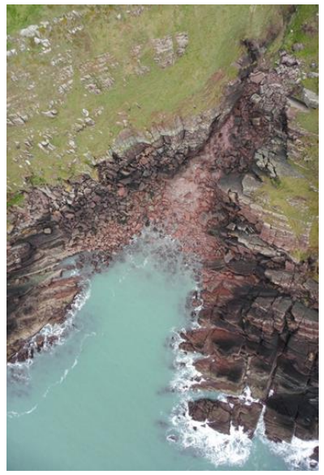
mWave Marine Energy Device and Onshore Infrastructure

ENVIRONMENTAL STATEMENT



June 2019

APPENDIX 2.1: mWave Onshore Noise

mWave Project, East Pickard Bay , Pembrokeshire
Temporary Onshore Works

Noise Impact Assessment
5136/NIA1

31st May 2019

For: **Bombora Wave Energy Europe Ltd**

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Contents

1.0 Introduction

The mWave project comprises the deployment and testing of a full scale Wave Energy Converter (WEC) in the coastal waters off East Pickard Bay, Angle Peninsula, Pembrokeshire. The WEC will not be grid-connected, although onshore facilities comprising a temporary communications cable, with associated termination box and anchors, and onshore control station are required to enable testing. The onshore facilities will be required for up to 18 months, with the actual testing of mWave being around 6 - 12 months. The control station is to be located in agricultural fields and the cable being laid on the ground from the control station to the coast.

Hunter Acoustics has been commissioned to assess the noise impact on nearby noise sensitive properties covering the installation of the control station and cable, operation of the control station, and its decommissioning.

This report details the results of an ambient background noise survey, noise prediction and impact assessment. Reference is made to current planning guidance including BS4142 and BS5228.

Graphs, tables and diagrams referenced in the report are included in Appendix A.

Acoustic terminology is given in Appendix B.

2.0 Planning Guidance

Installation of the on-shore cabling and control station are proposed to be short term (a 9 day period allowed for cabling laying and up to 2 weeks for installation of the control station) and can therefore be considered as construction noise. Reference is made to BS5228-1:2009 *Code of Practice for noise and vibration control on construction and open sites – Part 1: Noise, which* gives guidance on neighbourhood noise nuisance (Section 6) and significance of noise effects from construction projects (Annex E).

It is considered that traffic generation on the local highway network associated with the installation of the onshore element of the mWave Project is likely to be low and significant noise impacts are unlikely.

Noise impact during the testing of mWave and the associated operation of the Onshore Control Station (duration 6-12 months) is proposed to be assessed under BS4142:2014 methodology as it is proposed to contain intermittently running plant of an industrial/commercial nature.

2.1 Installation/Construction Noise – BS5228-1:2009

BS5228 outlines methods of determining significance of construction noise based on the change in ambient noise levels. The following 'ABC' method sets threshold values of significant effects based on the existing ambient noise climate.

Table E.1 **Example threshold of significant effect at dwellings**

Assessment category and threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23.00–07.00)	45	50	55
Evenings and weekends [D]	55	60	65
Daytime (07.00–19.00) and Saturdays (07.00–13.00)	65	70	75

NOTE 1 A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level.

NOTE 2 If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity.

NOTE 3 Applied to residential receptors only.

[A] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

[B] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

[C] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

[D] 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

2.2 Operational Noise – British Standard 4142:2014

British Standard 4142:2014 "Methods for rating and assessing industrial and commercial sound" This standard describes a rating method comparing L_{Aeq} noise levels from the industrial source with pre-existing background L_{A90} levels at the residential receiver. It advises at a difference (industrial noise - background) of:

- +10dB or higher, likely to be an indication of a significant adverse impact, depending on the context.
- A difference of + 5dB, likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

A penalty of between 0dB and 9dB can be applied to the industrial noise depending on its characteristics (tonality/impulsivity/intermittency), as described in sections 9.2 and 9.3 of BS4142:2014.

BS 4142 states under section 11;

"Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.

1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic

environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, absolute levels might be as relevant, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.
…"

3.0 Nearest Sound Sensitive Receivers

Figure 1 shows the location of the proposed temporary control station and onshore cable, along with the closest noise sensitive receivers, and sound monitoring positions A & B.

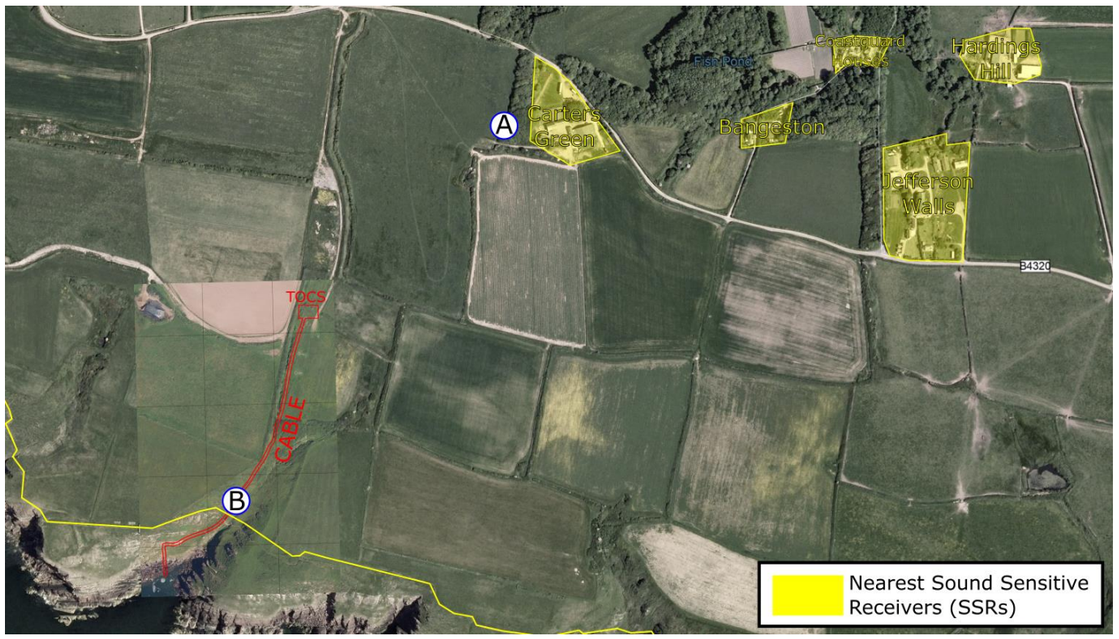

Figure 1 – Sound Sensitive Receivers Highlighted

The nearest sound sensitive receiver (SSR) is Carters Green approximately 470m north-east of the proposed temporary control station site.

4.0 Environmental Sound Survey

In order to set environmental noise limits, it is first necessary to define the existing ambient and background sound climate at the sound sensitive receivers (SSRs).

4.1 Procedure

Continuous sound monitoring was carried out at position A from 1645hrs on Friday the 3rd May 2019 until 0030hrs on Monday 6th May 2019, and at Position B from 1730hrs on Friday the 3rd May 2019 until 1000hrs on Tuesday 7th May 2019, to determine the existing background sound levels.

Data including L_{max}, L_{eq} and L_{90} was logged over consecutive 15-min periods.

The following measurement position was used, shown on site plan 5136/SP1 above.

Position A — Located in a field adjacent to Carters Green at a location deemed representative of the background sound climate at the nearest dwelling.

Position B — Located on a fence post situated approximately 20m from the coastal path gate. The location was deemed representative of the background sound climate at the coastal path.

4.2 Equipment

The following equipment was used:

Table 1– Equipment List

Make	Description	Model	Serial Number	Last Calibrated	Certificate No.
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-10021-E0	24 August 2017	UCRT17/1722
	Preamplifier	MA220	5435	24 August 2017	UCRT17/1722
	Microphone	Capsule	8547	24 August 2017	UCRT17/1722
Rion	Type 1 - Sound Level Meter	NL-32	1103396	01 March 2019	UCRT19/1270
	Preamplifier	NH-21	34335	01 March 2019	UCRT19/1270
	Microphone	UC-53A	317921	01 March 2019	UCRT19/1270
Rion	Calibrator (94.04dB @ 984Hz)	NC-73	10355197	01 March 2019	UCRT19/1273

Measurement systems were calibrated before and after the surveys, no variation occurred.

4.3 Weather Conditions

Approximate weather conditions for the survey period is shown in 5136/WH1 in Appendix A.

To summarise, the weather was dry and calm throughout the survey period.

4.4 Results

Results of continuous monitoring at positions A & B are summarised in Table 2 and shown in time history graphs 5136/TH1 & TH2 in Appendix A.

The noise climate appears consistent with a rural/coastal location with regular patterns across the monitoring period including higher levels first thing in the morning due to birdsong. (Note: highest L_{max} levels due to birds adjacent to microphone).

The following background sound levels have been determined using statistical analysis in line with BS 4142 methodology (see graph 5136/G1 & 5136/G2 in Appendix A).

Table 2 – Typical Ambient and Background Sound Levels

Position	Period	Ambient Sound Level $L_{Aeq,15min}$ (dB)	Background Sound Level $L_{A90,15mins}$ (dB)
A	Daytime (0700-1900hrs)	42	37
	Evening (1900-2300hrs)	38	34
	Night-time (2300-0700hrs)	39	35
B	Daytime (0700-1900hrs)	38	30
	Evening (1900-2300hrs)	28	26
	Night-time (2300-0700hrs)	30	19

5.0 Environmental Noise Criteria

5.1 Installation / Decommissioning Noise

Measured ambient sound levels are below the Cat A threshold of 65dB(A) daytime and therefore a 65dB $L_{Aeq,0700-1900hrs}$ daytime construction noise limit is indicated in line with BS5228:2009-1 'Threshold of Significance' guidelines.

5.2 Onshore Control Station Operational Noise

BS 4142 uses background sound levels (L_{A90}) as a basis for assessing impact at residential receivers. It is understood the proposed compressor and diesel generator are required to operate around the high tide and could therefore operate at any time of the day or night. The lowest typical background sound level is indicated to be 34dB $L_{A90,15mins}$ at Position A.

Bearing in mind the relatively quiet background sound climate, night time environmental noise criteria are indicated at a plant rating level ($L_{Ar,Tr}$) equivalent to the existing background (L_{A90}).

Table 3 –Environmental Noise Limits

Residential NSPs	Night-time Rating Limit $L_{Ar,Tr}$ (dB)
All surrounding residential NSPs	34

6.0 Noise Impact Assessment

Our analysis has used the proprietary NoiseMap Five computer modelling software, in conjunction with procedures of BS 5228: Parts 1 & 2 2009 'Code of Practice for assessing noise and vibration on construction and open sites'.

The model allows noise levels from sources to be predicted over large distances and varying terrain. Topographical data from NextMap Britain *Digital Terrain Model* and Google Earth have been used in our assessment. Carters Green is indicated to be fully or partially screened from the site / activities by the topography of the land.

Attenuation is included accounting for distance, air absorption, ground absorption and screening losses from site topography/local structures. The analysis predicts resultant noise levels at the SSRs.

6.1 Source Plant Noise Data

Noise modelling is based on source plant data taken from BS5228-1:2009 database and manufacturer's data (where available).

The following sections describe each stage of the proposed installation and operation with proposed plant, tools / machinery, and vehicle movements associated with each stage of the works.

6.1.1 Cabling Installation

There are two main sections for the onshore cable installation. The first section is between the MLWS and the proposed termination box and the second part is laying cable on the ground between the termination box and the control station. Both sections are summarised Table 4 and 5 below.

Table 4 - Cabling between MLWS and Termination box (above MHWS)

Cabling between MLWS and Termination box (above MHWS)	
Installation methodology	Cable will be brought onshore from the offshore cable laying vessel using a hand operated winch system which will be positioned in agricultural fields to the north. Two temporary anchor points will be required close to the coast. The cable will be brought up the side of the vertical gully, being fed through a conduit. The conduit will be pre-installed, attached to a semi-vertical rock face with rock clamps, using hand held tools only. No plant will be present within the intertidal area. A termination box and permanent anchor point will also be required. These will be screened by natural features where possible, or buried using hand tools. Cable installation to the termination box will require up to four personnel to be present within the intertidal area at any one time.
Cable specification	150 mm diameter reinforced cable.
Length of cabling	0.05 km
Duration of installation works	9 days in total - 3 days for offshore cable laying and pull from offshore vessel to termination box (as above). 6 days pre-installation works for rock clamps/conduit, termination box and anchor points. The activities will overlap. A temporary diversion of the footpath will be in place and used when needed.
Plant requirements	4WD vehicles and trailers in agricultural fields to north to pull cable using self-propelled hand operated winches. Pneumatic rock drill and compressor for anchor installations. Hand tools only will be used within the intertidal area.

Table 5 - Cabling between Termination Box and Control Station

Cabling between Termination Box and Control Station	
Installation methodology	A roll of cable will be brought to site on a trailer using a 4WD vehicle. The vehicle will position itself within agricultural fields to the north. One end of the cable pulled off drum down to the termination box. Once secured, the 4WD vehicle will work its way back up the agricultural fields to the control station. The cable will be laid on the ground secured by soil nails, where appropriate, following features such as fence lines and stone walls where available. The cable will cross the coastal footpath by an existing gate and a temporary diversion will be in place.
Cable specification	150 mm diameter reinforced cable.
Length of cabling	0.35km
Cable trench width	N/A
Cable trench depth	N/A
Duration of installation works	The cable laying from the termination box to the control station will take about 2 days overlapping with other cable laying activity.
Plant requirements	4WD vehicle/tractor with trailer. Hand tools only will be used within the coastal area.
Number of plant	4WD vehicles and trailer in agricultural fields to north.

The activity which is likely to generate the most noise during installation of the cable would be the installation of two temporary and one permanent anchor on top of the cliff and the attachment of clamps on the western rock face within East Pickard Bay. These activities will occur around the coastal area (approx 70m from coastal path) over approximately 2 days.

The attachment of the clamps to the rock and the anchors will be undertaken using hand held drill. The drill will be a CP 32A pneumatic rock drill, quoted at 111 dB(A) sound pressure level, and 122dB(A) sound power level. The drill will be powered by a 125 cfm compressor which will be towed and positioned in the agricultural field to the north.

Table 6 - Plant Noise Data Used in Clamp Fitting Prediction Model

Description	Qty	Lw/L_{Aeq} (dB)	Source
CP32 Pneumatic Rock Drill	1	L_w 122	CP (Manufacturer)
CPS 3.5 Air Compressor	1	L_w 98	CP (Manufacturer)

No noisy activities are identified with the manual installation of the cabling between the termination box and the control station.

6.1.2 Control Station Installation

A summary of the installation and operation activity associated with the control station is provided below.

Table 7- Control station installation and operation summary

Control station	
Installation	
Activity	Number of vehicles and anticipated duration
Site preparation	Wheeled digger to undertake minimal ground preparation works and delivery of stone (2 lorries) over 1 week.
Shipping containers	Delivery and installation of containers will require three trips by a lorry with HIAB which would occur over 2-3 days, depending on availability.
Bunded oil tank/Chemical toilet	2 vehicles single trip
Installation Staff	3 vehicles per day over 2 weeks
Operation	
Staff	2 vehicles once per day for first 2 months and then 2 vehicles once per week
HGV	Fuel delivery 1 HGV once every fortnight Servicing toilet facility when required.
Noise emissions	Generator 2-3hrs in every 6 hours (65dB at 7m). Compressor 98dB (2-3 hours in every 6 hours).
Control Centre Decommissioning	
Shipping containers	Removal of containers and other kit will require similar vehicles as for installation.

The temporary control station will constitute three 20-23ft shipping containers. Access for installation machinery for the control station and cabling will be via farm track on private land

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Table 8 - Plant Noise Data Used in Control Station Installation Prediction Model

Description	Qty	L_{Aeq}	(dB)	Source
Wheeled Excavator (Ground Clearance)	1	$L_{Aeq\ at\ 10m}$	66	BS5228 Table C.4 10
HGVs delivering Stone (Moving along access road)	1	$L_{Amax\ at\ 10m}$	81	BS5228 Table C.4 1
Lorry with HIAB (Installing Cabins)	1	$L_{Aeq\ at\ 10m}$	77	BS5228 Table C.4 53
Lorry with HIAB (Moving along access road)	1	$L_{Amax\ at\ 10m}$	83	BS5228 Table C.11 4

6.1.4 Control Station Operation

The temporary control station will house power and electrical facilities to support power and communications equipment for monitoring of marine device testing. The following preliminary plant selections have been used in the assessment:

Table 9 - Plant Noise Data Used in Control Station Operational Prediction Model

Description	Qty	L_{Aeq}	(dB)	Source
DHY65KSE 48kW Diesel Generator	1	$L_{Aeq\ at\ 7m}$	65	Hyundai (Manufacturer)
XATS138 Compressor	1	L_w	98	Atlas Copco (Manufacturer)

Compressor and Generator Operation is not continuous. The operation is linked to tide level – compressor would need to operate around high tide, and the generator powers the compressor. This could operate around 2-3 hours in every 6hours.

6.2 Noise Map Predictions

6.2.1 Cabling Installation (Fixing Clamps to Rock Face)

To allow for intermittency of the drilling works / fixing of rock bolts our model has allowed a 50% on-time; i.e. 30mins of drilling in an hour. Note: A diversion will be in place during key activities to keep people away when items cross the coastal path e.g. air feed for pneumatic drill. The anchor point and bolt drilling are in a precise locations close to the cliff top or in the gully which will mean that people would be about 100m away. The works are approximately 80m from the undiverted path. Figure 2 shows predicted noise levels from drilling and compressor.

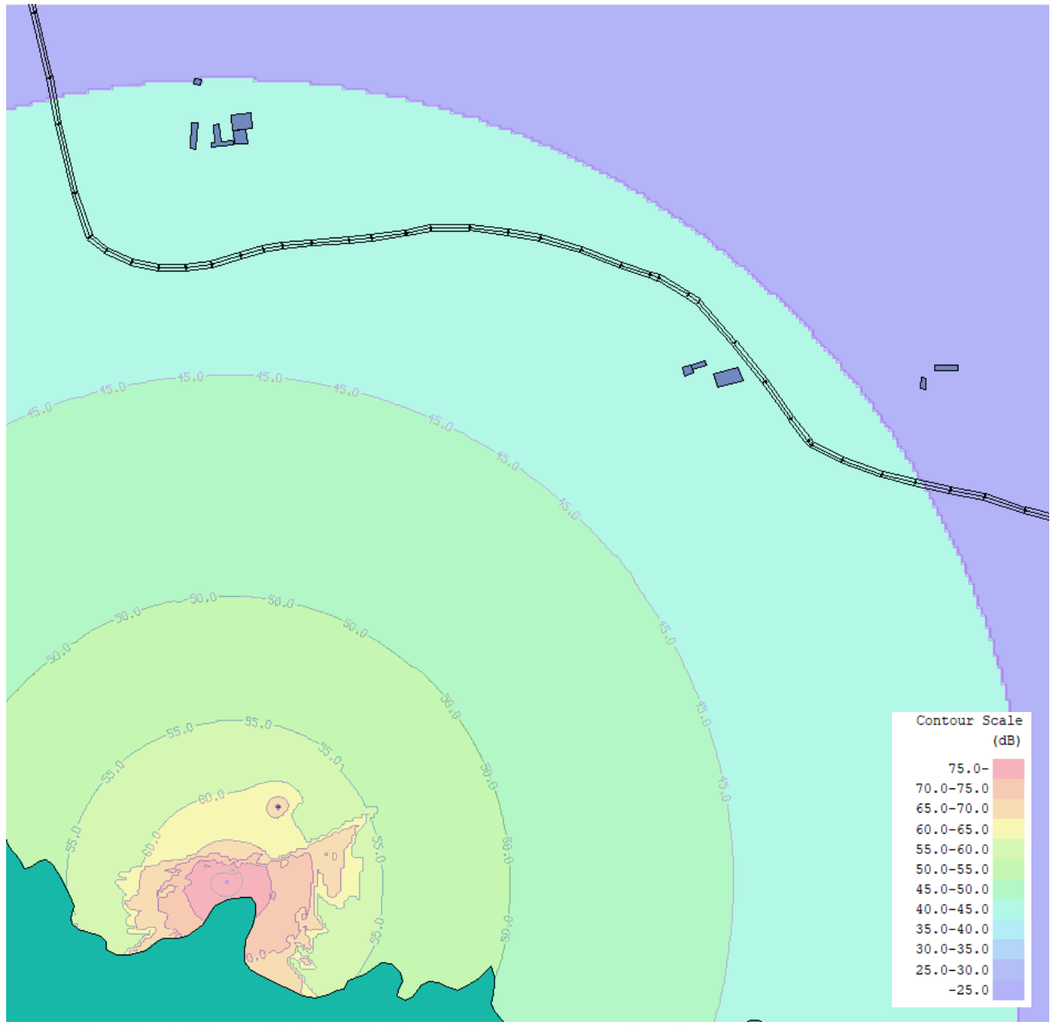

Figure 2 – Rock Clamp Fixing – Drill and Compressor - Daytime

A noise level of 43dB $L_{Aeq,1hr}$ is predicted at Carters Green. This is indicated to meet the 65dB$L_{Aeq,1hr}$ criterion. Noise levels of around 55dB-65dBL_{Aeq} are indicated on the Pembrokeshire Coast Path.

6.2.2 Control Station Installation

1. Ground Clearance / Preparation

The model has allowed a 100% on-time for the excavator i.e. working continuously, and 1 lorry delivering stone arriving and leaving during a worst-case daytime hour. Figure 3 shows predicted noise levels from the excavator and delivery of stone.

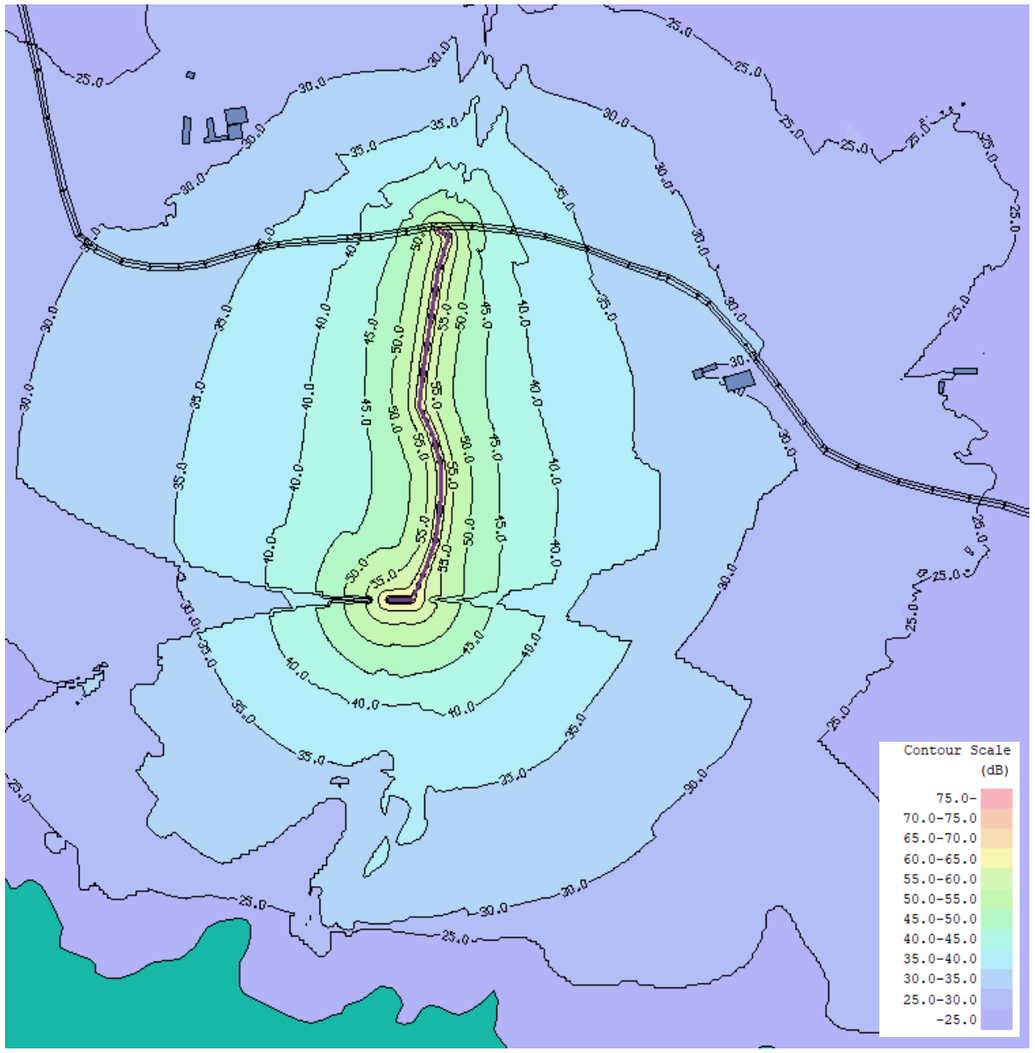

Figure 3 Ground Preparation / Delivery of Stone – Daytime

A noise level of 30dB $L_{Aeq,1hr}$ is predicted at Carters Green. This is indicated to meet the 65dB$L_{Aeq,1hr}$ criterion.

2. Delivery of Container

All deliveries to site would be during day time hours. We have allowed for the arrival of one lorry, unloading a cabin, and the lorry departing in a worst-case daytime hour period. Figure 4 shows predicted noise levels from the delivery of containers.

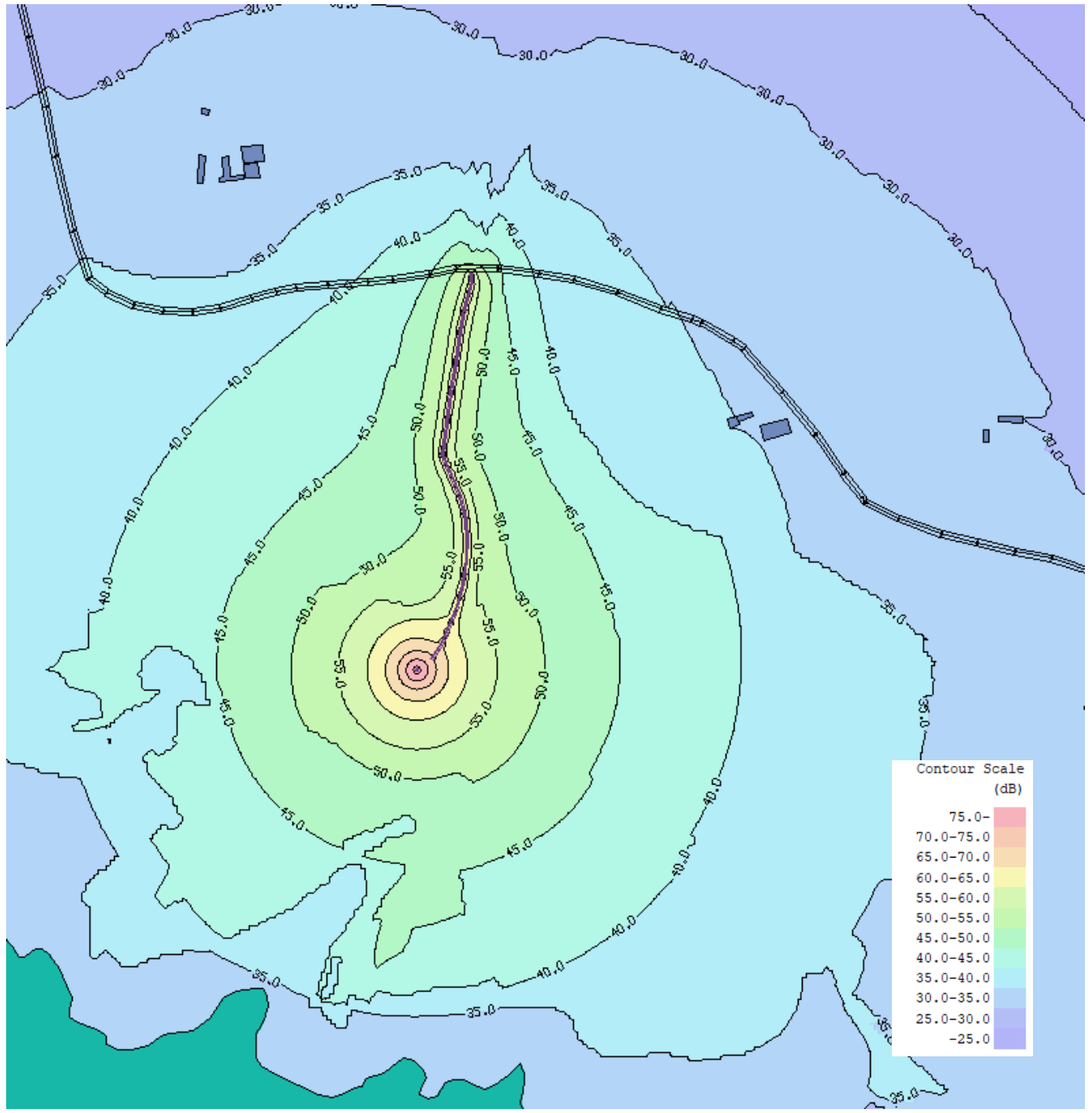

Figure 4 Delivery of Containers - Daytime

A noise level of 34dB $L_{Aeq,1hr}$ is predicted at Carters Green during the delivery and installation of the control station cabins. This is indicated to meet the 65dB$L_{Aeq,1hr}$ criterion.

6.2.3 Control Station Operational Noise

The model has allowed a 100% on-time for the generator and compressor to allow for continuous operation during a 15-minute night-time period, and for an hour during the daytime.

It is proposed that the compressor is enclosed in order to provide acoustic screening. In addition to this in order to provide maximum screening losses it is recommended that the Generator and Compressor are located to the south of the Cabins – this is shown in the model output.

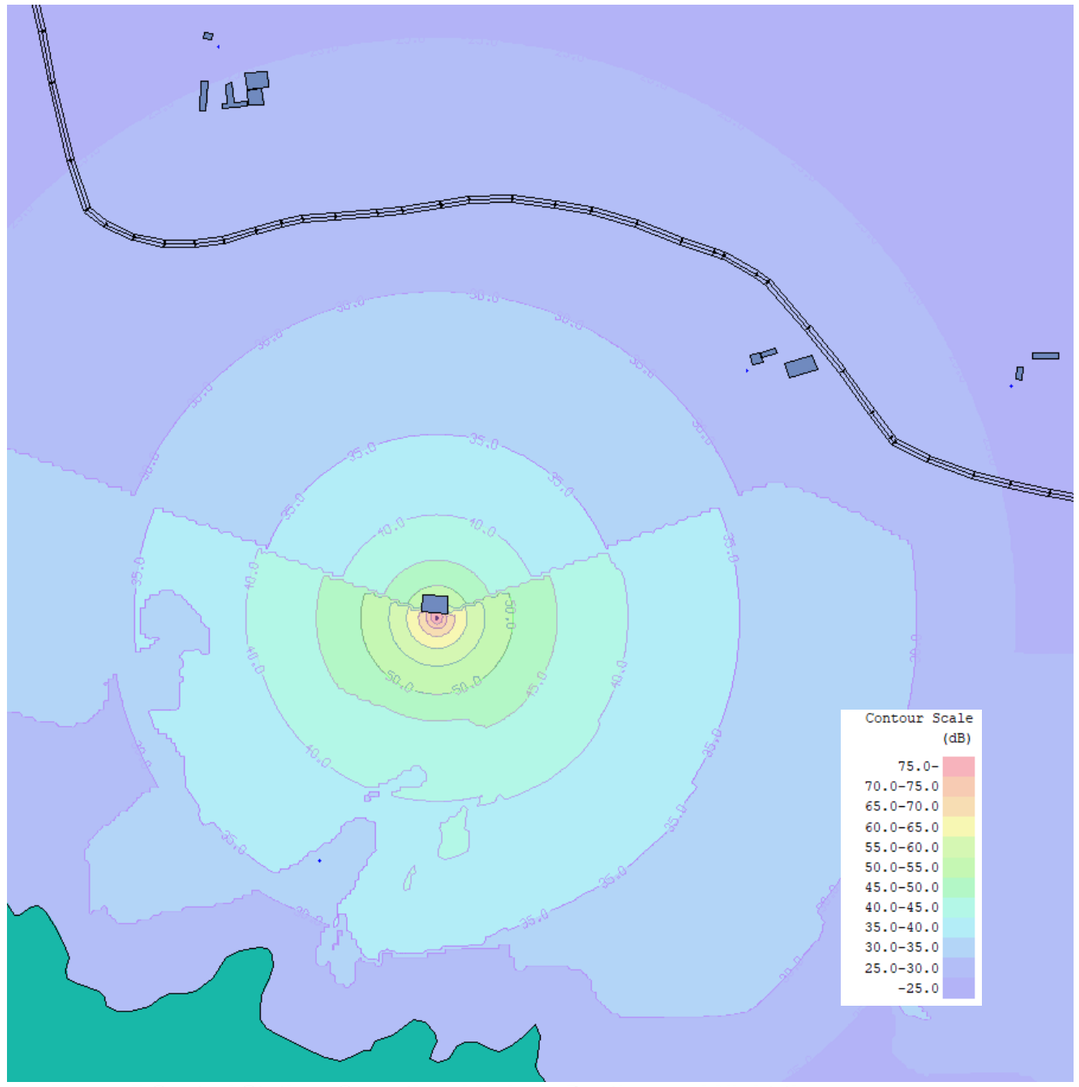

Figure 5 Control Station: Operational Noise – Daytime and Night-time

Figure 5 Noise Map shows predicted operational noise levels. A noise level of 28dB $L_{Aeq,15mins}$ is predicted at Carters Green during operation.

Table 10 shows a full BS 4142:2014 assessment based on 28dBL_{Aeq} generator and compressor noise levels predicted in the noise map model. This is based on full screening to compressor and generator – it is recommended that the plant is located to the south of the cabins to optimise screening losses.

A 6dB penalty has been applied to account for prominent tones typically associated with generators and compressors. This is considered a robust approach, as noise spectra are not available for generator and compressor. A 0dB 'rating level over background' is therefore indicated and the operational noise impact is therefore indicated to be low according to BS 4142:2014.

Table **10 – BS 4142 Assessment at Carters Green – Control Station Operational Noise (Night)**

Results		Relevant Clause	Commentary
Predicted Level at Carters Green	$L_{Aeq(15\ mins)}$ = 28dB	7.3.2	Predicted level from Noise Map model, with all plant operating
Residual sound level	$L_{Aeq(15\ mins)}$ = N/A	7.3.3	No correction for residual sound level is applied as we are working with a predicted specific sound level.
Background sound level (night-time)	$L_{A90(2300\text{-}0700hrs)}$ = 34dB	8.1.1 8.1.3 8.3	Background sound level measured on site
Assessment made during the night so the reference time interval is 15 min.		7.2	
Specific sound level calculated by correcting the ambient sound level to remove the contribution of the residual sound level.	$L_{Aeq(15\ mins)}$ = 34dB	7.3.4	
Acoustic feature correction	6dB	9.2	A 6dB correction in the design has been allowed for to account for likely tonal content associated with generator and compressor. This represents a robust assessment as no noise spectra are available for the proposed plant,
Rating Level	(28 + 6) = 34dB		
Background sound level (night-time)	$L_{A90(2300\text{-}0700hrs)}$ = 34dB	8.3	
Excess of rating over background sound level	(34 - 34) dB = 0dB	11	
Assessment indicates a low impact depending on context		11	BS4142 States: Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.
Uncertainty of assessment		10	Uncertainty in background noise measurements is considered low. Predicted noise levels have been based on manufacturer/supplier data and predicted back to the receivers using methodology from BS 5228, with screening losses limited. Uncertainty is therefore considered low.

7.0 Discussion & Conclusions

An initial noise impact assessment has been carried out for the proposed temporary onshore control station along with associated cabling as part of the mWave Project, Angle, Pembrokeshire.

An environmental noise survey has been carried out at the site to confirm ambient and background noise levels at the closest noise sensitive receivers.

Noise predictions and models have been carried out covering installation noise and operational noise, in line with current planning & British Standard guidance.

7.1 Installation Noise

Predicted noise levels from short-term installation works including rock drilling, control station groundworks and cabin deliveries are indicated to fall well below the BS 5228 daytime construction noise limit of 65dB$L_{Aeq,1hr}$.

Noise levels at the Coastal Path are indicated up to 65dBL_{Aeq} for the short-term duration (around 2 days) of drilling of rock anchors/clamps. This should not be considered excessive.

Decommissioning, based on the same activities, is indicated similar.

7.2 Operational Noise

Predicted operational noise levels from generator and compressor sources have been assessed in line with BS 4142:2014 methodology.

A 0dB ‘rating level over background’ is indicated and the operational noise impact is therefore indicated to be low, based on full screening being provided to diesel generator and compressor noise sources.

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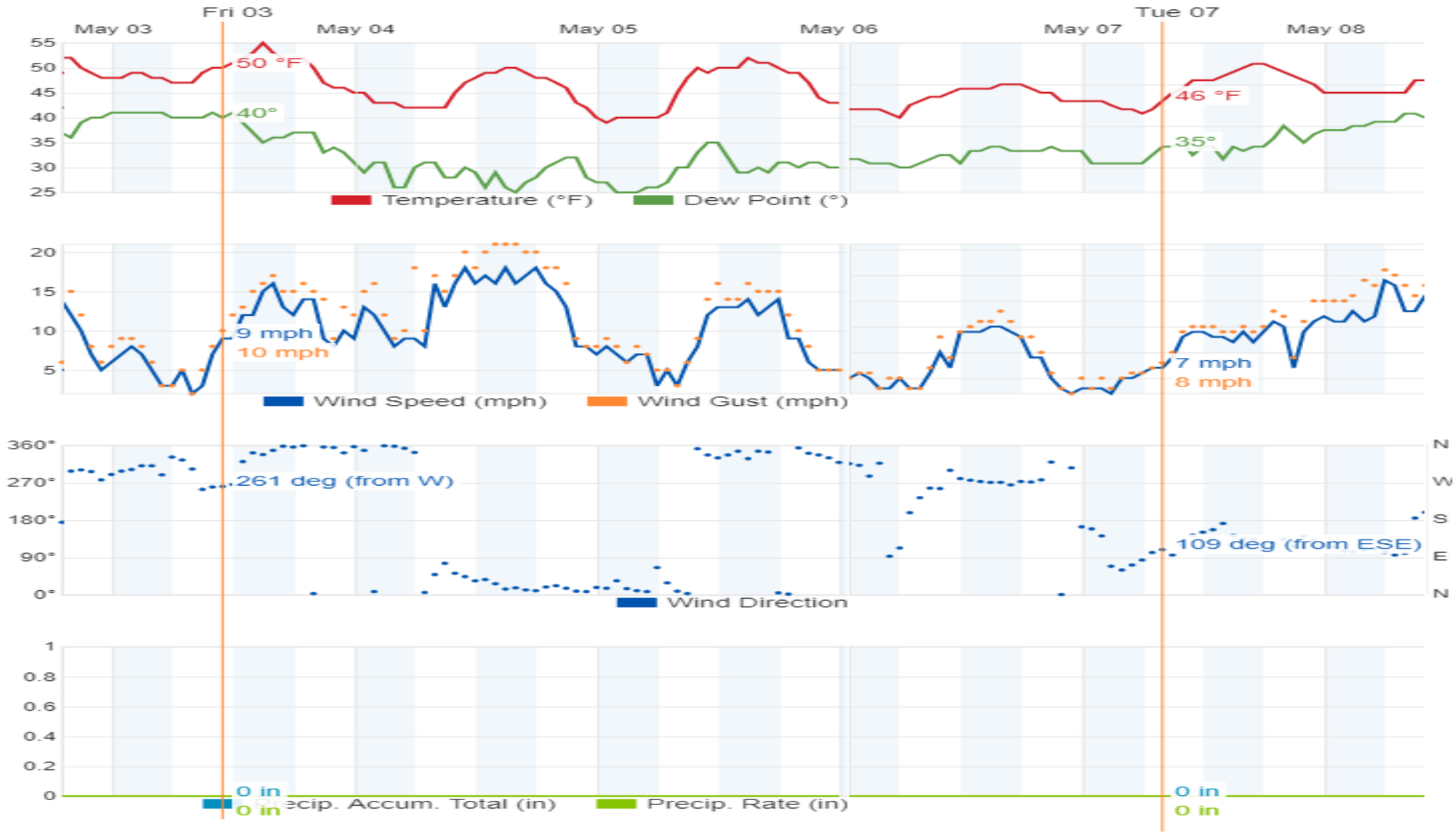
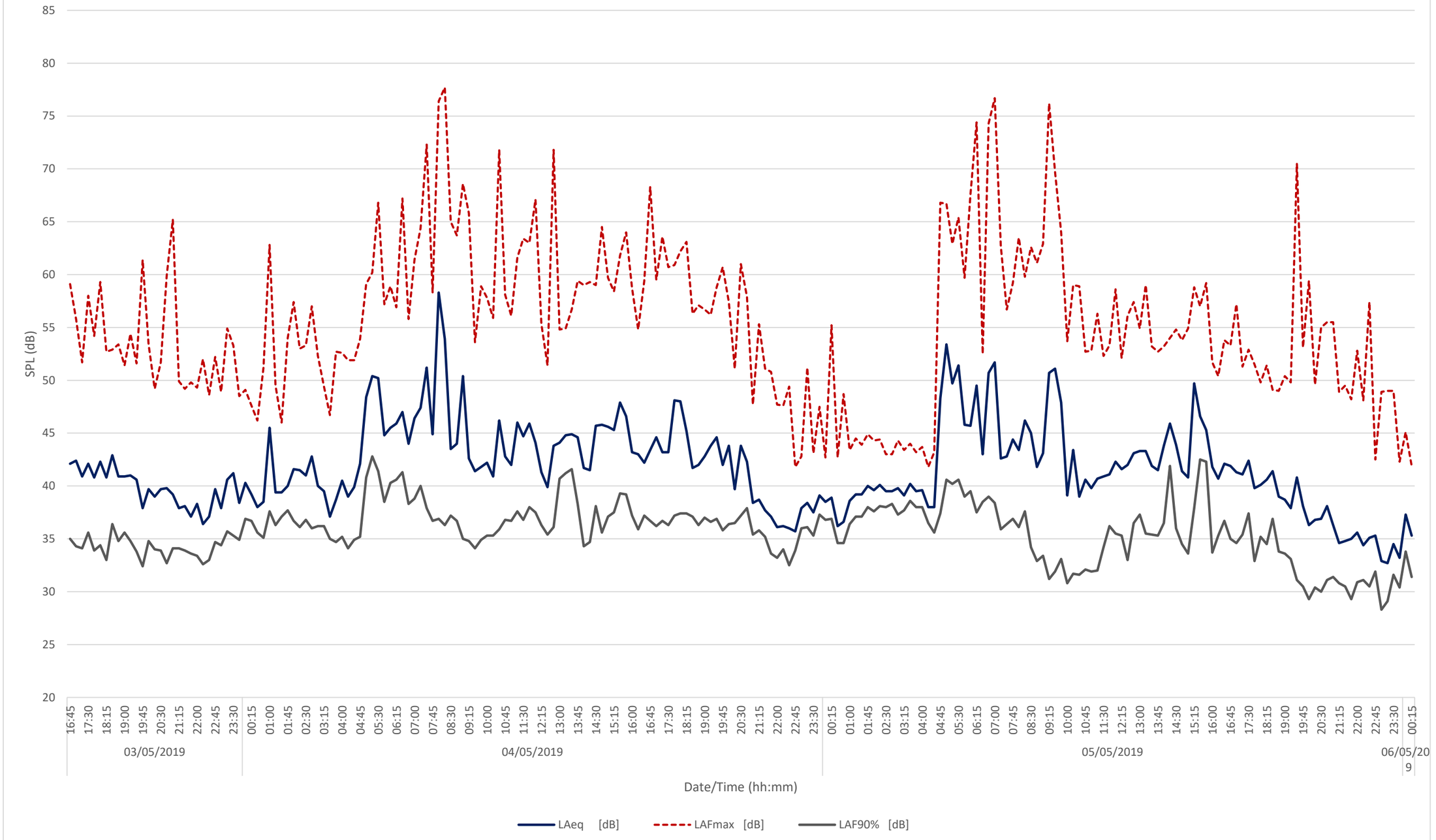
Appendix A – Graphs, Tables and Diagrams

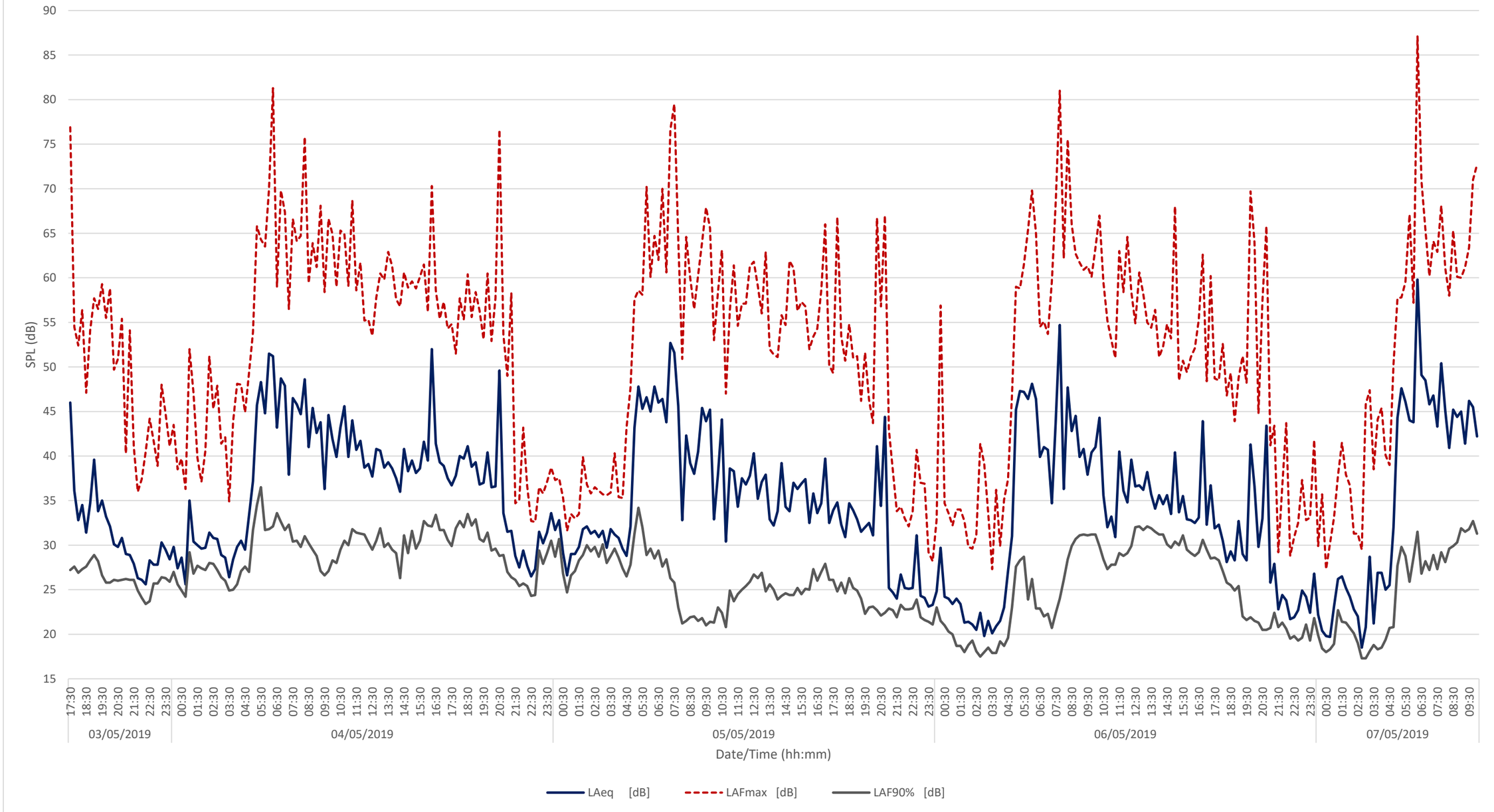
5136/WH1 - Approximate Weather History



5136/TH1 - Time History at Position A



5136/TH2 - Time History at Position B


SPL (dB)
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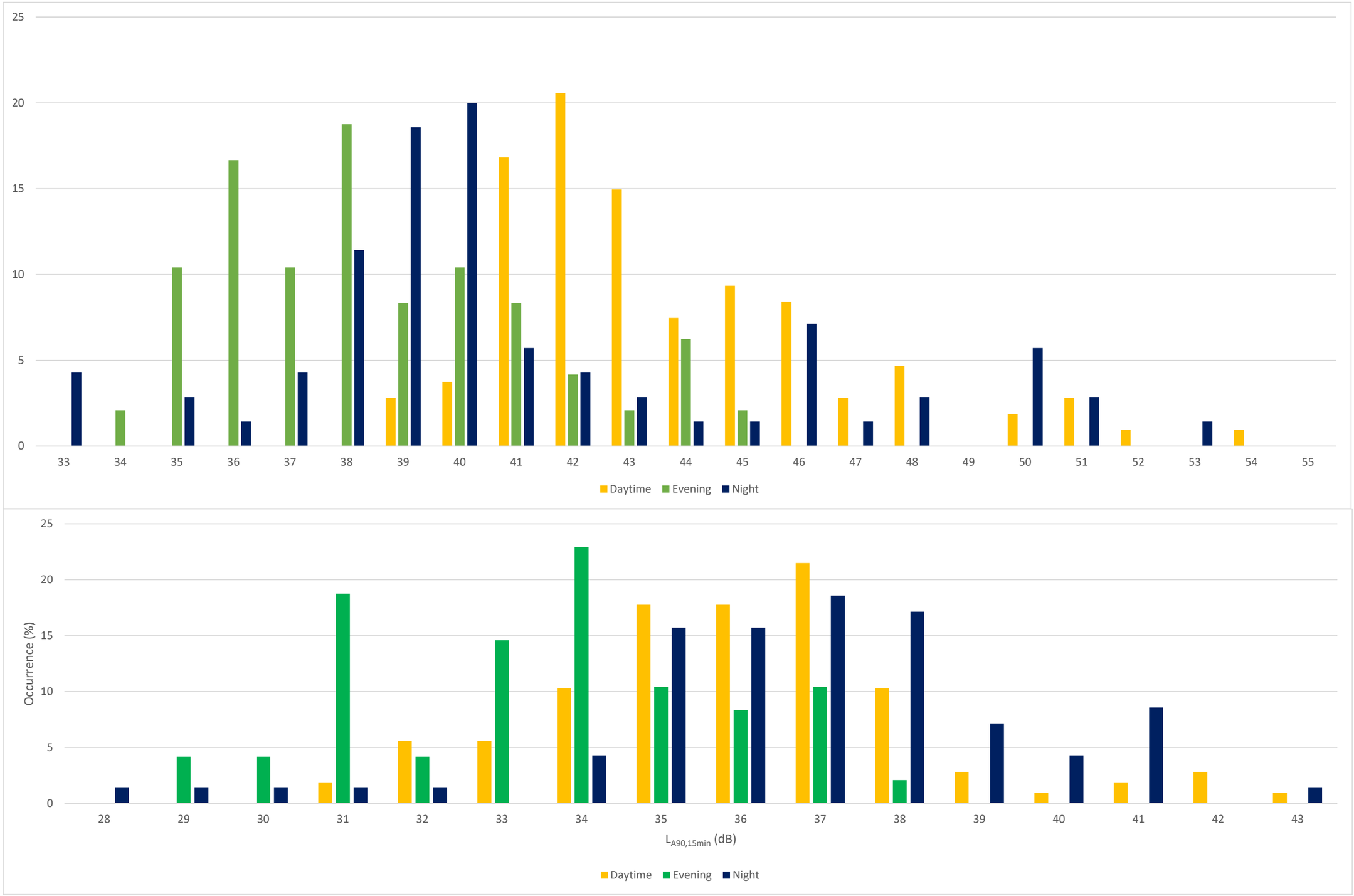
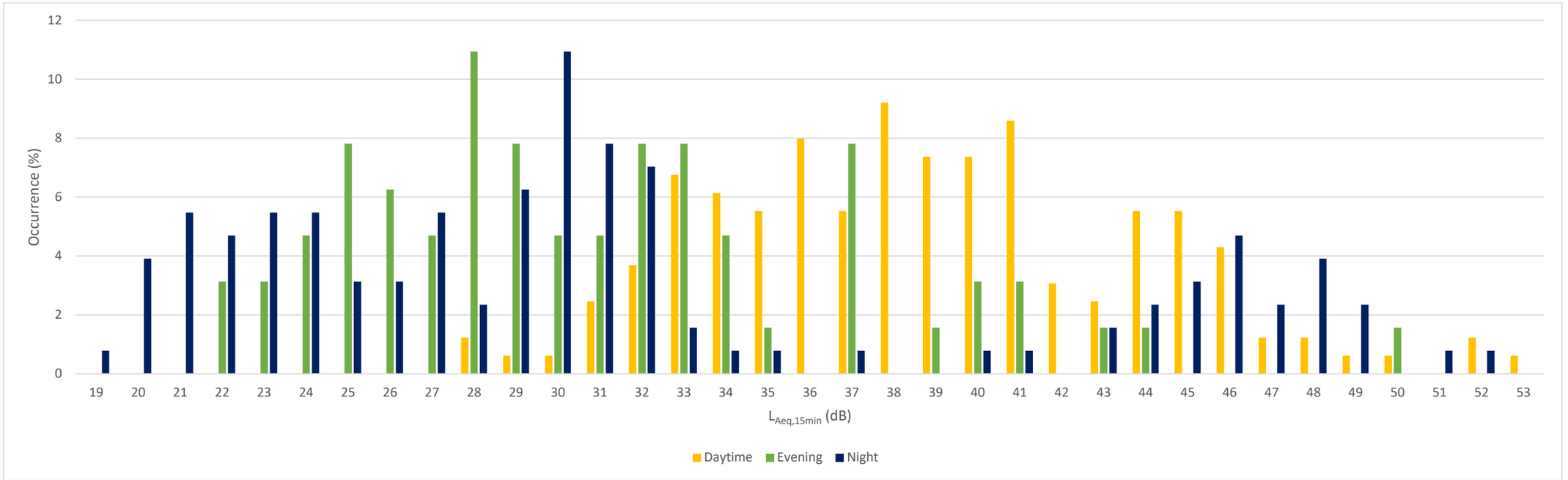
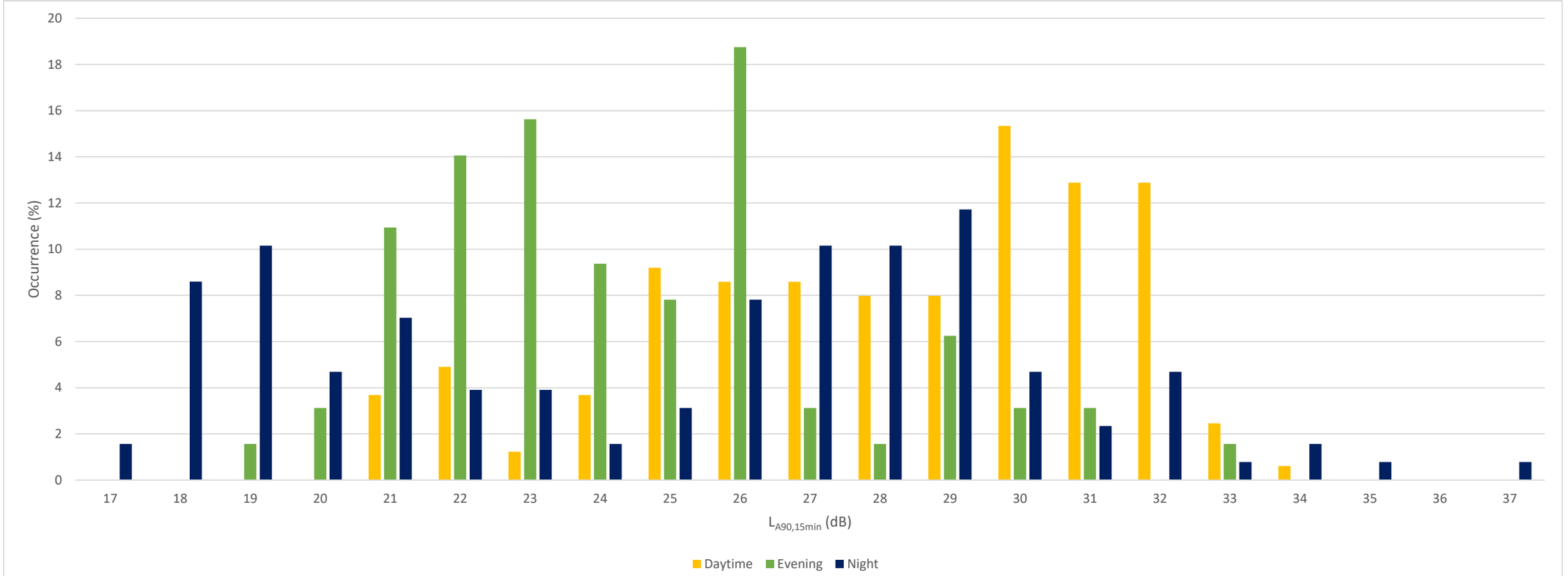
06/05/2019
07/05/2019
Date/Time (hh:mm)
LAeq [dB]
LAFmax [dB]
LAF90% [dB]

5136/G1 – Statistical Analysis of Ambient & Background Sound Levels Showing Most Commonly Occurring Values (Position A)



5136/G2 – Statistical Analysis of Background Sound Levels Showing Most Commonly Occurring Values (Position B)





Appendix B – Acoustic Terminology

Human response to noise depends on a number of factors including; loudness, frequency content, and variations in level with time. Various frequency weightings and statistical indices have been developed in order to objectively quantify 'annoyance'. The following units have been used in this report:

dB(A): The sound pressure level weighted to correspond with the frequency response of the human ear, and therefore a person's subjective response to frequency content.

L_{eq}: The equivalent continuous sound level is a notional steady state level which over a quoted time period would have the same acoustic energy content as the actual fluctuating noise measured over that period.

L_{90}: The sound level which is exceeded for 90% of the measurement period. i.e. The level exceeded for 54 minutes of a 1-hour measurement. It is often used to define the background noise level.

L_{10}: The sound level which is exceeded for 10% of the measurement period. i.e. The level exceeded for 6 minutes of a 1-hour measurement

L_{max}: The highest instantaneous sound level recorded during the measurement period.

$L_{Ar,Tr}$: The specific noise level plus any adjustment for the characteristic features of the noise