figure 4** show that the predicted noise from Woodhouse Substation cumulatively with the additional electrical infrastructure associated with KWF Grid Connection will not exceed 31dB(A) at the nearest dwelling (H1 - 330m).

At H3, H4 and H5, the nearest 3rd party dwellings to Woodhouse Substation, the predicted noise levels from the Substation cumulatively with the additional electrical infrastructure associated with KWF Grid Connection will not exceed 21dB(A), 20dB(A) and 18dBA) respectively. These noise levels are very low, in and around the threshold of detection for sound level meters, and unlikely to be audible above existing ambient noise levels.

At all locations the predicted substation noise emissions are below any of the EPA noise limit criteria for licenced sites (refer to **Table 2)**.

Further, there is a predicted maximum increase in noise levels at any of the houses, of 3dB(A) between *Scenario 1* and *Scenario 2*. A change of 3dB is just discernible by the human ear and very unlikely to be noticeable at such low emission levels.

4.2.4.2 Whole Project Noise Effects

<u>Construction Phase</u>

There is potential for cumulative noise impacts should the construction of the KWF Grid Connection and Authorised Knocknamona Windfarm occur during the same period. However, the typical sequence is for the main windfarm to be constructed first and internal cabling installed before advancing to the grid connection phase.

At worst there will be a limited extent of overlap of KWF Grid Connection works with Authorised Knocknamona Windfarm works. The works will be of temporary duration. There are no local residents or community facilities within 350m of both KWF Grid Connection and Authorised Knocknamona Windfarm works. Given this separation distance any cumulative increase in noise levels will be minor and will not exceed noise level thresholds in **Table 1**.

<u>Operational Phase</u>

The predicted noise levels from the existing Woodhouse Substation cumulatively with the additional electrical infrastructure associated with KWF Grid Connection at the houses in the vicinity are at least 10dB(A) below the allowable noise limit for the Authorised Knocknamona Windfarm, which is L_{90} 43dB(A). Due to the logarithmic additional of decibels if one noise source is at least 10dB(A) lower than another contributing noise source, there is no increase in noise levels at these houses. For example, 40dB(A) plus 30dB(A) is 40dB(A).

5. Mitigation Measures

5.1 Construction Phase

No specific construction phase mitigation measures are required as the construction noise thresholds are predicted not to be exceeded. However, construction works will be carried out in accordance with best practice and in line with recommendations contained within BS 5228-1:2009+A1:2014.

To mitigate against the impacts of noise on the local community during construction, the following measures are proposed:

- A pre-construction commitment to managing nuisance noise will be agreed through notification and consultation with affected parties, if deemed necessary.

- Working hours at the site during the installation phase will be limited to 08:00 to 18:00 Monday to Friday and 08.30 to 16.00 Saturday. Work on Sundays or public holidays will only be conducted in exceptional circumstances and subject to prior notification insofar as possible with the local community.

- Construction contractors will be required to comply with the requirements of the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations, 1988 as amended in 1990 and 1996 (S.I. No. 320 of 1988, S.I. No. 297 of 1990 and S.I. No. 359 of 1996), and the Safety, Health and Welfare at Work (Control of Noise at Work) Regulations, 2006 (S.I. No. 371 of 2006).

The main control measures will be control of noise at source using the following methods in line with Clause 8 'Control of noise' of BS 5228-1:2009+A1:2014:

- Operators of all mobile equipment will be instructed to avoid unnecessary revving of machinery (Clause 8.2.1 General).

- Use of appropriate plant and equipment where possible with low noise level generation where possible (Clause 8.2.2 Specification and substitution).

- All construction plant to be used on site should have effective well-maintained silencers (Clause 8.2.3 Modification of existing plant and equipment).

- Noise generating equipment will be located as far as possible away from local noise sensitive areas identified (Clause 8.2.5 Use and siting of equipment); and,

- Regular and effective maintenance of site machinery including a full maintenance schedule to ensure that all pieces of equipment are in good working order. With efficient use of well-maintained mobile equipment, considerably lower noise levels than those predicted can be attained (clause 8.2.6 Maintenance).

5.2 Operational Phase

The predicted noise levels herein show that the predicted noise levels from the KWF Grid Connection alone and cumulatively with Woodhouse Substation and with the Authorised Knocknamona Windfarm are within the EPA noise limit guidelines and also the authorised noise limits for the Whole Knocknamona Windfarm Project. No mitigation measures are required above those inherent to the design.

6. Conclusion

There will be noise emissions associated with the construction phase, but these will be temporary and of short duration. The predicted noise emissions based on the representative machinery typical for this scale of project are expected not to exceed the recommended noise thresholds typically adopted for construction projects in Ireland.

Generally, significant vibrations which may cause structural damage only occur from piling or blasting operations. There will be no blasting or piling required for KWF Grid Connection.

Once operational there will be low level noise emissions from the additional equipment installed in the existing Woodhouse Substation. The predicted noise emissions do not exceed commonly adopted and previously authorised noise limit criteria at the nearest houses. The addition of the new transformer is very unlikely to be noticeable at any receptor.

APPENDIX A

Noise Monitoring Equipment Installation Report

Sound monitor location - KWF GC - Location H1

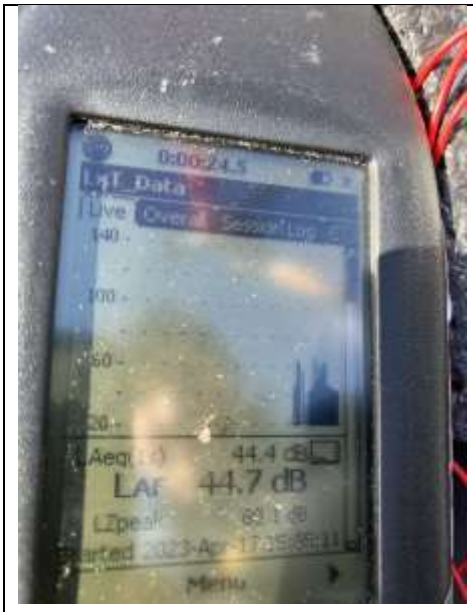
Location: KWG GC - Location H1
Consulted Landowner: Yes
Installer: Conor Brett
Installation Date: 17-04-2023
Time: 15:35pm
Photos Taken of Set Up: Yes

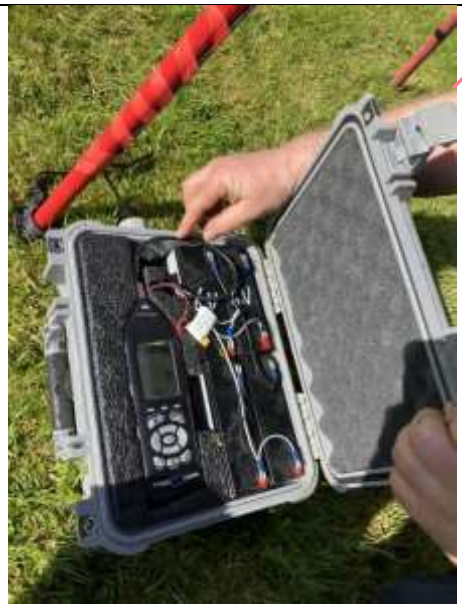
Sound monitor installed: Yes
Sound monitor location: 615397, 592218 (ITM):
Battery status at installation: 100%
Model: Larson Davis - See Calibration certs
Device Calibrated: Yes
Time Correct: Yes
Installation notes: None

Rain gauge installed: Yes
Rain gauge location: Same as Sound Monitor
Model: WatchDog series
Installation notes: None

Wind speed measurement installed: Yes
Wind speed measurement mast Height: 3m on site mast
Wind speed measurement mast Location: 615722, 591977 (ITM):
Installation notes: None
Model: Symphonie Plus 3

Surrounding environment:





Sound monitor location - KWF GC - Location H8

Location: KWG GC - Location H8
Consulted Landowner: Yes
Installer: Conor Brett
Installation Date: 14-06-2023
Time: 11:15am
Photos Taken of Set Up: Yes

Sound monitor installed: Yes
Sound monitor location: H8 - 616744, 592437 (ITM):
Battery status at installation: 100%
Model: Larson Davis - See Calibration certs
Device Calibrated: Yes
Time Correct: Yes
Installation notes: None

Rain gauge installed: Yes
Rain gauge location: Same as Sound Monitor
Model: WatchDog series
Installation notes: None

Wind speed measurement installed: Yes
Wind speed measurement mast Height: 3m on site mast
Wind speed measurement mast Location: 615722, 591977 (ITM):
Installation notes: None
Model: Symphonie Plus 3

Surrounding environment:

APPENDIX B

Noise Monitoring Equipment Calibration Certificates

Certificate of Calibration

MTS Calibration

Certificate Number: 38066

Measurement Microphone
Half-Inch diameter – Free-Field, 0 degree incidence response

Client: Environmental Measurements
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: **Larson Davis**
Instrument Model: **377B02**
Serial Number: **314623**

Sensitivity is calculated by the Insert Voltage method. The frequency response calibration is one of three independent measurements of the pressure response of the Object Microphone obtained by the Electrostatic Actuator measurement method. Microphone Capacitance is the polarised capacitance of the test microphone measured on a capacitance bridge relative to a reference microphone.

The frequency response, capacitance, and sensitivity of the microphone are shown graphically on Page 2
Uncertainties of these measurements are:

31.5 Hz to 4kHz	0.41 dB (k = 2.04)
5kHz to 10 kHz	0.87 dB (k = 2.17)
12.5 kHz to 40 kHz	1.81 dB (k = 2.17)
Sensitivity at 250Hz	0.16 dB (k = 2.0)

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k (as above) to provide a level of confidence of approximately 95%. The uncertainty evaluation has been calculated in accordance with UKAS publication M 3003 (December 1997).

Measurement Conditions:

Polarisation Voltage	**0V +/- 0.5V**
Temperature	**20.7 °C**
Atmospheric Pressure	**1012mBar ****
Relative Humidity	**51 %**

**** Note that the computer-produced Certificate shows a Pressure of 1037.9mbar - this is in error. The above measurement is traceable**

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Cal. Due
Condenser Microphone	Larson Davis	2541	4295	TE 102	September 2023
Acoustic Calibrator 250Hz	Larson Davis	CA250	2807	TE 104	November 2023
Real-Time Frequency Analyser	Larson Davis	2900	0492	TE 108	July 2023
Signal Generator	Hewlett Packard	33120A	US36016577	TE 111	October 2023
Digital Multimeter	Hewlett Packard	34401A	3146A63804	TE 105	October 2023

Date of Receipt : 8th February 2023
Date of Calibration : 21st February 2023
Date of Certificate: 21st February 2023

Authorised Signatory: .....

Tony Sherris

MTS Calibration Ltd
Company Registration Number: 06588525 England and Wales
The Grange Business Centre, Belasis Avenue, Billingham TS23 1LG, England
Telephone: +44 (0)1642 876410 E-Mail: jsherris@slmcal.co.uk or tsherris@slmcal.co.uk http\\www.slmcal.co.uk

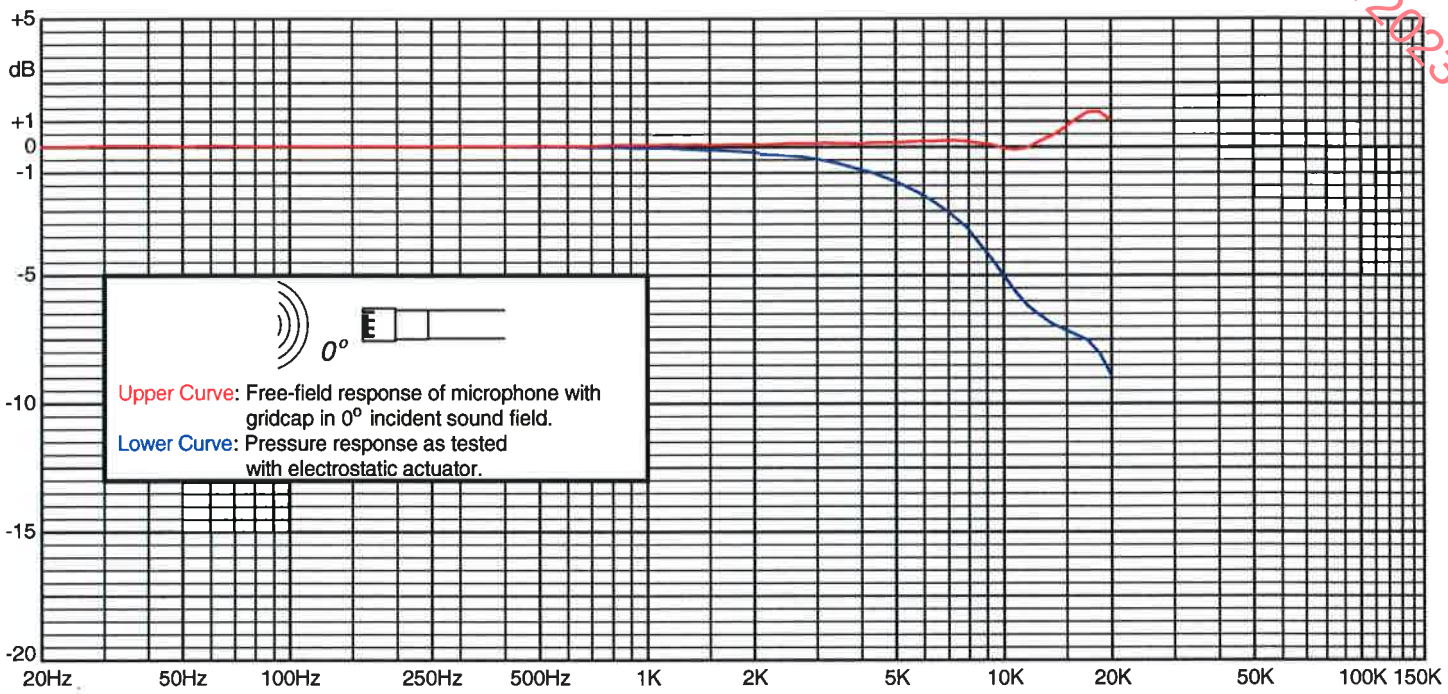
PCB 1/2" Microphone Calibration Chart
Model: 377B02 Serial Number: 314623

Calibration Test Performed By:
MTS Calibration Ltd
Billingham TS23 1LG

Open Circuit Sensitivity @ 1037.9 mbar & 250 Hz
-25.3 dB re 1V/Pascal
54.4 mV/Pascal
-0.7 K_0(-dB re 50 mV/Pascal)
Capacitance @ 250 Hz
13.1 pF

Test Conditions:

Polarization Voltage	**0** V
Ambient Pressure	**1037.9** mbar
Temperature	**20.7** °C
Relative Humidity	**51.0** %



Frequency Response (0 dB @ 250 Hz)
Free-field and actuator response with reference to level at 250 Hz

Freq (Hz)	Upper	Lower	Freq (Hz)	Upper	Lower	Freq (Hz)	Upper	Lower	Freq (Hz)	Upper	Lower	Freq (Hz)	Upper	Lower
19.95	0.00	0.00	316.23	0.02	0.01	926.12	0.06	-0.05	2712.27	0.14	-0.40	7943.28	0.22	-3.17
25.12	0.02	0.02	341.45	0.01	0.00	1000.00	0.07	-0.05	2928.64	0.14	-0.46	8576.96	0.13	-3.78
31.62	0.03	0.03	368.69	0.01	0.00	1079.78	0.06	-0.07	3162.28	0.15	-0.53	9261.19	0.10	-4.33
39.81	0.03	0.03	398.11	0.01	0.00	1165.91	0.08	-0.07	3414.55	0.14	-0.65	10000.00	-0.05	-5.00
50.12	0.00	0.00	429.87	0.01	-0.01	1258.93	0.07	-0.09	3686.95	0.13	-0.77	10797.75	-0.10	-5.66
63.10	0.05	0.05	464.16	0.02	-0.00	1359.36	0.08	-0.10	3981.07	0.12	-0.88	11659.14	-0.03	-6.19
79.43	0.02	0.02	501.19	0.03	-0.01	1467.80	0.07	-0.13	4298.66	0.16	-1.02	12589.25	0.21	-6.56
100.00	0.01	0.01	541.17	0.02	-0.02	1584.89	0.07	-0.14	4641.59	0.17	-1.19	13593.56	0.41	-6.89
125.89	0.02	0.02	584.34	0.01	-0.02	1711.33	0.08	-0.16	5011.87	0.16	-1.37	14677.99	0.71	-7.11
158.49	0.02	0.02	630.96	0.02	-0.02	1847.85	0.09	-0.19	5411.70	0.19	-1.59	15848.93	1.04	-7.31
199.53	0.01	0.01	681.29	0.01	-0.03	1995.26	0.09	-0.22	5843.41	0.22	-1.82	17113.28	1.34	-7.54
251.19	0.01	0.01	735.64	0.04	-0.03	2154.43	0.09	-0.26	6309.57	0.20	-2.09	18478.50	1.37	-8.03
271.23	0.01	0.01	794.33	0.05	-0.04	2326.31	0.10	-0.30	6812.92	0.24	-2.42	19952.62	1.03	-8.90
292.86	0.02	0.01	857.70	0.06	-0.04	2511.89	0.13	-0.33	7356.42	0.24	-2.79			

Tony Serris — Feb 21, 2023
Larson-Davis Model 9700 ES Microphone Calibration System

MTS Calibration Ltd,
The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01642 876 410

CERTIFICATE OF CALIBRATION

Approved Signatory:

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 22 February 2023 **Certificate Number:** 38064F

Third Octave Band Filter

Third-Octave Band Filter verification to BS EN 61260:1996

Client: ECO Power

Instrument Make: Larson Davis
Instrument Model: LxT1
Serial Number: 0005928

Associated Sound Level Meter

Instrument Make:	Larson Davis
Instrument Model:	LxT1
Serial Number:	0005928
Calibrated by:	MTS Calibration
Certificate Number:	38064
Date: of SLM calibration	22 February 2023
Date: of receipt	08 February 2023

Associated Preamplifier

Instrument Make:	Larson Davis
Instrument Model:	PRMLxT1L
Serial Number:	055776

The measurements were performed at The Grange Business Centre, Belasis Avenue, TS23 1LD. The results only apply to the item(s) tested.

Third-Octave Band Filter **Compliance with BS EN 61260: 1996 Class 1**

Test results summary. Detailed results are shown on subsequent pages.

		Comments
- Tabular Data		See Page 2
- Graphic Data for 125Hz filter	Complies	See Page 3
- Graphic Data for 1kHz filter	Complies	See Page 3
- Graphic Data for 8kHz filter	Complies	See Page 3

Because each digital filter will have the same amplitude characteristic relative to its centre frequency, only three filters were measured at each of the test frequencies specified by BS EN 61260:1996 for exact base 10 distribution. The measurements made were relative to the attenuation of the 1kHz filter at 1kHz input frequency and input level 0.72 V. Because the measurements include a linearity contribution from the sound level meter, and could be variable with frequency, the assessment is valid only for this pairing. The sound level meter was set for "Linear" frequency response on the lowest range setting which did not give overload at any test frequency or test level. Its compliance with the standard was assessed by referring the measurements to the tolerances specified.

Agreed and reported Decision Rule:

"Complies" indicates that the instrument conforms with the relevant accuracy requirements of the testing standard AND the expanded measurement uncertainty (k = 2 for approximately 95 % coverage probability) is no greater in magnitude than the accuracy requirements defined in BS EN 61260:1996.

Comments

The sound level meter and preamplifier were calibrated as a unit.
The input level used is selected to produce a sound level at 1kHz that is close to but not exceeding the maximum level on the reference range.
The centre frequency sequence of this filter set follows the exact base 10 midband frequency sequence of IEC 61260 and the measurements have been made accordingly.

Measurement Conditions:

Temperature	22.1	°C	± 1 °C
Atmospheric Pressure	1007.0	mBar	± 2 mBar
Relative Humidity	39.8	%	± 5 %

Uncertainties of measurements:

Within Passband (0.89 to 1.12 of centre frequency)	0.42	dB
Outside Passband	2.40	dB

Test Equipment:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Cal. Due
Signal Generator (set 3)	HP	33120A	US34007158	TE 163	Oct-23

Larson Davis Third Octave Band Filter Type LxT1

Serial Number : 0005928

Associated Sound Level Meter : Larson Davis Type : LxT1

Serial Number : 0005928

Third-Octave Filter Characteristics

A digital filter is measured only on 125, 1000, 8000 Hz centre frequencies because each filter of the set should be identical

Input exact base 10 centre frequency values **Input Level** 0.72 V **Measured as** 116.5 dB lin on 1kHz filter

	Fraction of Centre Frequency																
Centre Frequency (Hz)	0.19	0.32	0.53	0.77	0.89	0.92	0.95	0.97	1.00	1.03	1.06	1.09	1.12	1.29	1.86	3.05	5.28
16																	
20																	
25																	
31.5																	
40																	
50																	
63																	
80																	
100																	
125	-96.8	-83.*	-58.5	-76.1	-2.9	-0.4	0.0	0.0	0.0	0.0	0.0	-0.2	-2.9	-95.2	-101.4	-104.2	-105.9
160																	
200																	
250																	
315																	
400																	
500																	
630																	
800																	
1000	-94.1	-84.3	-58.5	-76.2	-2.9	-0.4	0.0	0.0	0.0	0.0	0.0	-0.2	-2.9	-95.6	-100.3	-101.6	-101.9
1250																	
1600																	
2000																	
2500																	
3150																	
4000																	
5000																	
6300																	
8000	-89.7	-90.4	-58.5	-75.9	-2.9	-0.4	0.0	0.0	0.0	0.0	0.0	-0.2	-2.9	-89.1	-87.0	-90.3	-84.1
10000																	
12500																	
16000																	
20000																	

Levels are in dB re-level on 1kHz filter at 1kHz input

General Specifications to BS EN 61260: 1996

Class 0																	
Tolerance +	-75.0	-62.0	-42.5	-18.0	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	-18.0	-42.5	-62.0	-75.0
Tolerance -	minus infinity				-4.5	-1.10	-0.40	-0.20	-0.15	-0.20	-0.40	-1.10	-4.5	minus infinity			
Class 1																	
Tolerance +	-70.0	-61.0	-42.0	-17.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	-17.5	-42.0	-61.0	-70.0
Tolerance -	minus infinity				-5.0	-1.3	-0.6	-0.4	-0.3	-0.4	-0.6	-1.3	-5.0	minus infinity			
Class 2																	
Tolerance +	-60	-55	-41	-16.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-16.5	-41	-55	-60
Tolerance -	minus infinity				-5.5	-1.6	-0.8	-0.6	-0.5	-0.6	-0.8	-1.6	-5.5	minus infinity			

Within the limitations of the measurements made, the Filter Set is fully functional and is within Class 1 specifications

Tested by: Nick Box

Date: 22 February 2023

Certificate Number: 38064F

Page: 2

of: 3

Third Octave Band Filter

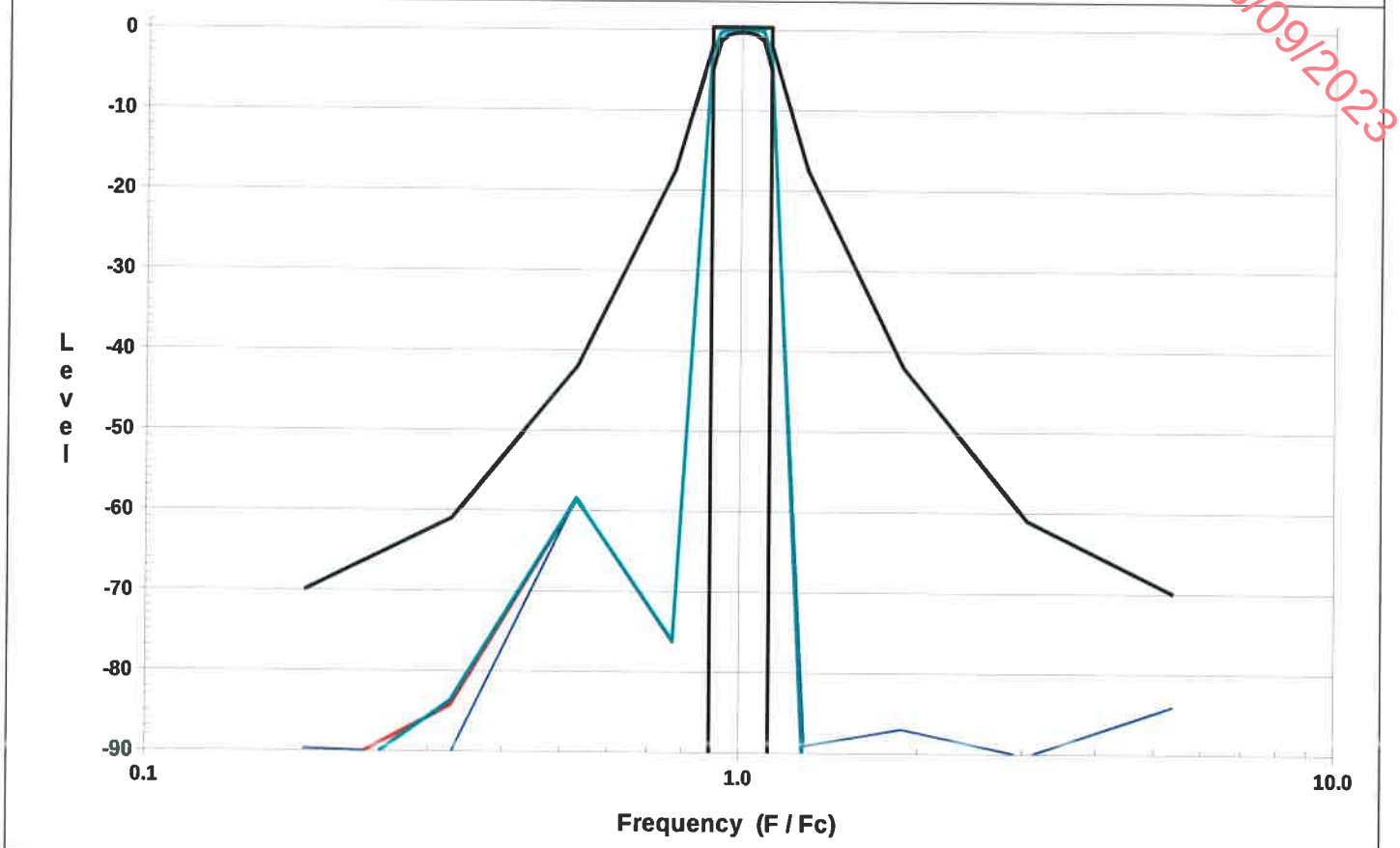
Larson Davis Type: LxT1

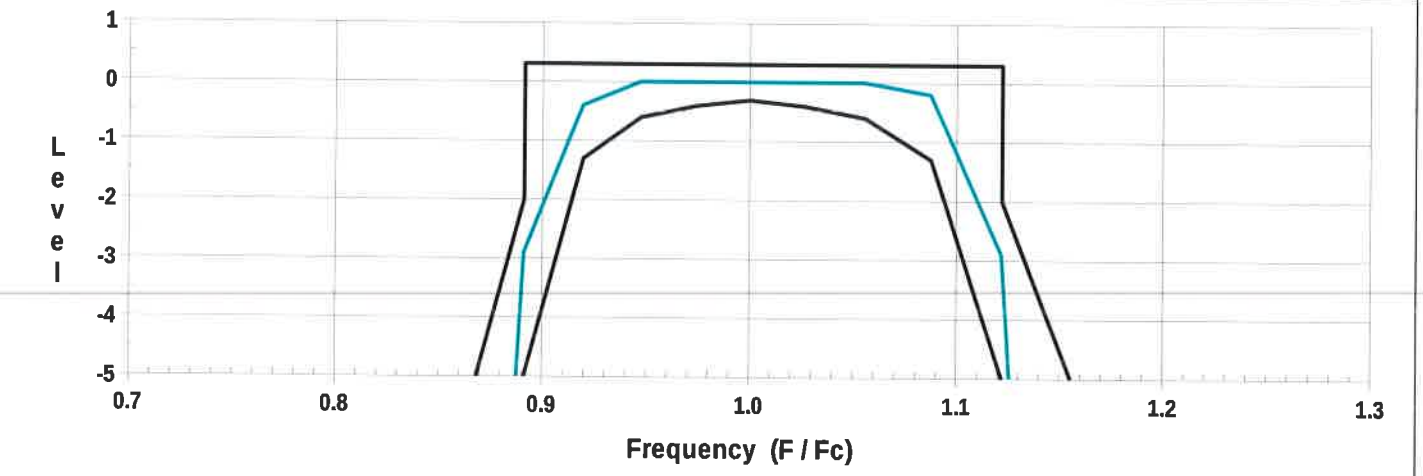
Serial Number: 0005928

125Hz Filter
1kHz Filter
8kHz Filter
where a line cannot be seen, it is covered exactly by another

Level measurement is attenuation in dB re- level at 1kHz on 1kHz filter

BS EN 61260: 1996 Class 1





Tested by:

Nick Box

Date: 22 February 2023

Certificate Number: 38064F

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of: 3

End of Certificate

MTS Calibration Ltd,
The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01642 876 410

CERTIFICATE OF CALIBRATION

Approved Signatory:

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 22 February 2023 **Certificate Number:** 38064

Sound Level Meter

Sound Level Meter Periodic Tests to EN 61672-3: 2013 Class 1

Client: ECO Power

Instrument Make: Larson Davis
Instrument Model: LxT1L
Serial Number: 0005928

Associated Equipment	Make	Model	Serial number
Preamplifier	Larson Davis	PRMLxT1L	055776
Microphone	PCB	377B02	314623
Calibrator	Larson Davis	CAL200	16931
Calibrator supplied by	the Client, with the SLM		

The measurements were performed at The Grange Business Centre, Belasis Avenue, TS23 1LD. The results only apply to the Items tested.

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 Class 1

Test results summary, detailed results are shown on subsequent pages.

Tests performed	Section	Results of test	Page	Comments
Calibration Certificate	22		1	
Additional information			2	
Indication with Calibrator Supplied	10	No Limit	3	
Self-Generated Noise	11	No Limit	3	
Frequency and Time-weightings at 1kHz	14	Complies	3	
Long term stability	15	Complies	3	
High stability	21	Complies	3	
Acoustic Tests	12	Complies	4	
Frequency Weighting A	13	Complies	5	
Frequency Weighting C	13	Complies	6	
Frequency Weighting Z	13	Complies	7	
Level Linearity	16	Complies	8	
Level Linearity Range Control	17		n/a	SLM only has one range
Tone-burst Response	18	Complies	9	
Peak C sound level	19	Complies	10	
Overload indication	20	Complies	11	

The instrument was within the above specification as received - no modifications were made

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3: 2013 for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2: 2013, to demonstrate that the model of sound level meter fully conformed to the Class 1 specifications in IEC 61672-1: 2013, the sound level meter submitted for testing conforms to the Class 1 specifications of IEC 61672-1: 2013

Additional tests performed	Reference	
Microphone full frequency response	38066	See additional certificate
Filter calibration, third octave or octave	38064F	See additional certificate
Calibrator calibration	38067U	See additional UKAS certificate

CERTIFICATE OF CALIBRATION

Additional Information

Issued by: **MTS Calibration Ltd**

Telephone: +44 (0)1642 876 410

RECEIVED 08/09/2023

Date of Issue:	22 February 2023	Certificate Number:	38064

Sound Level Meter Periodic Tests to EN 61672-3: 2013 Class 1

Client:	**ECO Power**		
Instrument Make:	**Larson Davis**	***Microphone Make:***	**PCB**
Instrument Model:	**LxT1L**	***Microphone Model:***	**377B02**
Serial Number:	**0005928**	***Serial Number:***	**314623**
Firmware version:	**2.302**		
date received:	**08 February 2023**		
date of test:	**22 February 2023**		

1. **The Instruction Manual referred to for instrument specifications was:** Larson Davis LxT1 Operation man.
   Manual reference : I 770.01 Rev M
   Date acquired : 20-10-2018
2. **The source of correction data for the correct use of the Calibrator was from:** Calibrator Manual
3. **The source of correction data for the Microphone Corrections used was from:** From LxT1 manual
4. **Information on the uncertainty of measurement, required by IEC 61672:3-2013, for the correction data given in the Instruction Manual was available.**
5. **In this Calibration, reference data for the sound level meter were:**
   Calibration Check Frequency: 1000 Hz
   Reference Sound Pressure Level: 114 dB re 20µPa
   Reference Range: Single Range
6. **The SLM configuration for the tests was:** SLM, Preamplifier and Microphone Without Extension cable
   Windshield None Supplied
   Case corrections L*D LxT1
7. **The calibrator used was supplied :** the Client, with the SLM
8. **Calibration certificate number for the calibrator used :**
9. **The calibrator level used in dB following appropriate corrections was :** 113.86 dB
10. **Indications of SLM to the calibrator at the calibration check frequency:**

	dB(A)
As received:	**114.20**
Following adjustment:	**113.90**

11. **Visual and Operational Inspection:(5 & 6)**
    Operation of Controls: ok
    Power Supply: not supplied
    Battery Condition as received: not supplied
    Battery Condition as assessed: Good
12. **Any other comments regarding the calibration**

Conformance and Uncertainty BS EN 61672-3:2013 section 4.1

"4.1, Conformance to a performance specification is demonstrated when the following criteria are both satisfied:
(a) a measured deviation from a design goal does not exceed the applicable acceptance limit and
(b) the corresponding uncertainty of measurement does not exceed the corresponding maximum-permitted uncertainty of measurement given in IEC 61672-1 for the same coverage probability of 95 %."

	At start of test	At end of test		
Ambient Temperature at Calibration (deg C ± 1)	21.1	21.4		
Ambient Pressure at Calibration (mPa ± 2)	1007.0	1007.0		
Ambient Relative Humidity at Calibration (% ± 5)	41.4	40.8		

Test Equipment used to perform this calibration:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Cal. Due
Acoustic Calibrator	Brüel & Kjær	4226	2141963	TE 206	Apr-24
Signal Generator (set 3)	HP	33120A	US34007158	TE 163	Oct-23
al-Time Frequency Analyser (set 3)	Larson Davis	2900	0510	TE 165	May-23

MTS Calibration Ltd
The Grange Business Centre, Belasis Avenue, Billingham TS23 1LG
Telephone: 01642 876410 **E-Mail:** dmarsh@slmcal.co.uk **or** tsherris@slmcal.co.uk

Larson Davis	**LxT1L**	**Sound Level Meter**			
Serial Number:	0005928				
Preamplifier Model:	PRMLxT1L	**Serial number:**	055776		
Microphone Model:	377B02	**Serial number:**	314623		

Section 10	**Indication with Calibrator Supplied**
Section 11	**Self-Generated Noise**
Section 14	**Frequency and Time-weightings at 1kHz**
Section 15	**Long term stability**
Section 21	**High stability**

Indication with Calibrator Supplied: (10)

on the reference level range = Single Range

Indication with MTS Calibrator if above calibrator not calibrated this time:

	dB(A)			corrected calibrator level	
as received	114.20				
after adjustment	113.90			113.86	dB(A)
					dB(A)

Self Generated Noise

On the most-sensitive level range = Single Range

Self Generated Noise with Microphone fitted: (11.1)

Instrument Range setting: Single Range

Instrument specification:	16.3	dB(A)
Measured level:	16.7	dB(A) Leq 30sec

background level measured with L*D 2900 at 16.5dBA
Preferably use at least 30 second Leq or
if not available use A Slow. average of 10 measurements over 60 seconds
if not available use A Fast. average of 10 measurements over 60 seconds

Self Generated Noise with Microphone replaced by electrical input device: (11.2)

Instrument Range setting: Single Range

		Instrument specification:	
Measured level:	8.2	11.30	dB(A) Leq 30sec
Measured level:	11.4	16.30	dB(C) Leq 30sec
Measured level:	17.9	24.30	dB(Z) Leq 30sec

The intent of this test is simply to measure and report noise levels. Exceedance of a measured level does not, by itself, mean that the performance of the sound level meter is no longer acceptable

Frequency and Time-weightings at 1kHz (14)

For this test, this instrument complies with BS EN 61672-1: 2013 Class 1 Tolerances

Input signal level 1kHz, A-weighting, Reference Level 114 dB

on the reference level range = Single Range

	A Fast	A Slow	A Leq	Uncertainty (+/-) dB	Tolerance +/- dB
- effect of F, S, Leq time weighting	114.00	114.00	114.00	0.10	0.2 / 0.1
	C Fast	Z Fast			
- effect of C, Z, LIN frequency weighting	114.00	114.00		0.10	0.2 / 0.2

Uncertainty of measurement | Maximum-permitted from 61672-1

Long-term stability (15)

For this test, this instrument complies with BS EN 61672-1: 2013 Class 1 Tolerances

Enter the dB micro Volt level required to produce the reference level ▶ 114.60 dBµV

Input signal level 1kHz, A-weighting, Reference Level 114 dB

on the reference level range = Single Range

	dB(A) Fast	Time HH:MM	Target	Uncertainty (+/-) dB	Tolerance +/- dB
First SLM reading	114.00	09:30			
Second SLM Reading with same input level	114.00	09:58			
Difference	0.00	00:28	25 – 35 min	0.10	0.1 / 0.1

Uncertainty of measurement | Maximum-permitted from 61672-1

High-level stability (21)

Set Level

For this test, this instrument complies with BS EN 61672-1: 2013 Class 1 Tolerances

Input signal level 1kHz, 1 dB less than upper level 117.1 dB

On the least-sensitive level range – Single Range

	dB(A) Fast	Time HH:MM	Target	Uncertainty (+/-) dB	Tolerance +/- dB
First reading	117.10	09:32			
Second Reading	117.10	09:37			
Difference	0.00	00:05	5 Min	0.10	0.1 / 0.1

Uncertainty of measurement | Maximum-permitted from 61672-1

Tested by : Nick Box

22 February 2023

Certificate Number: 38064

Section 12 Acoustical signal test of a frequency weighting
Multi-frequency calibrator method

For this test, this instrument complies with BS EN 61672-1: 2013 Class 1 Tolerances

Larson Davis LxT1L

Serial Number: 0005928

To be calibrated on C-weighting on the sound level meter reference range Single Range
To be calibrated on Fast Time Weighting

If possible adjust input level to achieve the SLM reference level - 114 dB at 1kHz
12.9 SLM should display a level between 70dB and 125dB at 1kHz

	SLM Indication				B&K 4226 sn 2141963 corrections (Pressure re 1 kHz, + = 4226 output is High)								
						Correction for C-weighting from BS EN 61672							
							Correction - Pressure to FF for Microphone						
								Effect of instrument case					
									Effect of wind shield				
										Meter should read			
	Reading 1 dB(C)	Reading 2 dB(C)	Reading 3 dB(C)	Average							Error without Windshield	Error with Windshield	Tolerance dB Class 1	
Set 4226 to 94 dB cal at 1000Hz	114.20	114.10	114.10	114.13	0.00	0.00	0.00	0.00	0.00	114.13	0.00		-0.7	0.7
Check indication at:														
125 Hz	114.00	114.00	114.00	114.00	-0.01	-0.20	0.00	0.00	0.00	113.92	0.08		-1	1
8000 Hz	107.90	107.90	107.90	107.90	-0.14	-3.00	2.90	0.00	0.00	108.09	-0.19		-2.5	1.5

Source of adjustment data (12.5)
From LxT1 manual
No Case corrections in manual, no correction made.
No Windshield supplied. Therefore no corrections were made.

from 61672 Table 2

125 Hz	0.15	0.23	0.60
1000Hz	0.15	0.23	0.60
8000Hz	0.15	0.31	0.70
Uncertainty of measurement dB			Maximum-permitted from dB 61672-1
Uncertainty of measurement including manufactures data dB			**Certificate Number:** 38064

Page: 4 **of:** 11

Tested by : Nick Box
22 February 2023

Comments

Larson Davis LxT1L Sound Level Meter

Serial Number 0005928

A-Weighting Test

For this test, this instrument complies with BS EN 61672-1: 2013 Class 1 Tolerances

Preamplifier Model: PRMLxT1L Serial Number: 055776

Microphone Model: 377B02 Serial Number: 314623

Electrical Response

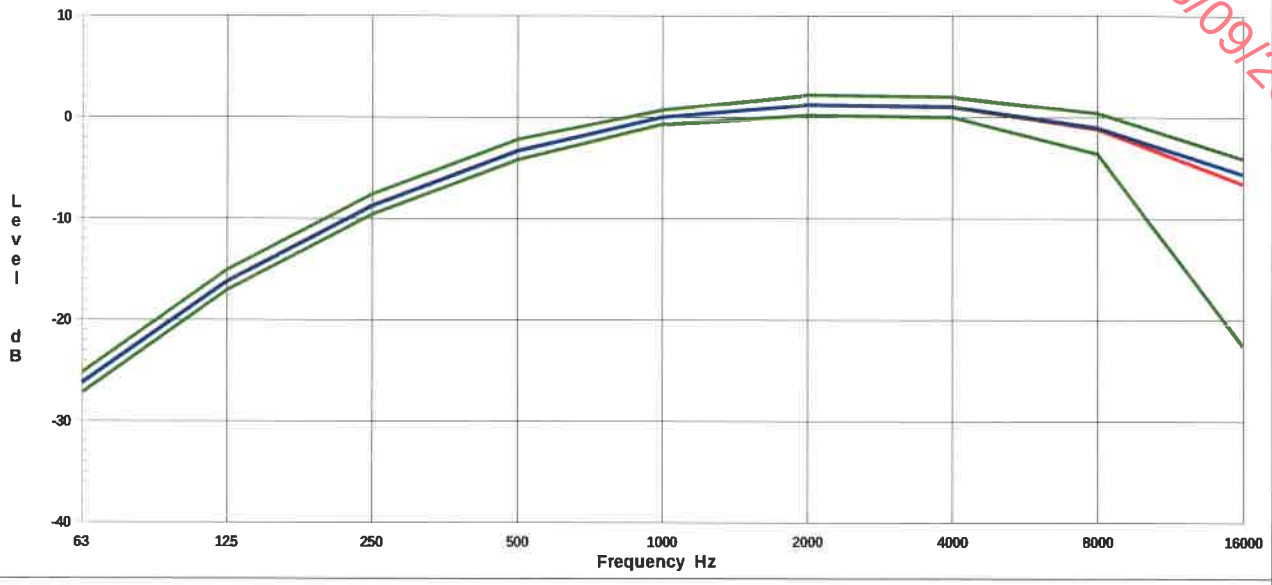
Acoustic Response - Free Field

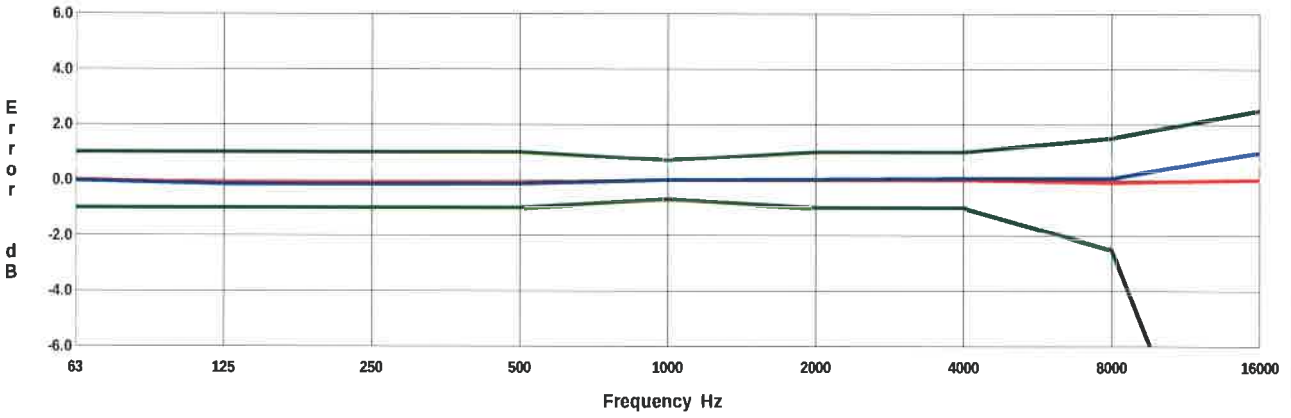
(acoustic response includes corrections for the microphone and other items as specified in the comments below)

BS EN 61672-1:2013 Class 1 tolerances

Measurements are: Fast-Time-weighted sound level

Indicated Input Level 73.1 dB(A) On the reference range





Numerical values – Red Electrical Response in dB and Blue Acoustic Response in dB.

Frequency	Electrical	Overall	Error	Frequency	Electrical	Overall	Error	Frequency	Electrical	Overall	Error
63	-26.2	-26.2	0.0	500	-3.3	-3.3	-0.1	4000	1.0	1.1	0.1
125	-16.2	-16.2	-0.1	1000	0.0	0.0	0.0	8000	-1.2	-1.0	0.1
250	-8.7	-8.8	-0.2	2000	1.2	1.2	0.0	16000	-6.6	-5.6	1.0

Tested By: Nick Box

Date: 22 February 2023

Certificate Number: 38064

Comments

No Windshield supplied. Therefore no corrections were made.

No Case corrections in manual, no correction made.

Larson Davis LxT1L Sound Level Meter

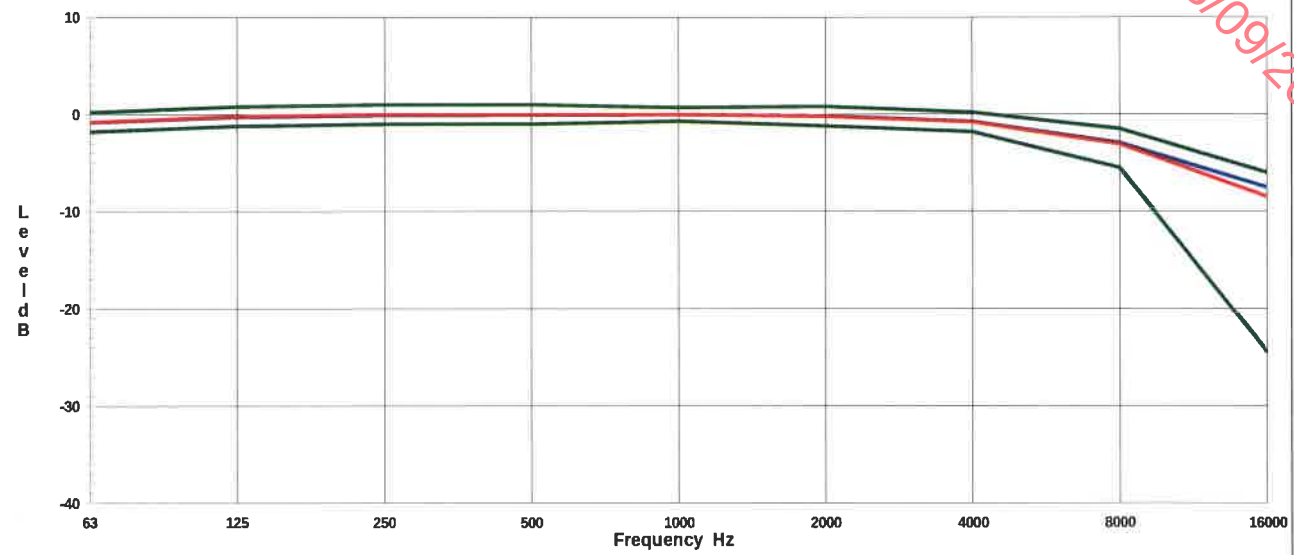
Serial Number 0005928
C-Weighting Test

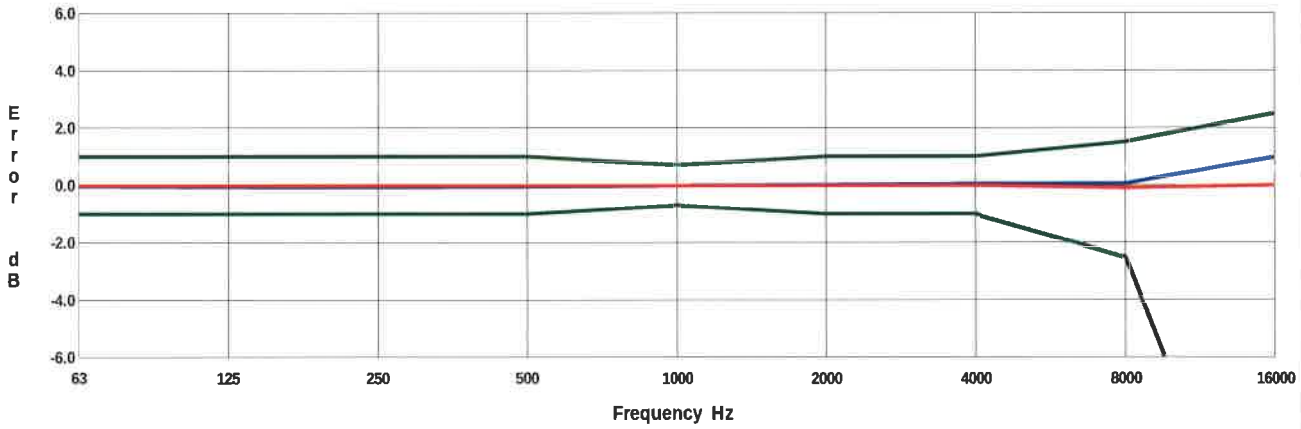
For this test, this instrument complies with BS EN 61672-1: 2013 Class 1 Tolerances

Preamplifier Model: PRMLxT1L Serial Number: 055776
Microphone Model: 377B02 Serial Number: 314623

Measurements are: Fast-Time-weighted sound level
Indicated Input Level 73.1 dB(A) On the reference range

Electrical Response
Acoustic Response - Free Field
(acoustic response includes corrections for the microphone and other items as specified in the comments below)
BS EN 61672-1:2013 Class 1 tolerances





Numerical values – Red Electrical Response in dB and Blue Acoustic Response in dB

Frequency	Electrical	Overall	Error	Frequency	Electrical	Overall	Error	Frequency	Electrical	Overall	Error
63	-0.8	-0.8	0.0	500	0.0	0.0	0.0	4000	-0.8	-0.8	0.1
125	-0.2	-0.3	-0.1	1000	0.0	0.0	0.0	8000	-3.1	-2.9	0.1
250	0.0	-0.1	-0.1	2000	-0.2	-0.2	0.0	16000	-8.5	-7.5	1.0

Tested By: Nick Box
Date: 22 February 2023

Certificate Number: 38064

Comments

No Windshield supplied. Therefore no corrections were made.

No Case corrections in manual, no correction made.

Larson Davis LxT1L Sound Level Meter

Serial Number 0005928

Z-Weighting Test

For this test, this instrument complies with BS EN 61672-1: 2013 Class 1 Tolerances

Electrical Response

Acoustic Response - Free Field

(acoustic response includes corrections for the microphone and other items as specified in the comments below)

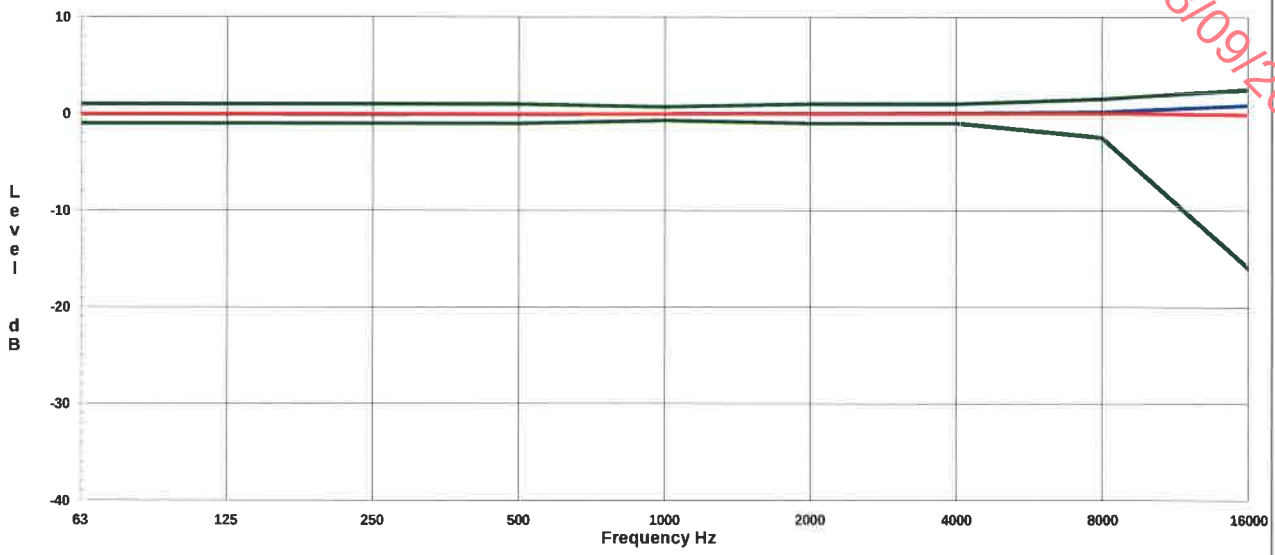
BS EN 61672-1:2013 Class 1 tolerances

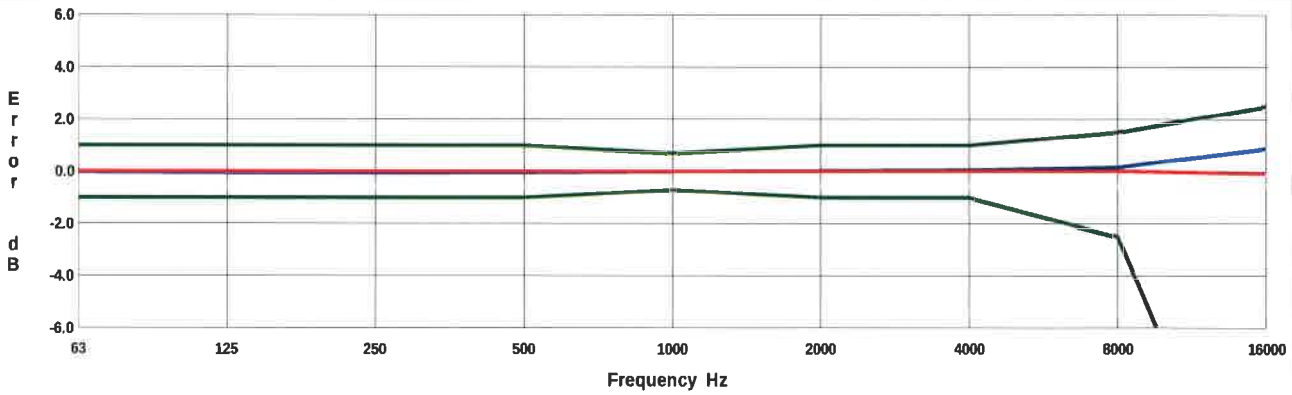
Preamplifier Model: PRMLxT1L **Serial Number:** 055776

Microphone Model: 377B02 **Serial Number:** 314623

Measurements are: Fast-Time-weighted sound level

Indicated Input Level 73.1 dB(A) On the reference range





Numerical values – Red Electrical Response in dB and Blue Acoustic Response in dB

Frequency	Electrical	Overall	Error	Frequency	Electrical	Overall	Error	Frequency	Electrical	Overall	Error
63	0.0	0.0	0.0	500	0.0	0.0	0.0	4000	0.0	0.1	0.1
125	0.0	-0.1	-0.1	1000	0.0	0.0	0.0	8000	0.0	0.2	0.2
250	0.0	-0.1	-0.1	2000	0.0	0.0	0.0	16000	-0.1	0.9	0.9

Tested By: Nick Box

Date: 22 February 2023

Certificate Number: 38064

Comments

No Windshield supplied. Therefore no corrections were made.

No Case corrections in manual, no correction made.

Larson Davis	LxT1L	Section 16: Level linearity on the reference range
Serial Number:	0005928	

	Neg	Pos	
applicable tolerance limit dB	-0.80	0.80	
Uncertainty of level measurement dB	-0.10	0.10	For this test, this instrument complies with
Maximum-permitted uncertainty (dB) from 61672-1	-0.30	0.30	BS EN 61672-1: 2013 Class 1 Tolerances

INPUT FREQUENCY 8kHz

Measurements to be made in dB(A) F time weighting		
Reference SPL	114.0	dB(A)
Reference Range	Single Range	dB(A)

Starting Point for tests of level linearity	113.3	dB(A)
lower limit of the linear operating range at 8kHz	20.3	dB(A)
upper limit of the linear operating range at 8kHz	117.0	dB(A)

Anticipated indication dB(A)	Input dBuV	dB(A) F Reference Range Reading	Error
113.3	115.00	113.30	0.00
108.3	110.00	108.30	0.00
103.3	105.00	103.30	0.00
98.3	100.00	98.30	0.00
93.3	95.00	93.30	0.00
88.3	90.00	88.30	0.00
83.3	85.00	83.30	0.00
78.3	80.00	78.30	0.00
73.3	75.00	73.30	0.00
68.3	70.00	68.20	-0.10
63.3	65.00	63.20	-0.10
58.3	60.00	58.20	-0.10
53.3	55.00	53.20	-0.10
48.3	50.00	48.20	-0.10
43.3	45.00	43.20	-0.10
38.3	40.00	38.20	-0.10
33.3	35.00	33.20	-0.10
28.3	30.00	28.30	0.00
23.3	25.00	23.30	0.00

Top 5dB of Reference Range dB(A) F				Bottom 5dB of Reference Range dB (A) F			
Anticipated indication dB(A)	in 1dB steps dBuV	Reading	Error	Anticipated indication dB(A)	in 1dB Steps dBuV	Reading	Error
117.00	118.70	117.00	0.00	25.30	27.00	25.30	0.00
116.00	117.70	116.00	0.00	24.30	26.00	24.30	0.00
115.00	116.70	115.00	0.00	23.30	25.00	23.30	0.00
114.00	115.70	114.00	0.00	22.30	24.00	22.40	0.10
113.00	114.70	113.00	0.00	21.30	23.00	21.40	0.10
112.00	113.70	112.00	0.00	20.30	22.00	20.50	0.20
	set value	measured value			set value	measured value	

Start point = 113.3 dB A at 8 kHz	115.00
Enter the input dBuV required to achieve this reading	

Certificate Number:	38064	Authorised signatory:	
Page	of		
8	11	22 February 2023	Nick Box

Larson Davis	LxT1L
Serial Number:	0005928

Section 18: Tone-burst response

For this test, this instrument complies with BS EN 61672-1: 2013 Class 1 Tolerances

Test frequency 4kHz Measured on A-weighting

Upper limit of linear operating range at 4kHz = 119.1 dB

Measured on Reference Level Range: Single Range

Uncertainty of measurement dB	0.12
Maximum-permitted (dB) from 61672-1	0.30

A F-Time-Weighted response

Range	Nominal Test Level	Actual Test Level	Burst Duration	Burst Count	Input level	Gain Used	Measured max F-time-weighted dB(A)				Actual Test Level	Actual Diff	BS EN 61672-1: 2013 Class 1 Tolerances dB		
dB	dBA	dBA F	ms		(mVrms)	dB	1	2	3	average	dBA F	dB			
Single Range	116.10	**116.10**	continuous		610.0	0.0					after		level	Min	Max
Single Range	116.10	116.10	200	800	610.0	0.0	115.1	115.1	115	115.10	116.10	-1.00	-1	-0.5	0.5
Single Range	116.10	116.10	2	8	610.0	0.0	97.9	97.9	97.9	97.90	116.10	-18.20	-18	-1.5	1
Single Range	116.10	116.10	0.25	1	610.0	0.0	88.70	88.70	88.80	88.70	116.10	-27.40	-27	-3	1

A S-Time-Weighted response

Range	Nominal Test Level	Actual Test Level	Burst Duration	Burst Count	Input level	Gain Used	Measured max S-time-weighted dB(A)				Actual Test Level	Actual Diff	BS EN 61672-1: 2013 Class 1 Tolerances dB		
dB	dBA	dBA S	ms		(mVrms)	dB	1	2	3	average	dBA S	dB			
		before									after		level	Min	Max
Single Range	116.10	116.10	200	800	610.0	0.0	108.6	108.6	108.6	108.60	116.10	-7.50	-7.4	-0.5	0.5
Single Range	116.10	116.10	2	8	610.0	0.0	89.00	89.00	89.00	89.00	116.10	-27.10	-27	-3	1

SEL-Time-Weighted response (LAE)

Range	Nominal Test Level	Actual Test Level	Burst Duration	Burst Count	Input level	Gain Used	Measured max SEL-time-weighted dB(A)				Actual Test Level	Actual Diff	BS EN 61672-1: 2013 Class 1 Tolerances dB		
dB	dBA	LEQ dBA	ms		(mVrms)	dB	1	2	3	average	LEQ dBA	dB			
		before									after		level	Min	Max
Single Range	116.10	116.10	200	800	610	0	109.10	109.10	109.10	109.10	116.10	-7.00	-7	-0.5	0.5
Single Range	116.10	116.10	2	8	610	0	89.10	89.10	89.10	89.10	116.10	-27.00	-27	-1.5	1
Single Range	116.10	116.10	0.25	1	610	0	80.00	80.00	80.00	80.00	116.10	-36.10	-36	-3	1

Tested By: Nick Box

Date: 22 February 2023

Larson Davis	LxT1L	Section 19: Peak C Sound Level
Serial Number:	0005928	For this test, this instrument complies with BS EN 61672-1: 2013 Class 1 Tolerances

The instrument was calibrated as for Dynamic Linearity Tests and subjected to
a single complete 8kHz sine pulse
positive and negative half-cycles of 500Hz sinusoid

Measurements are made on the least sensitive range — Single Range

Uncertainty of measurement dB	0.10
Maximum-permitted (dB) from 61672-1	0.35

Test Levels are referred to upper limit of the peak level range at 8kHz = 120.3 dB(C)

Nominal Test Level = 112.3 dB F, C-weighted

Test signal	Frequency Hz	Level F C-weighted	Level peak C-weighted	Error dB	BS EN 61672-1: 2013 Class 1 Tolerances dB level	Min	Max
Continuous	8kHz	112.30					
Single	8kHz		115.10	2.80	3.4	-2	2
Continuous Positive-going	500Hz	109.30					
half-cycle	500Hz		111.50	2.20	2.4	-1	1
Negative-going							
half-cycle	500Hz		111.50	2.20	2.4	-1	1

Tested by: Nick Box

Certificate Number: 38064

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Date: 22 February 2023

Larson Davis	LxT1L	Section 20: Overload indication
Serial Number:	0005928	For this test, this instrument complies with BS EN 61672-1: 2013 Class 1 Tolerances

The instrument was calibrated as for Dynamic Linearity Tests and set to dB(A) time averaged on the least sensitive level range
The test signal is positive-going and negative-going 4kHz half-cycle sinusoid

Test Levels are referred to upper limit of the least sensitive Range at 4 kHz **Single Range** **119.1** **dBA**

	dB(A) time average	SG Voltage pp	Gain Used (dB)	SG dBm
Indicated Start Level - continuous 4kHz	118.1	2.1800	0	-0.539
Overload Level - signal positive going half-cycle sinusoid				6.200
Overload Level - signal negative going half-cycle sinusoid				6.200

dB difference between + and - Input levels is	0.00
max permitted dB difference between + and - input levels is	1.50
Uncertainty of measurement dB	0.12
Maximum-permitted (dB) from 61672-1	0.25

It is confirmed that the overload indicator latches at the above levels

Tested by :

22 February 2023 **Nick Box**

Certificate Number:	38064		
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End of Certificate

MTS Calibration Ltd,
The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01642 876 410

0607

CERTIFICATE OF CALIBRATION

Approved Signatory:

RH SH

Tony Sherris

Issued by: MTS Calibration Ltd
Performed by Tony Sherris
Date of Issue: 20 February 2023 **Certificate Number:** 38067U

Sound Calibrator

Client: Environmental Measurements
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

On behalf of: ECO Power

The Device calibrated was:

Larson Davis **Model CAL200** **Serial Number 16931**

The measurements were performed at Elvington Close, Billingham, TS23 3YS and the measured values were as follows:

Output Level 1:	93.93	dB re 20µPa	± 0.15 dB (k= 2)
Fundamental Frequency 1:	1000.40	Hz	± 0.11 Hz (k= 2)
Total Harmonic Distortion 1:	0.47	%	± 0.013 % (k= 2)
Output Level 2:	113.98	dB re 20µPa	± 0.15 dB (k= 2)
Fundamental Frequency 2:	1000.40	Hz	± 0.11 Hz (k= 2)
Total Harmonic Distortion 2:	0.55	%	± 0.013 % (k= 2)

This measurement is valid only for the above device configured for calibration of a WS-2 microphone under the stated environmental conditions. For deviation of prevailing conditions, the manufacturer's literature for the calibrator should be referred to.

Date of Measurements: 20 February 2023 *Date of Receipt:* 08 February 2023

Method of calibration

A Reference Calibrator was used to establish the sensitivity of the measurement chain. The same measurement chain is then used to determine the output level of the Object Calibrator by the difference between its output and that of the nominated Reference Calibrator. Four independent measurements of the third-octave band sound pressure levels produced by the Reference Calibrators and the Object Calibrator are averaged to minimise uncertainties of the calibration. The measurement chain consists of a calibrated, Reference Microphone, Reference Preamplifier and Reference Analyser.

As well as providing a traceable measurement of the sound pressure level in the cavity of the Object Calibrator, the Calibrator's frequency and total harmonic distortion are also measured. Frequency is determined from the average of four independent measurements using a multimeter. The total harmonic distortion is measured from the average of three independent measurements by third octave analysis, subtracting the level of the fundamental frequency from the sum of the combined harmonics in the frequency band to 20kHz. The complete procedure is detailed in the MTS Calibration Ltd work procedure WP01.

The sound pressure level generated by the calibrator in its WS2 configuration was measured by reference to the reference Sound Calibrator as shown in the Test Equipment section below.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k (individually calculated as above), providing a coverage probability of approximately 95%. The uncertainty evaluation has been calculated in accordance with the current version of UKAS publication M3003. The uncertainty quoted for the Distortion Measurement is the Distortion Percentage as measured, multiplied by our Uncertainty as calculated for the individual measurement or our CMC, whichever is the larger.

Measurement Conditions:

Temperature	23	°C	± 1 °C
Atmospheric Pressure	1013	mBar	± 2 mBar
Relative Humidity	44	%	± 5 %

Test Equipment used during this calibration:

Equipment	Manufacturer	Model	Serial No.	Traceability Ref.	Calibration Due
Reference Calibrator	Brüel & Kjær	4231	2326247	TE 129	Nov-23
Multimeter	HP	34401A	36146A63804	TE 105	Oct-23
Microphone	B&K	4133	810486	TE 155	Aug-23
Real-Time Analyser (set 1)	Larson Davis	2900	0492	TE 108	Jul-23

End of Certificate

APPENDIX C

Noise Monitoring RAW Data

Noise Monitoring at H1 - RAW Data

Date	Time	LAeq	LAFmin	LAFmax	LAF10.00	LAF90.00
2023-04-17	16:00:00	48.3	42.7	61.3	50.0	45.0
2023-04-17	16:15:00	50.8	45.5	71.0	52.0	47.1
2023-04-17	16:30:00	48.5	45.5	64.8	49.6	46.8
2023-04-17	16:45:00	49.0	45.5	71.4	50.4	46.9
2023-04-17	17:00:00	50.1	45.8	62.2	52.8	47.0
2023-04-17	17:15:00	51.8	44.7	63.0	54.9	46.5
2023-04-17	17:30:00	55.8	44.8	69.9	60.1	48.2
2023-04-17	17:45:00	50.3	44.8	66.9	52.6	46.3
2023-04-17	18:00:00	50.1	43.7	70.2	51.2	45.9
2023-04-17	18:15:00	49.4	43.2	62.2	52.5	45.0
2023-04-17	18:30:00	51.4	43.6	64.8	54.9	45.5
2023-04-17	18:45:00	55.2	43.2	74.0	59.3	45.3
2023-04-17	19:00:00	50.4	43.2	70.2	53.4	45.2
2023-04-17	19:15:00	51.1	43.3	70.5	53.0	45.0
2023-04-17	19:30:00	50.3	43.3	68.9	51.4	45.1
2023-04-17	19:45:00	55.1	43.5	73.4	58.0	45.3
2023-04-17	20:00:00	51.7	43.8	69.3	54.8	45.5
2023-04-17	20:15:00	52.5	43.8	66.5	56.4	45.6
2023-04-17	20:30:00	52.9	43.4	67.2	56.9	45.2
2023-04-17	20:45:00	53.3	43.7	66.3	57.5	45.6
2023-04-17	21:00:00	50.3	44.0	67.0	52.7	45.5
2023-04-17	21:15:00	46.8	44.0	60.4	47.7	45.6
2023-04-17	21:30:00	46.3	43.2	64.9	46.2	44.4
2023-04-17	21:45:00	44.8	42.9	51.3	45.5	44.1
2023-04-17	22:00:00	44.8	43.0	50.2	45.5	44.0
2023-04-17	22:15:00	45.3	43.4	49.6	46.2	44.5
2023-04-17	22:30:00	46.0	44.3	49.4	46.7	45.3
2023-04-17	22:45:00	45.7	43.4	48.4	46.5	44.8
2023-04-17	23:00:00	45.1	43.0	52.9	45.9	44.3
2023-04-17	23:15:00	44.9	42.9	47.8	45.6	44.1
2023-04-17	23:30:00	45.0	42.9	48.4	45.7	44.2
2023-04-17	23:45:00	45.5	43.4	49.0	46.3	44.6
2023-04-18	00:00:00	46.1	43.8	51.1	47.1	45.1
2023-04-18	00:15:00	47.0	44.4	54.2	48.0	45.8
2023-04-18	00:30:00	47.5	45.0	52.7	48.5	46.4
2023-04-18	00:45:00	48.5	45.5	53.0	49.5	47.3
2023-04-18	01:00:00	47.9	45.0	53.0	48.9	46.9
2023-04-18	01:15:00	48.4	45.5	53.1	49.4	47.3
2023-04-18	01:30:00	48.4	45.9	54.5	49.4	47.4
2023-04-18	01:45:00	48.7	45.5	54.4	49.7	47.5
2023-04-18	02:00:00	48.4	45.7	52.9	49.4	47.3
2023-04-18	02:15:00	47.8	45.4	52.7	48.7	46.8
2023-04-18	02:30:00	47.9	45.1	54.4	48.8	46.9
2023-04-18	02:45:00	47.5	44.7	51.8	48.4	46.4
2023-04-18	03:00:00	46.8	44.6	51.1	47.6	46.0

2023-04-18	03:15:00	46.9	44.6	51.1	47.6	46.0
2023-04-18	03:30:00	46.9	44.7	50.6	47.7	46.1
2023-04-18	03:45:00	47.5	44.6	56.4	48.3	46.1
2023-04-18	04:00:00	47.6	45.0	54.9	48.5	46.3
2023-04-18	04:15:00	47.7	45.5	53.1	48.5	46.7
2023-04-18	04:30:00	47.5	44.8	52.0	48.5	46.5
2023-04-18	04:45:00	46.9	44.5	52.3	47.8	46.1
2023-04-18	05:00:00	46.8	44.7	51.0	47.6	46.0
2023-04-18	05:15:00	46.6	44.4	50.3	47.3	45.8
2023-04-18	05:30:00	47.4	44.1	56.6	49.1	45.7
2023-04-18	05:45:00	54.2	45.7	67.3	57.5	48.2
2023-04-18	06:00:00	56.2	45.9	76.9	57.4	49.7
2023-04-18	06:15:00	55.1	47.0	74.6	57.9	49.7
2023-04-18	06:30:00	52.5	47.1	72.6	54.9	48.5
2023-04-18	06:45:00	53.7	47.1	70.8	56.8	48.7
2023-04-18	07:00:00	53.3	47.2	65.1	56.4	49.0
2023-04-18	07:15:00	52.4	47.6	65.8	54.5	49.2
2023-04-18	07:30:00	54.6	48.0	70.4	57.9	50.5
2023-04-18	07:45:00	54.5	48.8	67.9	57.3	50.5
2023-04-18	08:00:00	53.1	47.5	66.5	56.2	49.1
2023-04-18	08:15:00	52.7	47.3	66.0	55.6	48.9
2023-04-18	08:30:00	52.0	47.0	65.6	54.6	48.7
2023-04-18	08:45:00	52.4	46.6	68.1	55.0	48.6
2023-04-18	09:00:00	51.8	45.9	71.2	53.7	47.5
2023-04-18	09:15:00	54.8	45.0	75.4	57.1	47.7
2023-04-18	09:30:00	52.4	45.9	68.1	54.6	48.1
2023-04-18	09:45:00	51.7	45.8	64.5	54.7	47.6
2023-04-18	10:00:00	55.9	43.7	86.6	50.4	45.5
2023-04-18	10:15:00	65.2	44.2	94.5	54.9	46.0
2023-04-18	10:30:00	51.4	44.7	68.0	53.2	47.1
2023-04-18	10:45:00	50.5	46.7	66.4	51.6	48.2
2023-04-18	11:00:00	53.7	45.5	85.1	53.2	47.7
2023-04-18	11:15:00	49.2	45.0	63.0	50.7	47.1
2023-04-18	11:30:00	54.4	45.2	72.0	57.5	47.3
2023-04-18	11:45:00	50.0	44.3	66.5	51.2	46.3
2023-04-18	12:00:00	51.9	44.4	71.3	54.2	46.2
2023-04-18	12:15:00	49.3	43.8	66.8	50.6	45.7
2023-04-18	12:30:00	49.2	44.0	63.3	51.5	45.8
2023-04-18	12:45:00	49.2	43.8	67.9	51.1	45.7
2023-04-18	13:00:00	50.1	43.4	67.5	51.3	45.4
2023-04-18	13:15:00	53.9	43.5	71.4	57.5	45.3
2023-04-18	13:30:00	51.7	44.1	71.7	54.0	45.8
2023-04-18	13:45:00	50.0	44.2	64.5	52.7	46.2
2023-04-18	14:00:00	49.8	44.1	70.0	51.7	45.6
2023-04-18	14:15:00	52.4	44.1	68.1	56.1	45.9
2023-04-18	14:30:00	49.8	44.3	65.9	51.9	46.1
2023-04-18	14:45:00	49.1	44.4	64.2	50.9	46.4
2023-04-18	15:00:00	48.9	43.8	69.9	50.0	45.8

2023-04-18	15:15:00	49.6	44.0	62.1	51.6	46.7
2023-04-18	15:30:00	54.6	44.4	71.9	56.6	46.8
2023-04-18	15:45:00	57.7	44.6	72.2	62.4	47.1
2023-04-18	16:00:00	51.0	44.7	63.9	54.1	46.6
2023-04-18	16:15:00	55.5	45.2	73.5	58.3	47.5
2023-04-18	16:30:00	52.9	47.8	73.0	53.2	49.4
2023-04-18	16:45:00	52.8	47.0	73.6	53.5	48.5
2023-04-18	17:00:00	49.7	46.8	60.2	50.7	48.2
2023-04-18	17:15:00	49.5	46.6	62.9	50.6	47.9
2023-04-18	17:30:00	49.4	45.0	58.2	51.7	46.6
2023-04-18	17:45:00	51.2	46.6	62.7	53.4	48.6
2023-04-18	18:00:00	51.2	47.5	59.8	53.0	49.0
2023-04-18	18:15:00	51.5	46.9	65.6	53.0	48.9
2023-04-18	18:30:00	52.0	47.4	63.7	54.3	49.2
2023-04-18	18:45:00	51.1	46.9	67.2	52.7	48.7
2023-04-18	19:00:00	52.8	47.1	70.8	54.6	48.9
2023-04-18	19:15:00	54.2	47.0	70.5	57.5	48.9
2023-04-18	19:30:00	54.1	46.1	66.8	57.9	48.3
2023-04-18	19:45:00	53.7	44.5	68.3	57.5	46.6
2023-04-18	20:00:00	53.0	42.2	66.9	56.9	45.0
2023-04-18	20:15:00	53.3	41.8	66.5	57.3	44.2
2023-04-18	20:30:00	52.1	42.1	65.9	56.0	44.3
2023-04-18	20:45:00	54.3	42.9	70.2	57.9	44.7
2023-04-18	21:00:00	47.5	41.7	63.1	49.5	43.0
2023-04-18	21:15:00	44.4	41.0	69.0	44.6	41.9
2023-04-18	21:30:00	44.5	41.0	68.2	43.4	41.9
2023-04-18	21:45:00	42.1	39.9	55.2	42.6	41.1
2023-04-18	22:00:00	42.5	40.5	55.3	43.2	41.5
2023-04-18	22:15:00	42.7	40.9	46.3	43.4	41.9
2023-04-18	22:30:00	43.2	41.3	45.3	43.9	42.4
2023-04-18	22:45:00	44.7	42.3	47.9	45.6	43.5
2023-04-18	23:00:00	45.8	42.9	58.2	46.9	44.6
2023-04-18	23:15:00	46.2	43.4	53.8	47.3	45.0
2023-04-18	23:30:00	48.2	45.2	53.4	49.5	46.8
2023-04-18	23:45:00	48.6	45.1	65.4	49.3	46.9
2023-04-19	00:00:00	47.8	45.0	52.5	48.9	46.7
2023-04-19	00:15:00	47.4	44.6	55.8	48.5	46.1
2023-04-19	00:30:00	47.0	44.0	50.8	47.9	45.9
2023-04-19	00:45:00	46.7	44.3	52.0	47.6	45.7
2023-04-19	01:00:00	57.3	43.7	87.9	50.9	45.3
2023-04-19	01:15:00	47.2	42.9	70.7	48.9	44.7
2023-04-19	01:30:00	44.7	42.5	47.6	45.5	43.9
2023-04-19	01:45:00	45.3	42.8	48.8	46.4	44.1
2023-04-19	02:00:00	46.6	44.0	61.9	47.6	45.5
2023-04-19	02:15:00	46.2	43.6	49.8	47.2	45.1
2023-04-19	02:30:00	47.4	44.8	51.6	48.3	46.4
2023-04-19	02:45:00	47.1	44.5	51.0	48.1	46.0
2023-04-19	03:00:00	47.2	44.7	51.0	48.1	46.1

2023-04-19	03:15:00	46.8	44.2	51.6	47.9	45.7
2023-04-19	03:30:00	46.8	44.0	51.4	47.7	45.7
2023-04-19	03:45:00	47.0	44.2	50.7	48.0	46.0
2023-04-19	04:00:00	47.0	44.4	50.7	47.9	46.0
2023-04-19	04:15:00	47.0	44.4	51.4	47.9	45.9
2023-04-19	04:30:00	46.4	43.6	50.0	47.4	45.2
2023-04-19	04:45:00	47.1	44.0	53.2	48.2	45.9
2023-04-19	05:00:00	46.5	43.7	51.6	47.5	45.4
2023-04-19	05:15:00	46.9	44.2	54.3	47.9	45.7
2023-04-19	05:30:00	52.3	44.7	63.6	55.7	47.3
2023-04-19	05:45:00	54.6	46.8	64.8	57.8	49.7
2023-04-19	06:00:00	55.1	44.9	71.2	56.9	48.4
2023-04-19	06:15:00	56.0	44.5	71.9	59.2	47.3
2023-04-19	06:30:00	59.1	46.4	91.7	58.0	49.0
2023-04-19	06:45:00	53.8	46.6	72.3	57.6	48.1
2023-04-19	07:00:00	54.6	46.6	75.5	58.2	48.2
2023-04-19	07:15:00	53.3	45.8	65.6	56.9	47.8
2023-04-19	07:30:00	52.8	45.9	70.9	56.8	47.2
2023-04-19	07:45:00	52.3	44.8	73.3	54.8	47.1
2023-04-19	08:00:00	52.9	44.8	74.6	55.3	46.6
2023-04-19	08:15:00	52.6	45.5	78.8	55.1	47.4
2023-04-19	08:30:00	58.6	45.5	72.5	60.5	48.1
2023-04-19	08:45:00	52.6	45.1	68.2	55.7	47.4
2023-04-19	09:00:00	53.3	45.0	67.7	57.1	47.0
2023-04-19	09:15:00	53.0	45.4	66.4	56.5	47.9
2023-04-19	09:30:00	53.0	45.7	66.1	56.5	47.7
2023-04-19	09:45:00	52.8	44.6	65.2	56.1	47.8
2023-04-19	10:00:00	51.6	45.8	64.2	54.4	47.8
2023-04-19	10:15:00	55.0	45.4	69.4	58.5	48.4
2023-04-19	10:30:00	55.0	45.1	69.5	58.0	47.5
2023-04-19	10:45:00	51.5	45.3	66.1	53.8	48.0
2023-04-19	11:00:00	52.2	44.8	69.1	54.6	47.4
2023-04-19	11:15:00	52.6	45.8	67.5	54.8	48.7
2023-04-19	11:30:00	51.9	46.5	63.5	54.4	48.3
2023-04-19	11:45:00	52.5	46.3	67.6	55.1	48.3
2023-04-19	12:00:00	55.0	45.5	74.6	56.5	47.5
2023-04-19	12:15:00	52.0	46.0	67.1	53.4	47.7
2023-04-19	12:30:00	52.4	45.4	71.3	55.8	47.4
2023-04-19	12:45:00	52.4	45.5	74.4	54.4	48.2
2023-04-19	13:00:00	53.8	45.6	72.4	56.3	47.9
2023-04-19	13:15:00	50.5	46.3	61.1	52.1	48.3
2023-04-19	13:30:00	55.5	46.3	71.7	58.9	48.2
2023-04-19	13:45:00	50.6	45.9	64.5	52.5	48.1
2023-04-19	14:00:00	50.7	47.5	60.9	52.1	49.0
2023-04-19	14:15:00	53.2	47.0	71.9	55.5	48.8
2023-04-19	14:30:00	54.0	47.8	74.6	56.4	49.6
2023-04-19	14:45:00	52.8	48.4	71.5	54.1	50.3
2023-04-19	15:00:00	52.5	47.2	70.3	54.5	48.9

2023-04-19	15:15:00	53.3	47.0	70.5	55.6	48.9
2023-04-19	15:30:00	52.9	46.5	67.5	56.0	48.5

Noise Monitoring at H8 - RAW Data

Date	Time	LAeq	LAFmin	LAFmax	LAF10.00	LAF90.00
14/06/2023	11:15:00	40.2	31.3	61.7	39.8	33.5
14/06/2023	11:30:00	37.9	30.8	57.8	39.9	33.1
14/06/2023	11:45:00	35.6	30.3	50.6	37.5	32.7
14/06/2023	12:00:00	37.2	31.6	51.2	39.6	33.8
14/06/2023	12:15:00	38.9	31.7	57.1	41.3	34.0
14/06/2023	12:30:00	37.5	31.8	52.8	39.7	33.4
14/06/2023	12:45:00	40.3	33.8	54.0	42.7	35.9
14/06/2023	13:00:00	40.5	33.3	55.3	42.5	36.4
14/06/2023	13:15:00	40.7	32.9	56.6	43.4	36.3
14/06/2023	13:30:00	42.0	34.8	58.7	44.1	38.6
14/06/2023	13:45:00	40.4	34.1	52.9	43.1	36.2
14/06/2023	14:00:00	37.4	33.0	55.3	39.2	34.7
14/06/2023	14:15:00	52.3	33.3	71.8	53.0	36.6
14/06/2023	14:30:00	53.6	50.5	73.9	53.9	51.7
14/06/2023	14:45:00	52.7	50.5	55.4	53.4	51.9
14/06/2023	15:00:00	52.5	50.4	58.4	53.2	51.6
14/06/2023	15:15:00	52.1	50.0	57.6	52.9	51.3
14/06/2023	15:30:00	51.9	48.7	59.4	52.7	50.9
14/06/2023	15:45:00	50.5	37.0	66.0	51.9	39.2
14/06/2023	16:00:00	41.1	35.3	53.0	43.4	37.9
14/06/2023	16:15:00	41.1	36.5	52.6	43.6	38.0
14/06/2023	16:30:00	40.7	36.0	50.5	42.7	38.3
14/06/2023	16:45:00	42.1	36.0	58.5	44.5	38.2
14/06/2023	17:00:00	40.7	34.5	55.9	42.9	36.9
14/06/2023	17:15:00	40.2	34.1	54.3	42.8	36.0
14/06/2023	17:30:00	38.0	31.8	54.8	40.3	33.8
14/06/2023	17:45:00	36.2	31.4	53.4	37.7	33.1
14/06/2023	18:00:00	35.8	30.4	58.2	36.4	32.3
14/06/2023	18:15:00	35.2	30.6	53.0	36.8	32.3
14/06/2023	18:30:00	38.2	29.8	61.3	38.6	32.0
14/06/2023	18:45:00	37.4	26.7	54.8	39.6	32.7
14/06/2023	19:00:00	34.9	28.7	55.9	36.2	30.8
14/06/2023	19:15:00	36.0	25.2	53.7	39.3	28.2
14/06/2023	19:30:00	31.0	24.8	46.1	33.3	26.4
14/06/2023	19:45:00	37.2	24.0	57.9	38.4	26.5
14/06/2023	20:00:00	32.8	23.4	49.3	36.4	26.3
14/06/2023	20:15:00	29.7	22.9	43.0	32.3	25.5
14/06/2023	20:30:00	35.7	20.7	53.1	39.0	23.8
14/06/2023	20:45:00	28.7	20.0	44.3	32.3	21.8
14/06/2023	21:00:00	27.2	19.6	55.6	29.3	20.9
14/06/2023	21:15:00	25.5	19.2	41.3	28.4	21.2
14/06/2023	21:30:00	23.0	18.8	42.1	24.6	20.1

14/06/2023	21:45:00	22.1	18.3	39.6	23.0	19.3
14/06/2023	22:00:00	22.9	18.3	45.0	23.9	19.3
14/06/2023	22:15:00	23.9	19.5	43.3	24.0	20.7
14/06/2023	22:30:00	22.6	19.5	47.8	23.8	20.6
14/06/2023	22:45:00	22.9	18.4	37.0	25.0	19.9
14/06/2023	23:00:00	23.5	17.8	39.5	25.2	18.7
14/06/2023	23:15:00	24.1	20.6	28.5	25.2	22.8
14/06/2023	23:30:00	21.9	17.6	35.8	23.8	19.2
14/06/2023	23:45:00	21.6	17.7	37.8	21.9	18.6
15/06/2023	00:00:00	22.2	17.6	54.0	22.6	18.9
15/06/2023	00:15:00	29.7	18.0	48.9	33.8	18.8
15/06/2023	00:30:00	22.3	18.1	46.0	22.9	18.8
15/06/2023	00:45:00	19.4	18.0	36.1	20.2	18.4
15/06/2023	01:00:00	20.4	17.9	42.0	20.8	18.7
15/06/2023	01:15:00	24.2	18.8	44.6	25.4	20.5
15/06/2023	01:30:00	27.7	21.4	46.8	28.5	22.8
15/06/2023	01:45:00	28.0	22.3	33.5	29.7	23.8
15/06/2023	02:00:00	24.8	22.2	31.6	25.8	23.7
15/06/2023	02:15:00	24.4	21.8	32.4	25.4	23.2
15/06/2023	02:30:00	22.9	19.5	32.1	24.2	20.7
15/06/2023	02:45:00	21.8	18.4	33.8	23.0	20.1
15/06/2023	03:00:00	28.7	18.2	61.2	24.3	19.1
15/06/2023	03:15:00	20.3	17.8	29.5	22.1	18.6
15/06/2023	03:30:00	22.3	18.2	36.9	24.8	19.5
15/06/2023	03:45:00	27.6	19.3	39.5	31.2	21.1
15/06/2023	04:00:00	50.6	19.3	62.5	52.7	22.9
15/06/2023	04:15:00	53.5	51.8	64.8	55.0	52.3
15/06/2023	04:30:00	53.9	52.1	61.1	55.3	52.6
15/06/2023	04:45:00	53.3	52.3	60.8	54.0	52.7
15/06/2023	05:00:00	52.7	51.9	57.4	53.1	52.3
15/06/2023	05:15:00	52.4	51.5	59.8	52.7	51.9
15/06/2023	05:30:00	51.9	30.3	65.0	52.6	35.8
15/06/2023	05:45:00	37.2	29.3	54.6	39.4	31.7
15/06/2023	06:00:00	41.3	29.7	55.6	45.2	32.5
15/06/2023	06:15:00	40.0	30.1	61.6	43.6	32.2
15/06/2023	06:30:00	50.3	30.7	71.0	48.5	35.2
15/06/2023	06:45:00	38.6	31.1	61.3	41.2	33.2
15/06/2023	07:00:00	40.1	25.8	58.9	42.9	31.0
15/06/2023	07:15:00	40.9	24.0	60.2	43.5	28.9
15/06/2023	07:30:00	40.1	23.8	56.9	43.0	29.4
15/06/2023	07:45:00	34.1	23.1	53.1	36.2	27.0
15/06/2023	08:00:00	34.6	23.0	57.5	36.9	27.1
15/06/2023	08:15:00	40.6	23.1	65.6	40.9	26.3
15/06/2023	08:30:00	37.7	23.0	60.3	39.1	26.4

15/06/2023	08:45:00	32.4	23.3	46.2	36.0	25.8
15/06/2023	09:00:00	37.7	24.4	54.7	40.3	28.2
15/06/2023	09:15:00	35.4	23.7	57.9	37.0	26.9
15/06/2023	09:30:00	35.8	24.3	55.1	39.1	26.6
15/06/2023	09:45:00	36.8	24.9	56.5	40.1	27.0
15/06/2023	10:00:00	35.6	24.4	54.0	37.7	26.8
15/06/2023	10:15:00	36.0	23.9	51.6	39.4	27.5
15/06/2023	10:30:00	35.3	24.6	48.3	39.3	27.3
15/06/2023	10:45:00	34.9	24.7	49.9	38.5	26.9
15/06/2023	11:00:00	43.9	24.4	55.8	51.0	27.0
15/06/2023	11:15:00	53.5	25.6	75.6	51.1	28.9
15/06/2023	11:30:00	43.5	24.9	61.5	45.0	28.2
15/06/2023	11:45:00	40.7	25.1	54.3	42.5	27.7
15/06/2023	12:00:00	49.2	24.3	70.5	49.1	26.6
15/06/2023	12:15:00	33.7	23.7	53.1	36.9	25.4
15/06/2023	12:30:00	29.1	23.5	51.8	31.4	25.0
15/06/2023	12:45:00	36.1	23.1	60.0	34.6	25.2
15/06/2023	13:00:00	31.2	23.8	46.6	34.1	25.8
15/06/2023	13:15:00	55.4	23.8	79.7	42.9	25.9
15/06/2023	13:30:00	38.5	23.3	60.1	38.2	24.8
15/06/2023	13:45:00	36.9	24.0	60.9	38.7	26.6
15/06/2023	14:00:00	47.1	24.5	62.1	51.0	28.1
15/06/2023	14:15:00	51.6	49.4	54.8	52.3	50.6
15/06/2023	14:30:00	50.8	47.6	53.8	51.5	49.9
15/06/2023	14:45:00	49.3	47.2	53.1	50.3	48.2
15/06/2023	15:00:00	48.8	46.7	51.9	49.6	47.8
15/06/2023	15:15:00	48.7	46.3	53.4	49.4	47.9
15/06/2023	15:30:00	48.4	31.1	63.0	49.1	34.2
15/06/2023	15:45:00	35.7	29.7	49.0	38.9	31.2
15/06/2023	16:00:00	44.5	29.5	70.9	42.9	31.3
15/06/2023	16:15:00	37.9	29.2	59.6	37.7	31.6
15/06/2023	16:30:00	36.3	29.2	55.3	38.4	31.3
15/06/2023	16:45:00	35.3	28.2	52.9	37.7	30.7
15/06/2023	17:00:00	34.5	25.4	55.4	36.4	27.5
15/06/2023	17:15:00	34.5	26.1	47.2	37.7	27.7
15/06/2023	17:30:00	38.4	30.0	60.3	38.2	32.1
15/06/2023	17:45:00	34.2	29.8	50.2	35.7	31.8
15/06/2023	18:00:00	35.6	28.3	55.1	36.6	29.9
15/06/2023	18:15:00	36.1	27.7	56.1	37.6	29.8
15/06/2023	18:30:00	38.8	27.9	61.9	37.9	29.8
15/06/2023	18:45:00	35.0	28.6	54.3	37.4	30.5
15/06/2023	19:00:00	33.3	28.6	53.7	35.0	30.2
15/06/2023	19:15:00	33.9	28.5	53.9	35.5	30.1
15/06/2023	19:30:00	33.3	26.9	48.4	35.2	29.6

15/06/2023	19:45:00	32.2	27.1	52.3	33.1	29.2
15/06/2023	20:00:00	41.9	28.5	69.7	35.6	30.7
15/06/2023	20:15:00	35.3	29.9	53.5	36.3	32.6
15/06/2023	20:30:00	38.1	31.2	59.5	37.1	32.7
15/06/2023	20:45:00	33.8	27.8	53.8	35.8	30.0
15/06/2023	21:00:00	41.3	28.3	60.2	44.7	30.6
15/06/2023	21:15:00	53.0	24.8	76.6	43.6	27.1
15/06/2023	21:30:00	53.2	23.0	76.9	37.9	24.8
15/06/2023	21:45:00	26.7	21.0	52.7	27.8	23.0
15/06/2023	22:00:00	22.7	18.7	49.4	22.5	19.6
15/06/2023	22:15:00	27.6	18.7	42.1	28.6	19.8
15/06/2023	22:30:00	24.5	19.3	44.2	26.4	21.1
15/06/2023	22:45:00	24.7	20.4	41.8	26.1	22.4
15/06/2023	23:00:00	27.5	21.3	38.9	30.6	23.1
15/06/2023	23:15:00	30.6	20.1	45.4	30.8	22.0
15/06/2023	23:30:00	24.5	20.3	33.5	26.5	22.1
15/06/2023	23:45:00	23.9	20.2	37.5	25.6	21.8
16/06/2023	00:00:00	25.5	20.8	38.2	27.2	22.3
16/06/2023	00:15:00	24.8	20.7	37.4	26.2	22.1
16/06/2023	00:30:00	28.3	19.6	46.3	30.1	21.2
16/06/2023	00:45:00	23.9	17.9	39.7	25.3	19.5
16/06/2023	01:00:00	24.5	18.3	43.1	26.7	19.2
16/06/2023	01:15:00	20.4	17.8	31.9	22.0	18.6
16/06/2023	01:30:00	20.5	18.1	41.9	20.9	18.7
16/06/2023	01:45:00	19.3	17.7	39.9	19.5	18.1
16/06/2023	02:00:00	18.8	17.6	42.7	19.0	18.1
16/06/2023	02:15:00	19.9	17.6	45.4	21.1	18.1
16/06/2023	02:30:00	19.3	17.2	30.0	20.4	18.0
16/06/2023	02:45:00	20.3	18.0	41.1	21.6	18.8
16/06/2023	03:00:00	22.7	18.0	39.6	24.8	18.8
16/06/2023	03:15:00	20.8	18.4	27.6	21.9	19.3
16/06/2023	03:30:00	20.1	18.5	28.1	20.9	19.3
16/06/2023	03:45:00	23.5	18.3	42.1	27.0	20.3
16/06/2023	04:00:00	50.0	18.9	64.9	53.1	20.4
16/06/2023	04:15:00	53.8	51.6	65.9	55.1	52.5
16/06/2023	04:30:00	54.0	52.4	64.7	55.1	52.9
16/06/2023	04:45:00	53.7	51.9	60.0	54.9	52.6
16/06/2023	05:00:00	52.7	51.8	58.7	53.1	52.3
16/06/2023	05:15:00	52.6	51.2	56.6	53.1	52.1
16/06/2023	05:30:00	51.9	30.5	64.5	52.8	50.3
16/06/2023	05:45:00	42.3	30.4	60.3	45.1	33.6
16/06/2023	06:00:00	38.4	30.0	50.3	42.7	32.4
16/06/2023	06:15:00	38.5	31.2	53.8	42.4	33.1
16/06/2023	06:30:00	39.2	30.8	50.3	42.8	33.8

16/06/2023	06:45:00	40.5	32.1	50.9	43.4	35.4
16/06/2023	07:00:00	39.2	31.9	53.2	41.6	35.1
16/06/2023	07:15:00	37.1	30.5	51.4	39.5	33.2
16/06/2023	07:30:00	56.7	31.7	78.5	50.7	33.5
16/06/2023	07:45:00	52.6	30.4	78.4	50.8	36.4
16/06/2023	08:00:00	49.1	28.0	71.4	45.9	33.8
16/06/2023	08:15:00	40.9	27.4	60.0	43.4	32.1
16/06/2023	08:30:00	53.1	26.1	76.6	45.2	29.8
16/06/2023	08:45:00	41.3	26.9	62.6	41.6	30.2
16/06/2023	09:00:00	35.7	26.8	51.8	38.8	29.4
16/06/2023	09:15:00	39.2	26.1	57.7	41.7	30.3
16/06/2023	09:30:00	47.1	28.4	60.3	51.3	37.4
16/06/2023	09:45:00	52.5	48.0	62.2	54.0	50.4

APPENDIX D

Glossary of Acoustic Terminology

Extract from Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4, January 2016)

APPENDIX I: GLOSSARY OF ACOUSTIC TERMINOLOGY

ambient noise	The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.
acoustic shadow	An acoustic shadow is an area through which sound waves fail to propagate, due to topographical obstructions or disruption of the waves via phenomena such as wind currents.
background noise	The steady existing noise level present without contribution from any intermittent sources. The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T ($L_{AF90,T}$).
broadband	Sounds that contain energy distributed across a wide range of frequencies.
competent person	Individual possessing a combination of technical knowledge, experience and skills as outlined in Section 2.0 and who can demonstrate both practical and theoretical competence.
criterion noise level	The long-term mean value of the noise level that must not be exceeded. This is generally stipulated in the IPPC/Waste licence and it may be applied to a noise source, a boundary of the activity or to an NSL in the vicinity of the site.
dB	Decibel - The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 μPa).
façade level	The noise level at a location 1m from the façade of a building is described by the term façade level, and is subject to a higher noise level than one in an open area (free-field conditions) due to reflection effects.
free-field	These are conditions in which the radiation from sound sources is unaffected by the presence of any reflecting boundaries or the source itself. In practice, it is a field in which the effects of the boundaries are negligible over the frequency range of interest. In environmental noise, true free-field measurement conditions are seldom achieved and generally the microphone will be positioned at a height between 1.2 and 1.5 metres above ground level. To minimise the influence of reflections, measurements are generally made at least 3.5 metres from any reflecting surface other than the ground.
Hertz (Hz)	The unit of sound frequency in cycles per second.
impulsive	A noise that is of short duration (typically less than one second), the sound pressure level of which is significantly higher than the background.

$L_{Aeq,T}$ This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T).The closer the L_{Aeq} value is to either the L_{AF10} or L_{AF90} value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources, such as traffic, on the background.

L_{AFN} The A-weighted noise level exceeded for N% of the sampling interval. Measured using the "Fast" time weighting.

$L_{Ar,T}$ The Rated Noise Level, equal to the L_{Aeq} during a specified time interval (T), plus specified adjustments for tonal character and/or impulsiveness of the sound.

L_{AF10} Refers to those A-weighted noise levels in the top 10 percentile of the sampling interval; it is the level which is exceeded for 10% of the measurement period. It is used to determine the intermittent high noise level features of locally generated noise and usually gives an indicator of the level of road traffic. Measured using the "Fast" time weighting.

L_{AF90} Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to describe a background level. Measured using the "Fast" time weighting.

L_{AFmax} The maximum RMS A-weighted sound pressure level occurring within a specified time period. Measured using the "Fast" time weighting.

L_{AFmin} The minimum RMS A-weighted sound pressure level occurring within a specified time period. Measured using the "Fast" time weighting.

L_{den} Is the 24 hour noise rating level determined by the averaging of the L_{day} with the $L_{evening}$ plus a 5 dB penalty and the L_{night} plus a 10 dB penalty. L_{den} is calculated using the following formula:

$$L_{den} = 10\log \frac{1}{24} \left(12 * 10^{\frac{}{10}} + 4 * 10^{\frac{}{10}} + 8 * 10^{\frac{10}{10}} \right)$$

Where:

- L_{day} is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the day periods of a year;
- $L_{evening}$ is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the evening periods of a year and;
- L_{night} is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the night periods of a year.

low background noise	In the context of this guidance, an area of low background noise is one where the existing background noise levels measured during an environmental noise survey are as follows: ○ Average Daytime Background Noise Level ≤40dB L_{AF90}, and; ○ Average Evening Background Noise Level ≤35dB L_{AF90}, and; ○ Average Night-time Background Noise Level ≤30dB L_{AF90}.
low frequency noise	LFN - noise which is dominated by frequency components towards the lower end of the frequency spectrum; see Appendix VI for a more detailed discussion.
L_{pA} (dB)	An 'A-weighted decibel' - a measure of the overall level of sound across the audible frequency range (20Hz – 20kHz) with A-frequency weighting (i.e. 'A–weighting') to compensate for the varying sensitivity of the human ear to sound at different frequencies.
noise	Any sound, that has the potential to cause disturbance, discomfort or psychological stress to a person exposed to it, or any sound that could cause actual physiological harm to a person exposed to it, or physical damage to any structure exposed to it, is known as noise.
noise sensitive location	NSL – any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.
octave band	A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.
rating level	See $L_{Ar,T}$.
RMS	The RMS (Root Mean Square) value of a set of numbers is the square root of the average of their squares.
SEL (L_{AX} or L_{AE})	Sound exposure level – a measure of the A-weighted sound energy used to describe noise events such as the passing of a train or aircraft; it is the A-weighted sound pressure level if occurring over a period of 1 second, would contain the same amount of A-weighted sound energy as the event.
sound power level	The logarithmic measure of sound power in comparison to a referenced sound intensity level of one picowatt (1pW) per m^2 where: $$Lw \quad 10Log \frac{W}{W_0} \text{ dB}$$ Where: W is the rms value of sound power in pascals; and W_0 is 1 pW.

sound pressure level	Sound pressure refers to the fluctuations in air pressure caused by the passage of a sound wave. It may be expressed in terms of sound pressure level at a point, which is defined as: $Lp \quad 20 Log \frac{P}{P_0}$ dB Where: P is the sound pressure; P_o is a reference pressure for propagation of sound in air and has a value of $2x10^{-5}$Pa.
specific noise level	A component of the ambient noise which can be specifically identified by acoustical means and may be associated with a specific source. In BS 4142, there is a more precise definition as follows: 'equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r.
time weighting	One of the averaging times (Fast, Slow or Impulse) used for the measurement of RMS sound pressure level in sound level meters.
tonal	Sounds which cover a range of only a few Hz which contains a clearly audible tone, i.e. distinguishable, discrete or continuous noise (whine, hiss, screech, or hum etc.) are referred to as being 'tonal'.
$^1/_3$ octave analysis	Frequency analysis of sound such that the frequency spectrum is subdivided into bands of one–third of an octave each.

Appendix 10.4: Explanation and Modelling of EMF

The data and descriptions in this appendix have informed Chapter 10: Air of the EIA Report

CONTENTS

A-10.4.1 Explanation of Electric Fields and Magnetic Fields

Electrical objects and anything connected to them produce two types of fields - electric fields and magnetic fields. The term "field" is used to describe the way an object influences its surrounding area. A temperature field, for example, surrounds a warm object, such as a space heater. EMF's surround any object that is generating, transmitting or using electricity, including appliances, wiring, office equipment, generators, batteries and any other electrical devices. EMFs are invisible and they cannot be felt or heard.

Electric fields occur as a result of the electric potential (or voltage) on these objects, and magnetic fields occur as a result of electric current flowing through these objects. Just like a temperature field, electric and magnetic fields can be measured and their levels depend on, among other things:

- Characteristics of the source of the field (voltage, current, cable configuration and formation; and
- Distance from the source of the field.

The Electric Field is measured in volts per metre (V/m) or (kV/m). Magnetic Fields are measured in microtesla (µT). Electric Fields and Magnetic Fields are highest closest to the source and their level reduces quickly with distance from the source. This is similar to the way that the heat from a candle or campfire weakens as you move farther away. Although ordinary objects do not block magnetic fields, electric fields can be easily blocked by objects such as trees and buildings.

A-10.4.1.1 Electromagnetic Fields in the Natural Environment

Both electric and magnetic fields occur naturally in our environment and even in our own bodies as part of the normal functioning of our cardiac and nervous systems. There is a natural electric field at the earth's surface that is created by electric charges in the upper atmosphere, also known as the ionosphere. During fair weather, these electric field levels vary between 100 and 150 volts per meter (V/m) over flat surfaces. During stormy weather, on the other hand, storm clouds often contain large quantities of electric charge, and the electric field may reach intensities up to 20,000 V/m over flat surfaces and can be considerably higher above hillocks or near the tops of objects such as trees. The Earth's magnetic field, which is due mainly to currents circulating in the outer layer of the Earth's core, extents from the Earth's core out into space. Its magnitude at the Earth's surface varies between about 30 µT (microTesla) at the equator and about 60 µT at the poles.

Such naturally occurring electric and magnetic fields do not change direction and are, therefore, referred to as static or direct current (DC) fields. Naturally occurring electric and magnetic fields differ from the extremely low frequency electromagnetic Fields (ELF-EMF) produced by the power system, which fluctuate at a fixed frequency and are referred to as alternating current (AC) fields. For this reason, the existing levels of naturally occurring static EMF fields are not taken into account in this EIA Report chapter.

A-10.4.1.2 Electromagnetic Fields in the Built Environment

In the built environment, man-made sources of EMF include the power system and communication networks. In Ireland, the AC electric and magnetic fields produced by the power system vary at a frequency of 50-Hertz (Hz) (i.e. the fields alternate direction and intensity back and forth 50 times each second). Electric and magnetic fields are produced in all residential and working environments as a result of nearby electrical wiring, appliances, power lines and telecommunication masts, among other things. A comparison of electric and magnetic fields from 110kV electrical power system infrastructure with the typical electric and magnetic fields emitted by common household appliances is included in Section A-10.4.2. In summary this comparison demonstrates that in many cases, residential electrical appliances and tools can generate higher magnetic and electric fields in their close proximity (30cm) than at either the fence of an 110kV substation compound or directly above 110kV underground cables.

In a recent study of homes in the UK, most of homes had average magnetic field levels in the range 0.2µT to 0.4µT which were attributed to low voltage sources (i.e., wiring, appliances, and distribution circuits)

(Mastanyi et al, 2007). Electric field measurements in residential environments, average exposures were found to be less than 10 V/m (Bracken et al, 1990)

A-10.4.2 Typical Electric and Magnetic Fields in Residential and Working Environments

Field measurements, carried out by CEI, of the electric fields and magnetic fields near 110kV substations and underground cables are shown below in Table 1 and Table 2.

Table 1: Electric Fields measured from electrical power system infrastructure

Electrical power system	0 meter distance[1] (V/m)	30 meters distance (V/m)	100 meters distance (V/m)	ICNIRP Limit
110kV Substation	40	20	Less than 1	5000 V/m
Underground Cables[2]	n/a	n/a	n/a	5000 V/m

Table 2: Magnetic Fields measured from electrical power system infrastructure

Electrical power system	0 meter distance (µT)	30 meters distance (µT)	100 meters distance (µT)	ICNIRP Limit
110kV Substation	1	0.4	0.16	100µT
Underground Cables[3]	3.8	0.02	0.002	100µT

Measurements of the typical electric and magnetic fields near domestic appliances are shown in Table 3 and Table 4 below.

Table 3: Typical Electric Fields Household Appliances

Electric appliance	Electric field strength (V/m) at 30cm	ICNIRP Limit
Stereo receiver	180	**5000 V/m**
Iron	120	**5000 V/m**
Refrigerator	120	**5000 V/m**
Mixer	100	**5000 V/m**
Toaster	80	**5000 V/m**
Hair dryer	80	**5000 V/m**
Colour TV	60	**5000 V/m**
Coffee machine	60	**5000 V/m**

[1] A distance of 0 m corresponds to the central point above the underground cable, or at the substation fence.

[2] There is no electric field above ground level for underground cables, as the soil, earth materials and metallic sheath, which surrounds each cable, removes the potential for electric fields outside the cable.

[3] Scaled to reflect similar level expected based on the maximum MVA load 34MW for the KWF Grid Connection Underground Cables.

Electric appliance	Electric field strength (V/m) at 30cm	ICNIRP Limit
Vacuum cleaner	50	**5000 V/m**
Electric oven	8	**5000 V/m**
Light bulb	5	**5000 V/m**

Table 4 Typical Magnetic Fields Household Appliances

Electric appliance	3 cm distance (µT)	30 cm distance (µT)	1 m distance (µT)	ICNIRP Limit
Hair dryer	6 – 2000	0.01 – 7	0.01 – 0.03	**100µT**
Electric shaver	15 – 1500	0.08 – 9	0.01 – 0.03	**100µT**
Vacuum cleaner	200 – 800	2 – 20	0.13 – 2	**100µT**
Fluorescent light	40 – 400	0.5 – 2	0.02 – 0.25	**100µT**
Microwave oven	73 – 200	4 – 8	0.25 – 0.6	**100µT**
Electric oven	1 – 50	0.15 – 0.5	0.01 – 0.04	**100µT**

The ICNIRP limit[4] for EMF exposure for electric fields is 5000 V/m. As can be seen from Table 3, the typical exposure levels from common household appliances are below and in compliance with the ICNIRP limits in close proximity to the appliance. For example, an operational refrigerator can expose the user or resident to 120 V/m at a distance of 30cm from the appliance. Any exposure to electric fields at this level is typically for momentary or brief periods at any one time.

The ICNIRP limit[5] for EMF exposure for magnetic fields is 100µT. Low voltage sources, such as home appliances, contribute significantly to our overall exposure to magnetic fields. In a recent study of homes in the UK, for example, 77% of homes had average magnetic field levels above 0.2 µT and 57% of homes had average magnetic field levels above 0.4 µT which were attributed to low voltage sources (i.e., wiring, appliances, and distribution circuits) (Mastanyi et al, 2007). The typical[6] magnetic fields which people can be exposed to, at various distances from electrical equipment and appliances, in residential and public premises are presented in Table 4. As can be seen from Table 4, the use of a vacuum cleaner can expose the user to 200µT at a distance of 3cm and up to 20µT at a 30cm distance from the appliance.

While the comparison between operational 110kV substations or underground cables and domestic appliances provides valuable perspective, and indeed demonstrate that some common household appliances breaches the ICNIRP limit at very close proximity, it is limited by several differences between power lines and appliances. First, electric and magnetic fields are only associated with appliances for the duration that the appliance or tool is in use, while power lines are typically in service at all times. Furthermore, the field levels from appliances drop off at a faster rate with distance, compared to electricity transmission networks.

[4] http://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf
[5] http://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf
[6] Source: http://www.who.int/peh-emf/about/WhatisEMF/en/index3.html

A-10.4.3 Criteria for Modelling Theoretical Worst-Case Effects

In order to categorically demonstrate that the maximum possible power load of the electric cables and equipment associated with the KWF Grid Connection, Knocknamona Windfarm, Woodhouse Windfarm and Woodhouse Substation (in order to facilitate a cumulative evaluation), will comply with the EU EMF Exposure Recommendations and the ICNIRP limits, the theoretical worst-case contribution of the various electrical plant to EMF levels in the environment is evaluated in this report. The worst-case levels of EMF have been modeled using the criteria outlined in Table 5, the results of the modelling are summarized in Table 6 and provided in full in Sections A-10.4.5 to A-10.4.7.

Table 5: Criteria for modelling theoretical worst-case effects

Project Element	Worse-Case Scenario Criteria
KWF GRID CONNECTION	
KWF Grid Connection Underground Cabling	The maximum capacity possible of the electricity, 34MW, which a maximum voltage of 33kV for the underground cable will be capable of delivering, and the associated electrical current of 280 Amps. It should be noted that this is the maximum possible power load for the electrical cables and has been modelled to demonstrate categorically compliance with the EU EMF Exposure Recommendation. The configuration of the cable design is the trefoil configuration. The minimum distance between the cables and the ground surface using this trefoil formation is 0.8m.
Additional plant and apparatus in Woodhouse Substation	The closest piece of electrical apparatus from the Woodhouse Substation Compound perimeter fence is at least 5m. The worst case scenario EMF from the equipment in the compound is modelled from the perimeter fence, and is referred to throughout this report as the measurement of EMF at '0 meters'
KNOCKNAMONA WINDFARM	
Knocknamona Windfarm Internal Windfarm Cables	The maximum capacity possible of the electricity, 17MW, which a maximum voltage of 33kV for the underground cable will be capable of delivering, and the associated electrical current of 280 Amps. And at the Authorised Knocknamona Windfarm Substation there are two cable sets routed adjacent to each other, into the Substation, with a combined maximum of 34MW. It should be noted that this is the maximum possible power load for the electrical cables and has been modelled to demonstrate categorically compliance with the EU EMF Exposure Recommendation. The configuration of the cable design is the trefoil configuration. The minimum distance between the cables and the ground surface using this trefoil formation is 0.8m.
Knocknamona Windfarm turbines	The closest distance of a member of the public to electrical parts – i.e. at ground level, right beside the turbines (0m distance)
WOODHOUSE WINDFARM AND WOODHOUSE SUBSTATION	
Woodhouse Windfarm Internal Windfarm Cables	The maximum capacity possible of the electricity, 10MW, which a maximum voltage of 33kV for the underground cable will be capable of delivering, and the associated electrical current of 280 Amps. It should be noted that this is the maximum possible power load for the electrical cables and has been modelled to demonstrate categorically compliance with the EU EMF Exposure Recommendation. The configuration of the cable design is the trefoil configuration. The minimum distance between the cables and the ground surface using this trefoil formation is 0.8m.
Woodhouse Windfarm Turbines	The closest distance of a member of the public to electrical parts – i.e. at ground level, right beside the turbines (0m distance)
Woodhouse Substation	The closest piece of electrical apparatus from the Woodhouse Substation Compound perimeter fence is at least 5m. The worst case scenario EMF from the equipment in the compound is modelled from the perimeter fence, and is referred to throughout this report as the measurement of EMF at '0 meters'

110kV Overhead Line at Woodhouse Substation	The maximum capacity possible of the electricity, 188MW, which a maximum voltage of 110kV for the overhead lines will be capable of delivering, and the associated electrical current of 280 Amps. It should be noted that this is the maximum possible power load for the electrical cables and has been modelled to demonstrate categorically compliance with the EU EMF Exposure Recommendation. The minimum distance between the overhead lines and the ground surface 8m.

A-10.4.4 Modelling of Worst Case EMF from KWF Grid Connection

The electric fields and magnetic fields were modelled, at various distances from KWF Grid Connection electrical plant, using worst-case scenario criteria outlined in Table 5.

The results of this modelling (see Table 6 and Sections A-10.4.5 to A-10.4.7). The results of the modelling are presented in Table 6 (electric fields) and Table 7 (magnetic fields).

The modelling demonstrates that the electric field and magnetic field emissions from KWF Grid Connection will be at levels **substantially less the ICNIRP limit of 5000 V/m and 100µT respectively.** Furthermore, the magnetic field levels will rapidly dissipate with increasing distance from the source.

Table 6: Contribution to ambient electric fields (worst case scenario) by the KWF Grid Connection

Electrical Plant	Distance from operational electrical apparatus or cables (m)	Existing Ambient Electric Fields (V/m)	Worst Case Electric Field Contribution (V/m)	Predicted Worst Case Ambient Electric Field (V/m)	ICNIRP Guideline Limit (V/m)
KWF Grid Connection Underground Cabling	0m	less than 1	None	No increase	5000
	30m	less than 1	None	No increase	5000
	100m	less than 1	None	No increase	5000
Additional Plant and Apparatus at Woodhouse Substation	0m	less than 1	40	41	5000
	30m	less than 1	20	21	5000
	100m	less than 1	less than 1	Less than 1	5000

Table 7: Contribution to ambient magnetic fields (worst case scenario) by the KWF Grid Connection

Electrical Plant	Distance from operational electrical apparatus or cables (m)	Existing Ambient Magnetic Fields (µT)	Worst Case EMF Contribution (µT)	Predicted Worst Case Ambient EMF levels (µT)	ICNIRP Guideline Limit (µT)
KWF Grid Connection Underground Cabling	0m	0.2	3.8	4.0	100
	30m	0.2	0.02	0.22	100
	100m	0.2	0.002	0.202	100
Additional Plant and Apparatus at Woodhouse Substation	0m	0.2	1	1.2	100
	30m	0.2	0.4	0.6	100
	100m	0.2	0.16	0.36	100

A-10.4.5 Modelling of Worst Case EMF from Related Projects

In order to facilitate the cumulative evaluations, the electric fields and magnetic fields were modelled, at various distances from the Related Projects; Knocknamona Windfarm, Woodhouse Windfarm and Woodhouse Substation, using worst-case scenario criteria outlined in Table 5. The results of the modelling are presented in Table 8 (electric fields) and Table 9 (magnetic fields).

Table 8: Contribution to ambient electric fields (worst case scenario) by Knocknamona Windfarm, Woodhouse Windfarm and Woodhouse Substation

Related Project	Distance from operational electrical apparatus or cables (m)	Existing Ambient Electric Fields (V/m)	Worst Case Electric Field Contribution (V/m)[7]	Predicted Worst Case Ambient Electric Field (V/m)	ICNIRP Guideline Limit (V/m)
Knocknamona Windfarm Internal Windfarm Cables	0m	less than 1	None	less than 1	5000
	30m	less than 1	None	less than 1	5000
	100m	less than 1	None	less than 1	5000
Knocknamona Windfarm Turbines	0m	less than 1	none	less than 1	5000
	30m	less than 1	none	less than 1	5000
	100m	less than 1	none	less than 1	5000
Woodhouse Windfarm Internal Windfarm Cables	0m	less than 1	None	less than 1	5000
	30m	less than 1	None	less than 1	5000
	100m	less than 1	None	less than 1	5000
Woodhouse Windfarm Turbines	0m	less than 1	none	less than 1	5000
	30m	less than 1	none	less than 1	5000
	100m	less than 1	none	less than 1	5000
Woodhouse Substation	0m	less than 1	40	41	5000
	30m	less than 1	20	21	5000
	100m	less than 1	less than 1	less than 1	5000
110kV Overhead Lines	0m	less than 1	1230	1230	5000
	30m	less than 1	70	70	5000
	100m	less than 1	less than 1	less than 1	5000

[7] The electric field generated by turbine's transformer and generator are screened by the housing and are also at a substantial height above ground level so will not contribute to the ambient electric field levels.

Table 9: Contribution to ambient magnetic fields (worst case scenario) by Knocknamona Windfarm, Woodhouse Windfarm and Woodhouse Substation

Related Project	Distance from operational electrical apparatus or cables (m)	Existing Ambient Magnetic Fields (μT)	Worst Case EMF Contribution from the Knocknamona Windfarm (μT)[8]	Predicted Worst Case Ambient EMF levels during the operation stage (μT)	ICNIRP Guideline Limit (μT)
Knocknamona Windfarm Internal Windfarm Cables	0m	0.2	3.8	4.0	100
	30m	0.2	0.02	0.22	100
	100m	0.2	0.002	0.202	100
Knocknamona Windfarm Turbines	0m	0.2	0.2	0.4	100
	30m	0.2	0.07	0.207	100
	100m	0.2	0.07	0.207	100
Woodhouse Windfarm Internal Windfarm Cables	0m	0.2	3.8	4.0	100
	30m	0.2	0.02	0.22	100
	100m	0.2	0.002	0.202	100
Woodhouse Windfarm Turbines	0m	0.2	0.2	0.4	100
	30m	0.2	0.07	0.207	100
	100m	0.2	0.07	0.207	100
Woodhouse Substation	0m	0.2	1	1.2	100
	30m	0.2	0.4	0.6	100
	100m	0.2	0.16	0.36	100
110kV Overhead Lines	0m	0.2	17.9	7.8	100
	30m	0.2	1.12	1.32	100
	100m	0.2	0.10	0.30	100

[8] Scaled to reflect similar level expected based on the expected MVA load from the Authorised Knocknamona Windfarm Turbines.

A-10.4.6 Descriptive Summary of Modelling Results

Table 10: Summary of EMF Modelling Results

Project Element	Electric Fields	Magnetic Fields
KWF GRID CONNECTION		
KWF Grid Connection Underground Cables	The electric fields generated by the KWF Grid Connection Underground Cables will be *completely screened* by the earth materials such as soil and a metallic sheath which will surround each cable, and **no electric fields will be emitted** above ground.	Directly above the KWF Grid Connection Underground Cables, the **maximum level of the magnetic fields**, generated by the underground cables, will be **3.8µT**
Additional plant and apparatus in Woodhouse Substation	Electric fields will be very low due to the shielding which will be provided by the extensive metalwork within the substation compound, which will include electrical equipment housings, steelwork, the control building and metal palisade perimeter fence. Immediately outside the perimeter fence, the **worst-case EMF** from the substation are expected to be **40 V/m.**	Magnetic fields will be very low due to the shielding which will be provided by the extensive metalwork within the substation compound, which will include electrical equipment housings, steelwork, the control building and metal palisade perimeter fence. Immediately outside the perimeter fence, the **worst-case EMF** from the substation are expected to be **1µT**
KNOCKNAMONA WINDFARM		
Knocknamona Windfarm Internal Windfarm Cables	The electric fields generated by the Internal Windfarm Cables will be *completely screened* by the earth materials such as soil and a metallic sheath which will surround each cable, and **no electric fields will be emitted** above ground.	Directly above the Internal Windfarm Cables, the **maximum level of the magnetic fields**, generated by the underground cables, will be **3.8µT**
Knocknamona Windfarm Turbines	The electric field generated by the transformer, generator and cables are screened internally by the housing over the transformer and generator, and by the steel turbine tower. The turbine's transformer and generator are also at a substantial height above ground level and **will not contribute to the ambient electric field levels**.	Magnetic fields will be very low due to the shielding which will be provided by the extensive metalwork within the wind turbine, which will include turbine housings and steelwork. Right beside the turbine, **worst case** EMF are expected to be **0.2µT**[9]
WOODHOUSE WINDFARM AND WOODHOUSE SUBSTATION		
Woodhouse Windfarm Internal Windfarm Cables	The electric fields generated by the underground cables will be *completely screened* by the earth materials such as soil and a metallic sheath which will surround	Directly above the Internal Windfarm Cables, the **maximum level of the magnetic fields**, generated by the underground cables, will be **3.8µT**

[9] https://www.ncbi.nlm.nih.gov/pubmed/24529028

	each cable, and **no electric fields will be emitted** above ground.	
Woodhouse Windfarm Turbines	The electric field generated by the transformer, generator and cables are screened internally by the housing over the transformer and generator, and by the steel turbine tower. The turbine's transformer and generator are also at a substantial height above ground level and **will not contribute to the ambient electric field levels**.	Magnetic fields will be very low due to the shielding which will be provided by the extensive metalwork within the wind turbine, which will include turbine housings and steelwork. Right beside the turbine, **worst case** EMF are expected to be **0.2µT**[10]
Existing Woodhouse Substation	Electric fields will be very low due to the shielding which will be provided by the extensive metalwork within the substation compound, which will include electrical equipment housings, steelwork, the control building and metal palisade perimeter fence. Immediately outside the perimeter fence, the **worst-case EMF** from the substation are expected to be **40 V/m.**	Magnetic fields will be very low due to the shielding which will be provided by the extensive metalwork within the substation compound, which will include electrical equipment housings, steelwork, the control building and metal palisade perimeter fence. Immediately outside the perimeter fence, the **worst-case EMF** from the substation are expected to be **1µT**
Existing 110kV Overhead Line at Woodhouse Substation	Directly under the Overhead Lines, the **worst-case EMF** is expected to be **1.23 kV/m.**	Directly under the Overhead Lines, the maximum level of the magnetic fields, generated will be **17.9µT**

[10] https://www.ncbi.nlm.nih.gov/pubmed/24529028

A-10.4.7 EMF Graphs

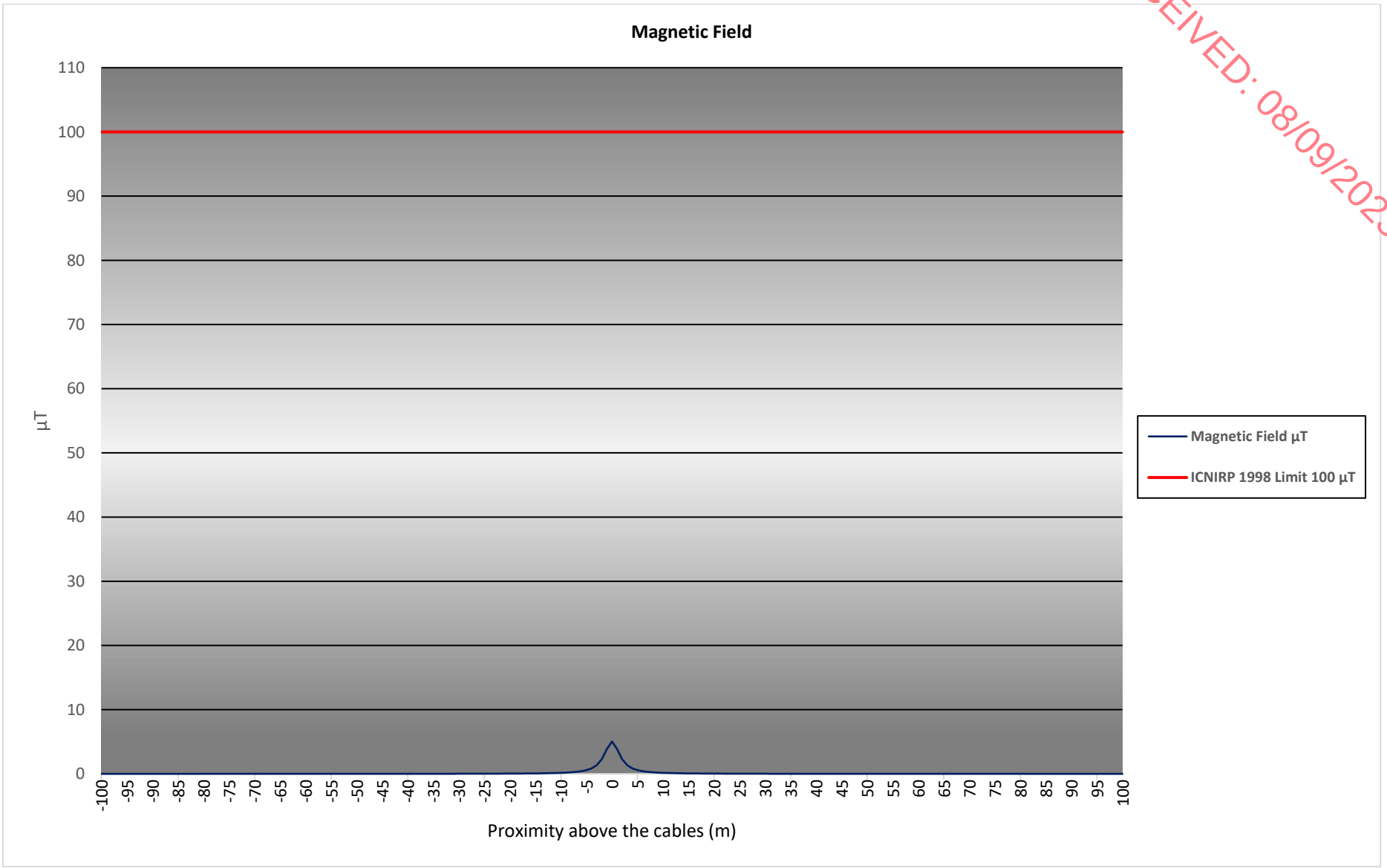

Plate 1: Maximum Possible Magnetic Field from the KWF Grid Connection Underground Cables

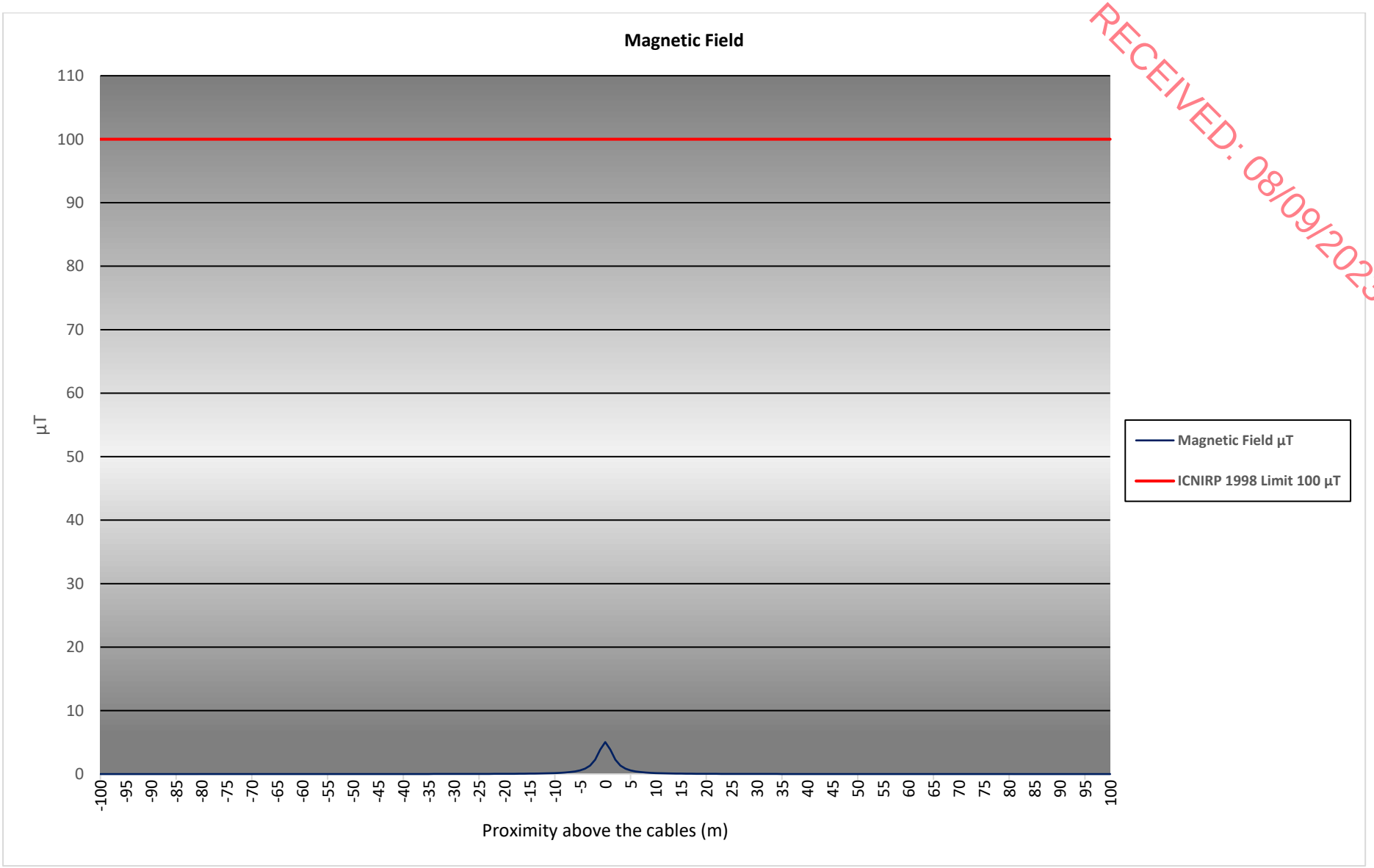

Plate 2: Maximum Possible Magnetic Field from the Knocknamona Windfarm Internal Windfarm Cable

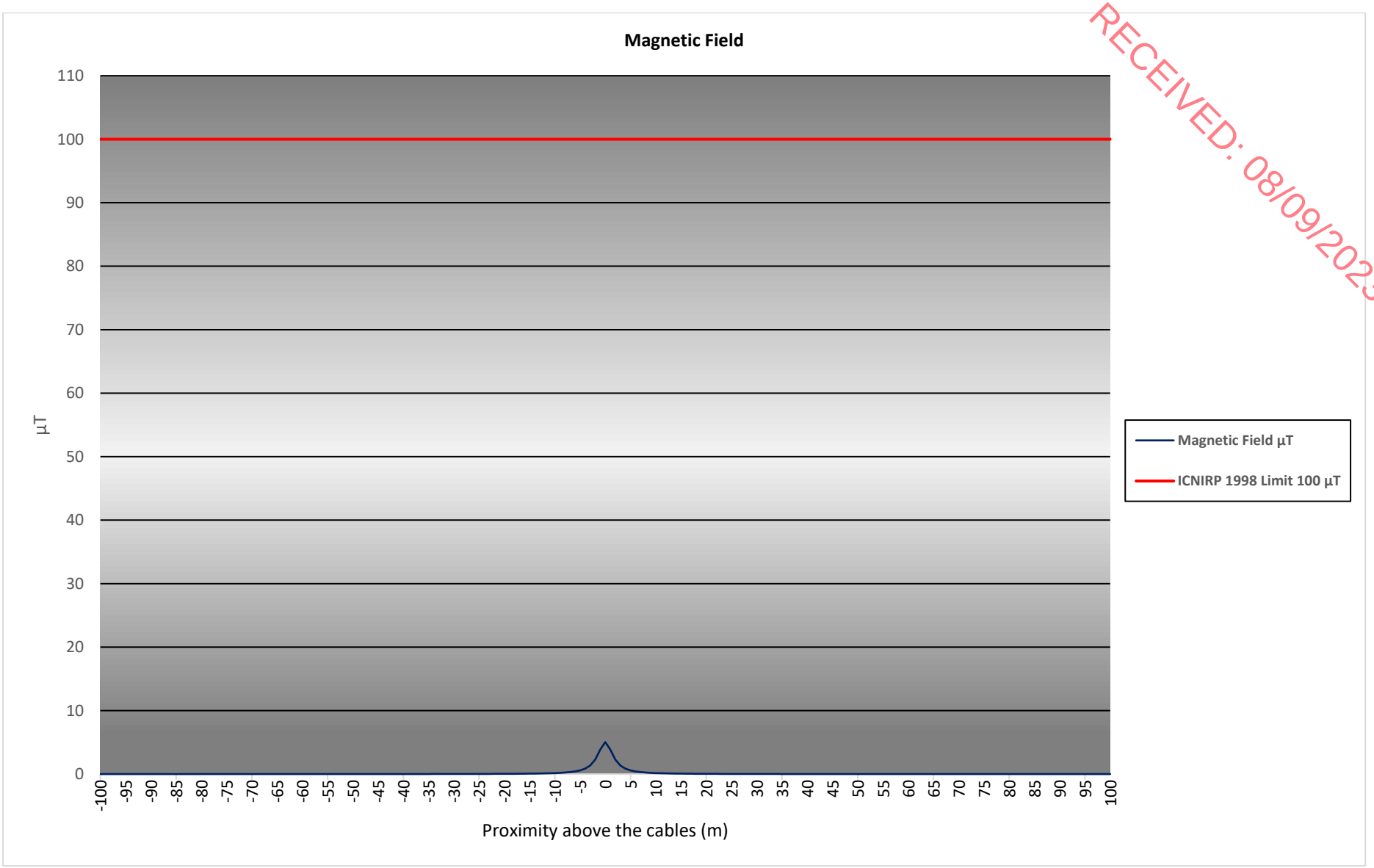

Plate 3: Maximum Possible Magnetic Field from the Woodhouse Windfarm Internal Windfarm Cable

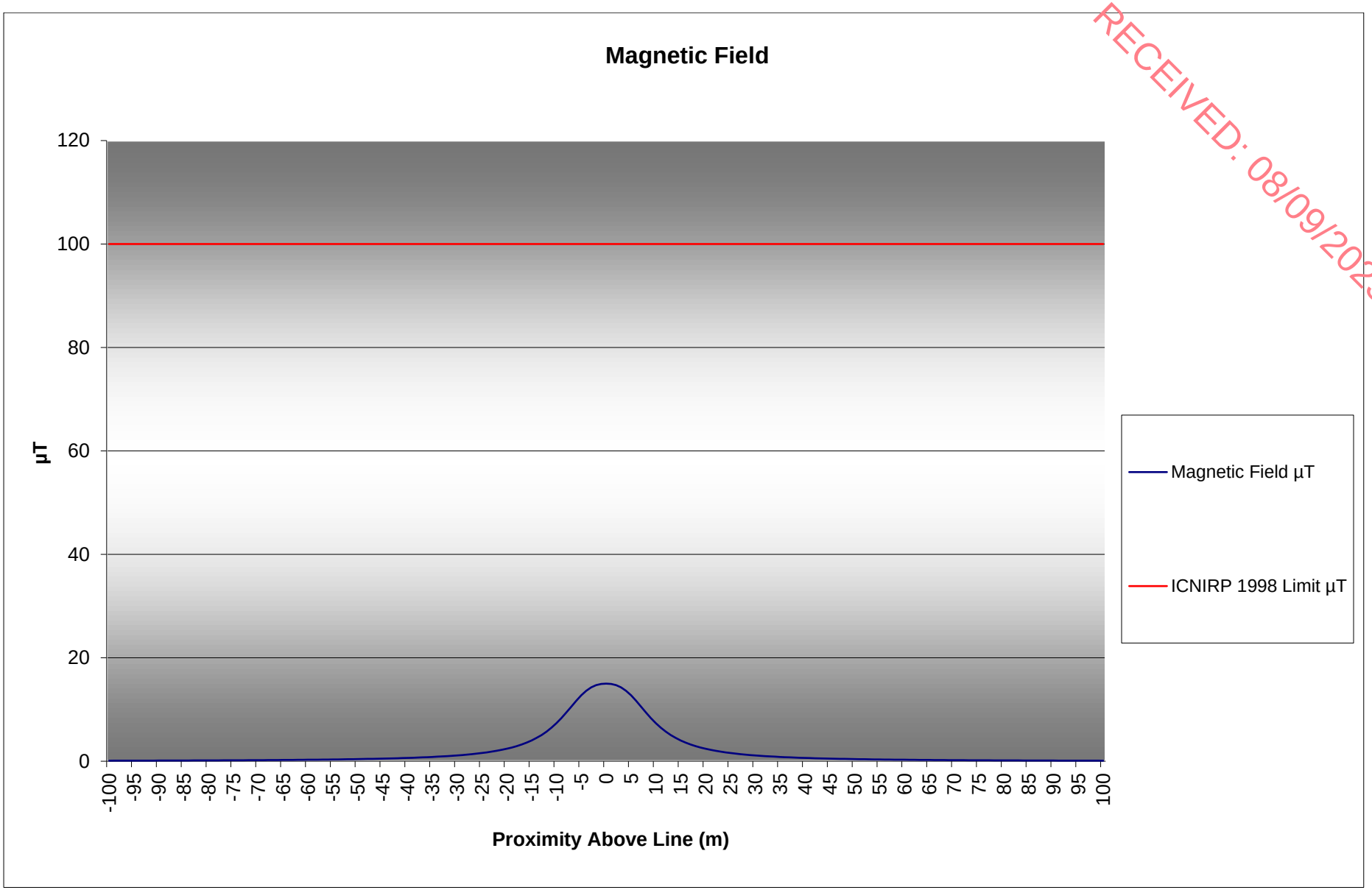

Plate 4: Maximum Possible Magnetic Field from the Woodhouse Substation 110 kV OHL

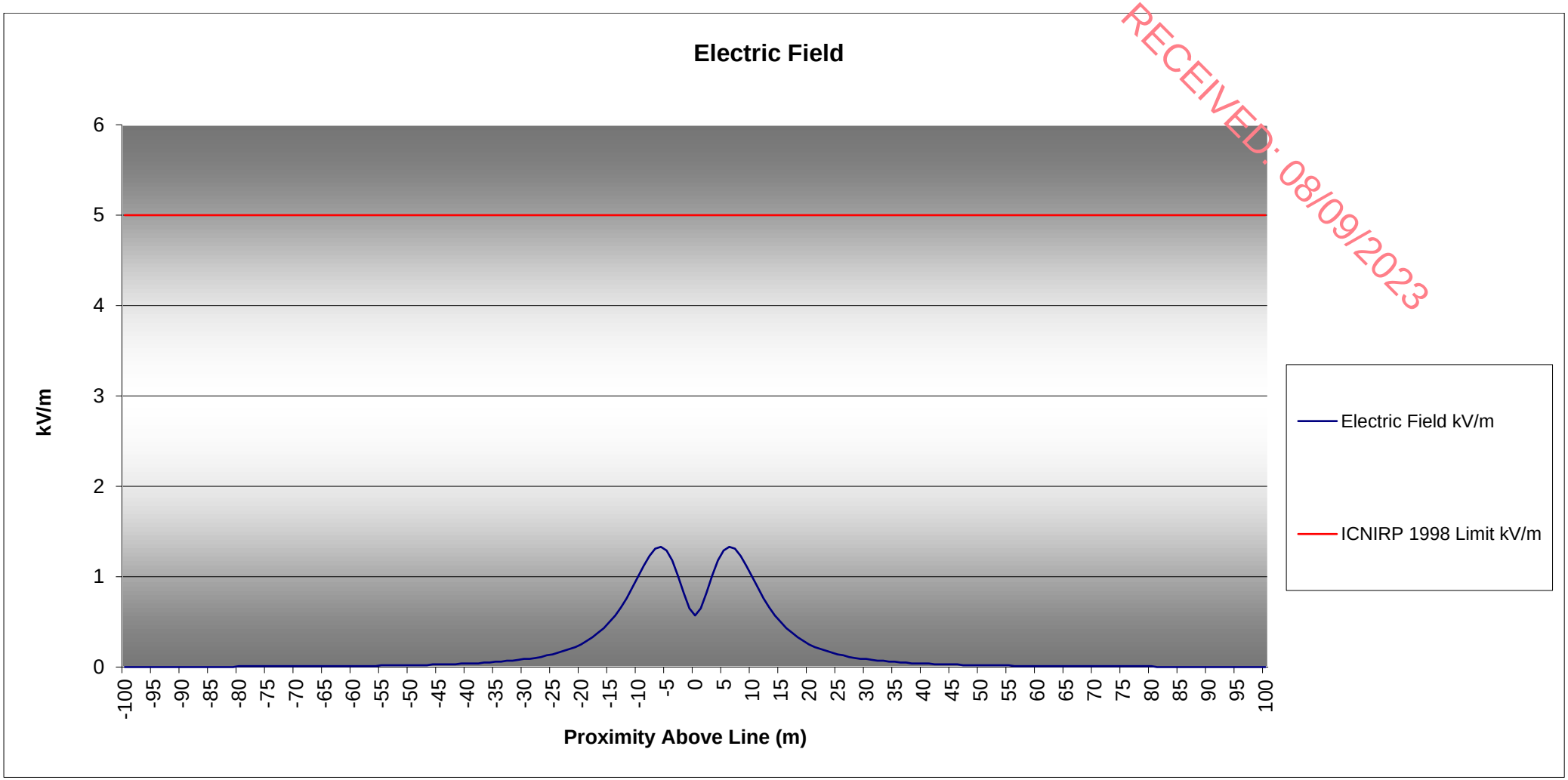

Plate 5: **Maximum Possible Electric Field from the Woodhouse Substation 110 kV OHL**