Appendix 10.1-10.4 – Noise and Vibration

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Appendix 10.1 Glossary of Acoustic Terminology

Parameter	Description
Acoustic Environment	Sound at the receiver from all sound sources as modified by the environment.
Ambient Sound	Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far. Comprises of the residual sound and the specific sound when present.
A-Weighted Decibel (dBA)	A decibel level that has been corrected for the A-Weighting curve.
A-Weighting	Octave band and 1/3 octave band filters that correlate to the response of the human hearing system to sound pressure levels at different frequencies.
Background Sound	The level of sound measured in the absence of extraneous noise sources.
Background Sound Level ($L_{A90,T}$)	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using a fast time-weighting and quoted to the nearest whole number of decibels.
Decibel (dB)	A logarithmic unit used to describe the ratio between the measured level and a reference level of 0 dB. The ratio can be sound pressure, intensity or power.
Equivalent Continuous A-Weighted Sound Pressure Level ($L_{Aeq,T}$)	Value of the time-averaged A-weighted sound pressure level, in decibels (dB), of a continuous steady sound for the duration of the specified time interval, T.
Façade Level	The sound pressure level at a distance of 1 metre from the façade
Fast Time Weighted	The speed at which the instrument responds to changes in amplitude of the measured signal. The response time of a fats time-weighted instrument is 0.125 seconds.
Free-Field Level	The sound pressure level measured away from any reflective surfaces.
Frequency (f)	The number of cycles of pressure fluctuations within a given period of time. Measured in Hertz.
Hertz (Hz)	The unit of frequency or pitch of a sound. One hertz is equal to one cycle per second.
L_{AMax}	The maximum A-weighted level measured during a given time period.
Octave Band	Band of frequencies where the upper limit of the band is twice the frequency of the lower limit. E.g., the 1000 Hz band contains noise energy at all frequencies from 707 to 1414 Hz.
Peak Particle Velocity (PPV)	The maximum instantaneous velocity of a particle at a point during a given time interval.
Percentile Level ($L_{AN,T}$)	The A-Weighted Sound Pressure Level which is exceeded for N% of the specified time interval. E.g., the $L_{A90,1hour}$ is the A-weighted sound level exceeded for 90% of 1 hour.
Sound Energy	The energy present in a sound field that causes mechanical vibration in any medium through which a sound wave passes. Measured in Joules (j).

Parameter	Description
Sound Energy Level	The logarithm of the ratio of the sound energy (J) to the reference sound energy level (J0). The reference value for sound energy is 1 ρJ. Defined as: $L_J = 10log\left(\frac{J}{J_0}\right)$
Sound Exposure Level (L_{AE})	The level of sound, equal to 1 second of duration, that has the same sound energy as the actual noise event considered. Is also referred to as the SEL, or the LAX. Defined as: $L_{AE} = L_{Aeq} + 10log_{10}(t)$
Sound Power (L_W)	The total sound energy radiated by a source, in all directions. Measured in watts (W).
Sound Power Level (L_W)	The logarithm of the ratio of the sound power (W) to the reference sound power level (W0). The reference value for sound power is 1 ρW. Defined as: $L_{AE} = L_{Aeq} + 10log_{10}(t)$
Sound Pressure	The difference between the pressure caused by a sound wave and the ambient pressure of the medium the sound wave is passing through. Measured in Pascals.
Sound Pressure Level (L_p)	The logarithm of the ratio of a given sound pressure (p) to the reference sound pressure (p0). The reference value for sound pressure is 20 μPa. Defined as: $L_p = 20log\left(\frac{p}{p_0}\right)$
Sound Sources	Sounds generated by nature or human activity.

Appendix 10.2 Policy Context, Legislation, Guidance and Standards

A.1 Local Policy

Argyll and Bute Local Development Plan

A.1.1 The Argyll and Bute Local Development Plan was adopted in March 2015 and "*sets out a settlement strategy and spatial framework for how the Council wants to see Argyll and Bute*". In addition, the Argyll and Bute Local Development Plan Supplementary Guidance document was adopted in March 2016 to "*provide further information or detail specified in relation to those policies or proposals*".

A.1.2 Supplementary Guidance LDP BUS 1 Business and Industry Proposals in Existing Settlements and Identified Business and Industry Areas provides additional detail to Policy LDP 5 Supporting the Sustainable Growth of Our Economy of the Adopted Argyll and Bute Local Development Plan and states:

"*Proposals for the development of new, or extensions to existing, business and industrial enterprises (Use Classes 4, 5, 6 and 7) and waste management developments (as defined in SG SERV 5) within existing settlements and industry and business areas will normally be permitted provided that:…*

…(c) In residential locations the proposed development would not erode the residential character of the area, or adversely affect local residents, through an increase in traffic levels, noise, fumes or hours of operation…."

Argyle and Bute Proposed Local Development Plan 2

A.1.3 The Argyle and Bute Proposed Local Development Plan 2 is currently being prepared and will replace the adopted Argyll and Bute Local Development Plan and associated Supplementary Guidance.

A.1.4 Policy 22 Economic Development states:

"*… B. Windfall Industrial and Business Development:*

Where the developer demonstrates that there are no suitable sites within the preferred areas, proposals for built development or change of use for windfall Industrial and business development (excluding retail) and waste management, will require to take the aims and approach in Table 3 into account and:…

i) in the Settlement boundaries ensure developments…:

> *d) will not erode the residential amenity of the area, including cumulative impacts, nor adversely affect local residents, through an increase in traffic levels, noise, fumes or hours of operation*."

A.2 National Policy

Scottish Planning Policy (SPP)

A.2.1 A revised Scottish Planning Policy was published in June 2014 (The Scottish Government, 2014) and sets out national planning policies which reflect Scottish Ministers' priorities for operation of the planning system and for the development and use of land.

A.2.2 With respect to noise, Paragraph 106 states:

"*Efficient handling of planning applications should be a key priority, particularly where jobs and investment are involved. To assist with this, pre-application discussions are strongly encouraged to determine the information that should be submitted to support applications. Such information should be proportionate and relevant to the development and sufficient for the planning authority requirements on matters such as the number of jobs to be created, hours of working, transport requirements, environmental effects, noise levels and the layout and design of buildings. Decisions should be guided by the principles set out in paragraphs 28 to 35.*"

A.2.3 Paragraph 169 Development Management states:

"*Proposals for energy infrastructure developments should always take account of spatial frameworks for wind farms and heat maps where these are relevant. Considerations will vary relative to the scale of the proposal and area characteristics but are likely to include…:*

- *Impacts on communities and individual dwellings, including visual impact, residential amenity, noise and shadow flicker…."*

A.2.4 Paragraph 252 states that:

"*Applications should be supported, where necessary, by sufficient information to demonstrate:*

- *operational arrangements (including noise, light, access, waste and odour) are satisfactory and sufficient mitigation plans are in place…."*

Planning Advice Note PAN 1/2011 Planning and Noise

A.2.5 Planning Advice Note PAN 1/2011 Planning and Noise (The Scottish Government, 2011) provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. Information and advice relating to noise impact assessment (NIA) methods is provided and includes details of the legislation, technical standards and codes of practice for specific noise issues.

A.2.6 In relation to development management, Paragraph 15 states:

"*Issues which may be relevant when considering noise in relation to a development proposal include:*

- *Type of development and likelihood of significant noise impact,*
- *Sensitivity of location (e.g. existing land uses, NMA, Quiet Area),*
- *Existing noise level and likely change in noise levels,*
- *Character (tonal, impulsivity etc), duration, frequency of any repetition and time of day of noise that is likely to be generated, and*
- *Absolute level and possible dose-response relationships e.g. health effects if robust data available."*

A.2.7 In relation to Noise Impact Assessment, Paragraph 19 states:

"*The preparation and consideration of planning applications that raise significant noise issues can be greatly assisted by a Noise Impact Assessment (NIA). Planning authorities can require a NIA either as part of an Environmental Impact Assessment or separately. The need for noise impact assessments is best identified during preapplication discussions. The purpose of a NIA is to demonstrate whether any significant adverse noise impacts are likely to occur and if so, identify what effective measures could reduce, control and mitigate the noise impact. Before a NIA is commissioned, planning authorities and applicants are advised to:*

- *Agree any potential representative limits of noise and /or the relevant NIA methodology in the context of the proposed development, its location and the surrounding area, and*
- *Establish criteria for assessing any significant adverse noise impact or predict and describe ambient noise levels (including noise from transport sources) that the proposed development is likely to generate and/or is likely to be subjected to.*

For further information on NIA methodologies see the Technical Advice Note."

A.2.8 In relation to Roads, Paragraph 23 states:

"*Road traffic noise impact assessments should take account of level, potential vibration, disturbance and variation in noise levels throughout the day, the pattern of vehicle movements and the configuration of the road system. When upgrading existing roads it will normally be sufficient to base noise assessments on the current measured noise level. When considering proposals for the development or improvement of major roads, forecast noise levels can be ascertained from the relevant roads authority. In some cases, roads authorities may have prepared predictions of the effects of road traffic noise but this will depend upon accurate data on traffic flow being available*."

A.2.9 In relation to Industrial Sources, Paragraph 31 states:

"*Due to its variable character industrial noise is generally difficult to assess. Since background noise levels vary throughout a 24-hour period it will usually be necessary for Noise Impact Assessments to assess the acceptability of noise levels for separate periods (e.g. day, evening, night and weekend) chosen to suit the hours of operation of the proposed development. Noise that may result from traffic generated by new industrial developments is likely to be a relevant consideration*."

A.3 Legislative Context

Planning (Scotland) Act 2019

A.3.1 The Planning (Scotland) Act came into force in November 2019 (The Scottish Parliament, 2019) and informs how the National Planning Framework is to be prepared.

A.3.2 Section 25 of the Act inserts Section 41A into the Town and Country Planning (Scotland) Act 1997:

"*Conditional grant of planning permission: noise-sensitive developments*

(1) A development that is the subject of an application for planning permission is a "noise-sensitive development" if residents or occupiers of the development are likely to be affected by significant noise from existing activity in the vicinity of the development (a "noise source").

(2) Without prejudice to the generality of section 41(1), a planning authority—

(a) must, when considering under section 37 whether to grant planning permission for a noise-sensitive development subject to conditions, take particular account of whether the development

includes sufficient measures to mitigate, minimise or manage the effect of noise between the development and any existing cultural venues or facilities (including in particular, but not limited to, live music venues), or dwellings or businesses in the vicinity of the development, and

(b) may not, as a condition of granting planning permission for a noise-sensitive development, impose on a noise source additional costs relating to acoustic design measures to mitigate, minimise or manage the effects of noise."

Control of Pollution Act

A.3.3 The Control of Pollution Act (CoPA) (HMSO, 1974) covers a wide range of environmental pollution including noise. Parts of the Act have been superseded by the Environmental Protection Act 1990.

A.3.4 Section 60 of the Act relates to the 'Control of Noise on Construction Sites' and Section 61 relates to obtaining 'Prior Consent for Work on Construction Sites'. These parts of the Act are often used in conjunction with other standards to determine acceptable noise levels in relation to construction, hours of operation and specific working methods or mitigation.

A.3.5 A Section 61 application outlines the proposed construction works, hours of operation and a mitigation plan to reduce noise and vibration impact through the use of Best Practicable Means. It allows prior consent to be agreed between the contractor and the council and assists with protecting the contractor from legal action being taken under Section 60 of CoPA or Section 80 of the Environmental Protection Act 1990.

Environmental Protection Act

A.3.6 The Environmental Protection Act (EPA) (HMSO, 1990) requires local authorities to investigate noise complaints from premises (land and buildings) and vehicles, machinery or equipment in the street. This includes noise arising from construction sites.

A.3.7 If the local authority is satisfied that noise from a development amounts to a statutory nuisance then the authority must serve an abatement notice on the person responsible or in certain cases the owner or occupier of the property. The notice may require that the noise or nuisance be completely stopped or limited to certain times of the day.

A.4 Guidance and Standards

British Standard 7445:2003 'Description and Measurement of Environmental Noise – Part 1: Guide to Quantities and Procedures'

A.4.1 BS 7445-1:2003 (British Standards Institution, 2003) describes methods and procedures for measuring noise from all sources which contribute to the total noise climate of the community's environment, individually and in combination. The results are expressed as equivalent continuous A-weighted sound pressure levels, $L_{Aeq,T}$.

A.4.2 BS 7445-1 states that sound level meters that are used for noise measurements should conform to the Type 1 (or Type 2 as a minimum) as described in BS EN 61672:2013 Electroacoustics (British Standards Institution, 2013). Sound level meters should be calibrated according to the instructions of the manufacturer and field calibration should be undertaken at least before and after each series of measurements.

British Standard 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites Part 1 Noise

A.4.3 BS 5228-1:2009+A1:2014 (British Standards Institution, 2014) gives recommendations for basic methods of noise control relating to construction sites, including sites where remediation, ground treatment or related civil engineering works are being carried out, and open sites, where work activities/operations generate significant noise levels, including industry-specific guidance.

A.4.4 Annexes C and D detail current and historical sound level data associated with different construction operations that can be used to calculate the impact of noise from construction sites.

A.4.5 Annex E outlines example criteria for the assessment of the potential significance of noise effects and describes methods to identify the likely significance of noise levels from surface construction activity.

British Standard 5228-2:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites Part 2 Vibration

A.4.6 BS 5228-2:2009+A1:2014 (British Standards Institution, 2014) provides advice on the human response to construction vibration. BS 5228-2 suggests that, for construction activities, it is considered appropriate to provide guidance in terms of the Peak Particle Velocity (PPV) as measured outside the building.

A.4.7 Annex B outlines criteria for the assessment of the significance of vibration effects. Furthermore, Table B.1 provides guidance that compares the predicted Peak Particle Velocity (PPV) and the consequences in terms of human perception and disturbance.

A.4.8 **Table 1** outlines the guidance on effects of vibration levels.

Table 1: Guidance on Effects of Vibration Levels

Vibration Level A), B), C)	Effect
0.14 $mm \cdot s^{-1}$	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 $mm \cdot s^{-1}$	Vibration might be just perceptible in residential environments.
1.0 $mm \cdot s^{-1}$	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10 $mm \cdot s^{-1}$	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.

A) The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient.

B) A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available.

C) Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.

A.4.9 Table B.2 of BS 5228-2:2009+A1:2014 provides guidance on PPV vibration limits for transient excitation for different building types**. Table 2** outlines the transient vibration guide values for cosmetic damage to buildings.

Table 2: Transient Vibration Guide Values for Cosmetic Damage

Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or Framed Structures. Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	
Un-reinforced or light framed structures. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
NOTE 1 Values referred to are at the base of the building. NOTE 2 At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.		

BS 6472-2:2008 Guide to Evaluation of Human Exposure to Vibration in Buildings Part 2: Blast-Induced Vibration

A.4.10 BS 6472-2:2008 (British Standards Institution, 2008) gives guidance on human exposure to blast-induced vibration in buildings. It is primarily applicable to blasting associated with mineral extraction, however it might also be useful in assessing other forms of vibration that are caused by blasting, including when explosives are utilized in civil engineering works.

A.4.11 BS 6472-2 suggests that, for blasting, it is considered appropriate to consider the Peak Particle Velocity (PPV) as measured outside the building on a well-founded hard surface as close to the building as possible.

A.4.12 Section 6 of the standard outlines guidance for the maximum satisfactory magnitudes for vibration outside buildings with respect to human response in terms of a Peak Particle Velocity (PPV) and is based on up to three blast vibration events per day.

A.4.13 **Table 3** outlines the guidance on effects of vibration levels.

Table 3: Maximum Satisfactory Magnitudes of Vibration With Respect to Hunam Response for up to Three Blast Vibration Events Per Day

Place	Time	Satisfactory Magnitude [A] PPV mm/s
Residential	Day [D]	6.0 to 10.0 [C]
	Night [D]	2.0
	Other Times [D]	4.5
Offices [B]	Any Time	14.0
Workshops [B]	Any Time	14.0

NOTE 1 This table recommends magnitudes of vibration below which the probability of adverse comment is low (noise caused by any structural vibration is not considered).

NOTE 2 Doubling the suggested vibration magnitudes could result in adverse comment and this will increase significantly if the magnitudes are quadrupled.*

[A] The satisfactory magnitudes are the same for the working day and the rest of the day unless stated otherwise.

[B] Critical working areas where delicate tasks impose more stringent criteria than human comfort are outside the scope of this standard.

[C] Within residential properties people exhibit a wide variation of tolerance to vibration. Specific values are dependent upon social and cultural factors, psychological attitudes and the expected degree of intrusion. In practice the lower satisfactory magnitude should be used with the higher magnitude being justified on a case-by-case basis.

[D] Within residential properties people exhibit a wide variation of tolerance to vibration. Specific values are dependent upon social and cultural factors, psychological attitudes and the expected degree of intrusion. In practice the lower satisfactory magnitude should be used with the higher magnitude being justified on a case-by-case basis.

* A selection of the available notes.

A.4.14 Section 6.2 goes on to state that:

"*When more than three blast vibration events occur in a working day the following relationship should be used to apply an additional multiplying factor, F, to reduce the satisfactory magnitudes.*

$$F = 1.7N^{0.5}T^{-d}$$

Where:

N is the number of blast vibration events per day (and is greater than 3);

T is the blast vibration event duration typical for the site or sites;

d is zero where T is less than 1 x, 0.32 for wooden floors and 1.22 for concrete floors.

A blast vibration event is defined as a ppv exceeding 0.5 mm·sp1, or background vibration, whichever is the greater. The duration is the length of time, in seconds, during which this level is exceeded."

Assessment of Noise: Technical Advice Note

A.4.15 The Assessment of Noise: Technical Advice Note (The Scottish Government, 2011) provides guidance which may assist in the technical evaluation of noise assessments. Advice on the role of the statutory planning system in helping to prevent and limit the adverse effects of noise is set out in Planning Advice Note 1/2011 (The Scottish Government, 2011).

A.4.16 Chapter 2 Noise Impact Assessment "outlines a framework for assessing the noise impacts that could potentially arise when either

- *a noise source is planned to be developed or, an existing noise source is to be further developed- referred to as noise generating development (NGD); or*
- *a noise sensitive development is planned or, an existing noise sensitive development is to be further developed - referred to as noise sensitive development (NSD)."*

Stage 1: Initial Process

A.4.17 The initial process requires the identification of all noise sensitive receptors (NSRs) that may potentially be affected by the development and to prioritise each NSR according to their level of sensitivity, as per the guidance outline in **Table 4** below.

Table 4: Level of Sensitivity Associated with Various Examples of NSRs

Sensitivity	Description	Example of NSR
High	Receptors where people or operations are particularly susceptible to noise	▪ Residential, including private gardens where appropriate. ▪ Quiet outdoor areas used for recreation ▪ Conference facilities ▪ Theatres/Auditoria/Studios ▪ Schools during the daytime ▪ Hospitals/residential care homes ▪ Places of worship
Medium	Receptors moderately sensitive to noise, where it may cause some distraction or disturbance	▪ Offices ▪ Bars/Cafes/Restaurants where external noise may be intrusive. ▪ Sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf, bowls)
Low	Receptors where distraction or disturbance from noise is minimal	▪ Buildings not occupied during working hours ▪ Factories and working environments with existing high noise levels ▪ Sports grounds when spectator noise is a normal part of the event ▪ Night Clubs

Stage 2: Quantitative Assessment

A.4.18 The procedure within a quantitative assessment depends on the type of development i.e. NGD or NSD. The final procedure in this stage is to determine the magnitude of the impact.

The following descriptors and the corresponding generic criteria, as shown in **Table 5,** provides a classification of magnitude on noise impacts.

Table 5: Classification of Magnitude of Impacts

Descriptors of Magnitude of Impact	Generic Criteria of Description
Major	Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse). Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial).
Moderate	Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements (Adverse). Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial).
Minor	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (Adverse). Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial).
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse). Very minor benefit to or positive addition of one or more characteristics, features or elements (Beneficial).
No Change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

A.4.19 The above magnitudes of impact can be applied to either NGDs or NSDs, based on relevant guidance outlined in documents such as WHO Guidelines for Community Noise and the DMRB.

Stage 3: Qualitative Assessment

A.4.20 A qualitative assessment allows additional factors to be included in the assessment procedure to augment the quantitative evaluation. The outcome from this process allows the magnitude of impacts determined from the quantitative assessment to be adjusted accordingly.

A.4.21 An example of assigning descriptors for qualitative impacts from noise at residential receptors is outlined in **Table 6** below.

Table 6: Example of Assigning Descriptors for Qualitative Impacts from Noise on Residential Properties.

Perception	Criteria of Descriptor for Residential Dwellings	Descriptor for Qualitative Impact
Noticeable (Very Disruptive)	Significant changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm.	Major
Noticeable (Disruptive)	Causes an important change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in character of the area.	Moderate
Noticeable (Mildly Intrusive)	Noise can be heard and may cause small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; closing windows more often. Potential for non-awakening sleep disturbance. Can slightly affect the character of the area but not such that there is a perceived change in the quality of life.	Minor
Just Noticeable (Non-Intrusive)	Noise can be heard, but does not cause any change in behaviour or attitude, e.g. increasing volume of television; speaking more loudly; closing windows. Can slightly affect the character of the area but not such that there is a perceived change in the quality of life.	Negligible
Not Noticeable	None	No Impact

Stage 4: Level of Significance

A.4.22 The level of significance of the noise impact at the NSR is obtained through the relationship of the receptor's sensitivity to noise and the magnitude of the noise impact.

A.4.23 **Table 7** provides a framework in determining the level of significance relating the magnitude of impact with the sensitivity of the receptor.

Table 7: Significance of Effects

Magnitude of Impact	Level of Significance Relative to Sensitivity of Receptor		
	Low	Medium	High
Major	Slight/Moderate	Moderate/Large	Large/Very Large
Moderate	Slight	Moderate	Moderate/Large
Minor	Neutral/Slight	Slight	Slight/Moderate
Negligible	Neutral/Slight	Neutral/Slight	Slight
No Change	Neutral	Neutral	Neutral

A.4.24 The levels of significance can be described as follows:

Very Large: These effects represent key factors in the decision-making process. They are generally, but not exclusively, associated with impacts where mitigation is not practical or would be ineffective.

Large: These effects are likely to be important considerations but where mitigation may be effectively employed such that resultant adverse effects are likely to have a Moderate or Slight significance.

Moderate: These effects, if adverse, while important, are not likely to be key decision-making issues.

Slight: These effects may be raised but are unlikely to be of importance in the decision-making process.

Neutral: No effect, not significant, noise need not be considered as a determining factor in the decision making process.

Stage 5: The Decision Process

A.4.25 The resultant levels of significance of the noise impact at the NSRs would be used to inform the decision process when applying for planning permission.

Design Manual for Road and Bridges LA 111 Traffic Noise and Vibration

A.4.26 The Design Manual for Roads and Bridges (DMRB) LA 111 Noise and Vibration (National Highways, 2020) sets out the method for assessing noise and vibration associated with the construction, operation and maintenance of highway projects. DMRB provides guidance on quantifying the noise and vibration impacts generated by changes in road traffic. The assessment has been informed by the criteria outlined in DMRB.

The Calculation of Road Traffic Noise

A.4.27 The Calculation of Road Traffic Noise (CRTN) (Department for Transport Welsh Office, 1988) describes procedures for traffic noise calculation and is suitable for the assessment of schemes where road traffic noise may have an impact.

A.4.28 Section 1 details the method of predicting noise associated with traffic flows on a road scheme at a reception point from the road scheme.

IEMA Guidelines for Environmental Noise Impact Assessment 2014

A.4.29 The IEMA Guidelines for Environmental Noise Impact Assessment 2014 (IEMA, 2014) detail an assessment process applicable to a wide range of potential environmental noise sources where a specific assessment method either does not exist or is not considered to be appropriate.

A.4.30 The guidelines suggest that by defining the sensitivity of receptors, the change in noise environment as a result of the source under consideration, and considering the type of noise, an assessment of the potential noise impact can be undertaken.

A.4.31 Receptors are those aspects of the environment sensitive to changes in baseline conditions. The sensitivity of a particular receptor depends upon the extent to which it is susceptible to such changes. Residential receptors are typically considered to have a high sensitivity with commercial and industrial receptors considered to have a low or negligible sensitivity.

A.4.32 Based on the IEMA guidelines, **Table 8**. details the relative change in sound level and the corresponding magnitude of change at a typical receptor of high sensitivity (e.g. a residential receptor).

Table 8: Magnitude of Change and Description of Effect at a Receptor with High Sensitivity

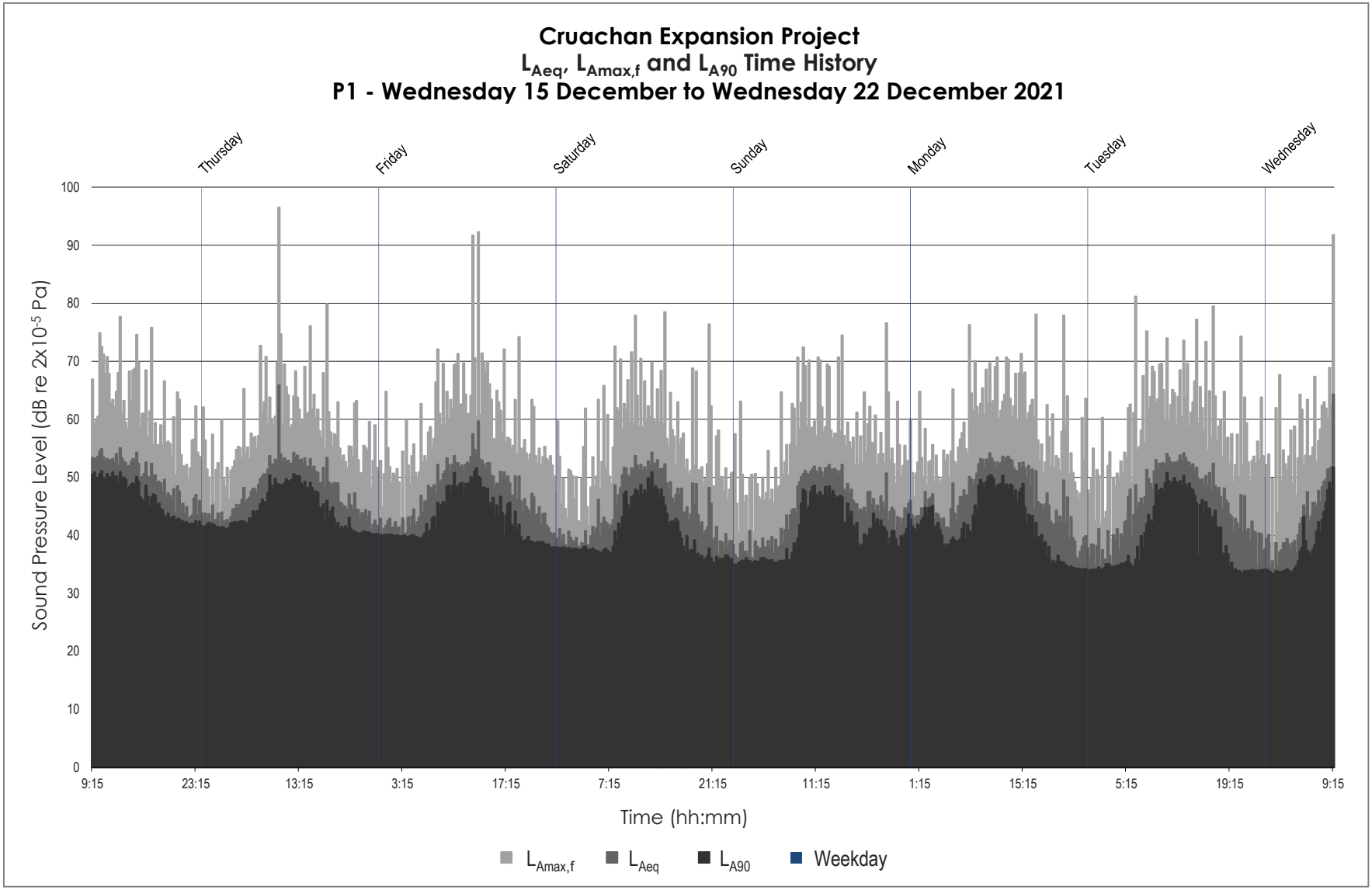
Relative Change in Sound Level	Magnitude of Change	Description of Effect
Greater than 10 dB change	Large	Noticeable and Very Disruptive Very Substantial Impact
5 to 9.9 dB change	Medium	Noticeable and Disruptive Substantial Impact
3 to 4.9 dB change	Small	Noticeable and Intrusive Moderate Impact
2.9 dB or less change	Negligible	Noticeable and Not Intrusive

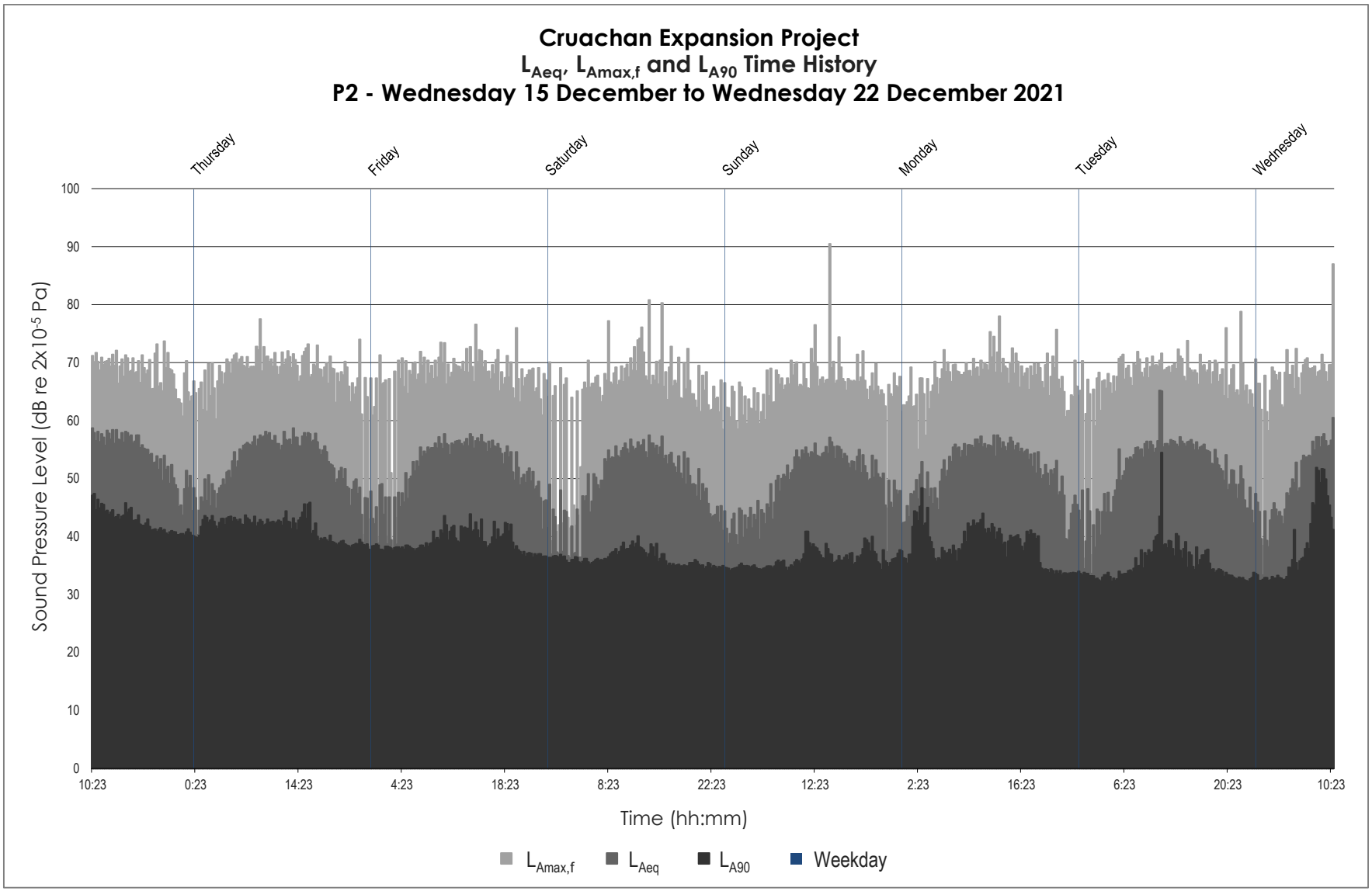
Appendix 10.3 Environmental Sound Survey Instrumentation

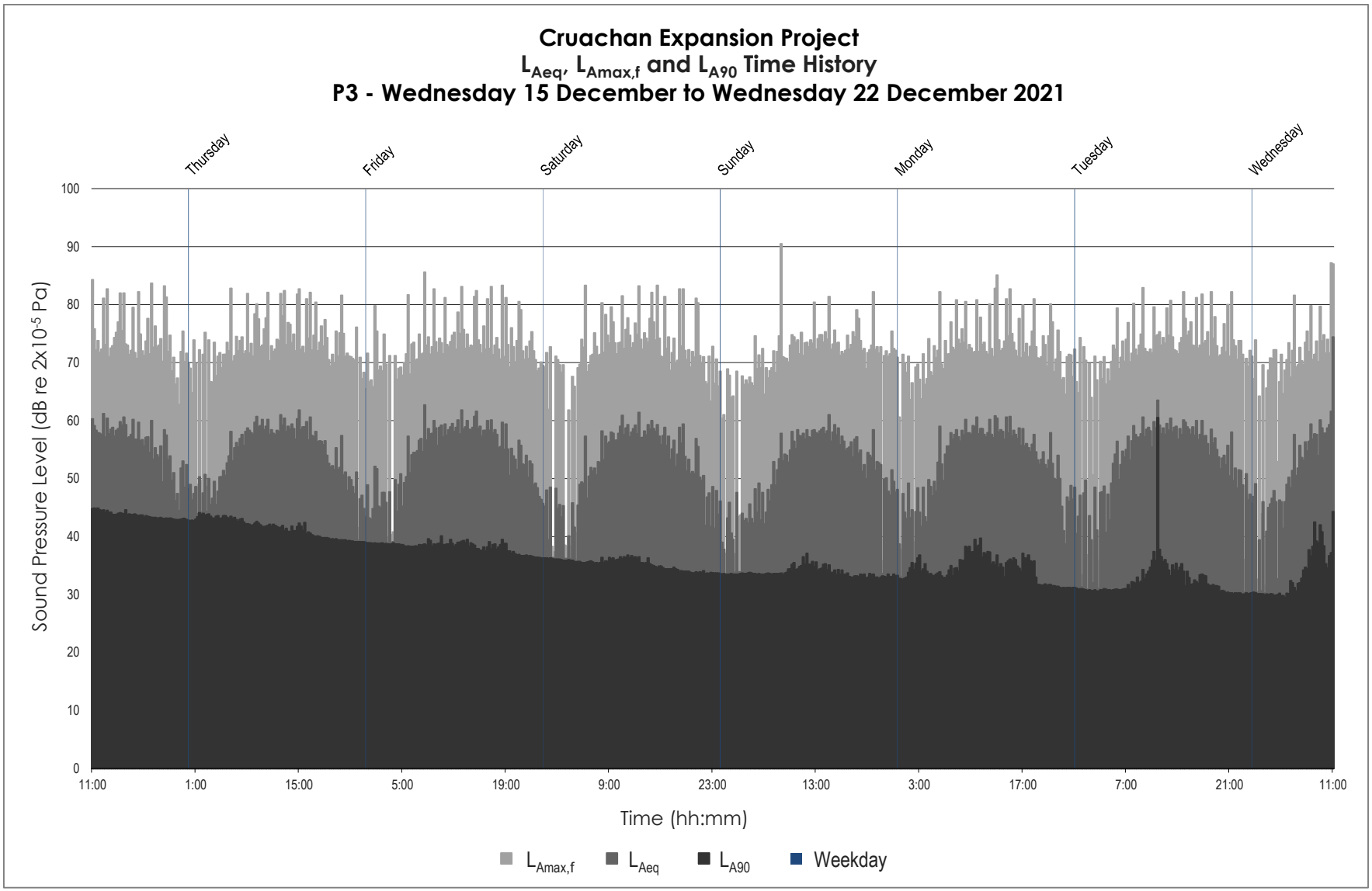
Description	Manufacturer	Type	Serial Number	Laboratory Calibration Date*
Sound Level Meter	Rion	NL-52	1043458	10/09/2021
½" Pre-Polarised microphone		UC-59	07233	
Pre-amplifier		NH-25	43487	
Sound Level Meter	Rion	NL-52	542903	06/02/2021
½" Pre-Polarised microphone		UC-59	06480	
Pre-amplifier		NH-25	42931	
Sound Level Meter	Rion	NL-52	542902	08/01/2020
½" Pre-Polarised microphone		UC-59	07374	
Pre-amplifier		NH-25	43580	
Sound Level Meter	Rion	NL-52	1043457	07/02/2021
½" Pre-Polarised microphone		UC-59	07232	
Pre-amplifier		NH-25	43486	
Sound Level Meter	Rion	NL-52	930517	08/01/2020
½" Pre-Polarised microphone		UC-59	00598	
Pre-amplifier		NH-25	00559	
Sound Level Meter	Rion	NL-52	542901	09/01/2020
½" Pre-Polarised microphone		UC-59	06478	
Pre-amplifier		NH-25	42929	
Sound Level Meter	Rion	NL-52	1043456	13/02/2021
½" Pre-Polarised microphone		UC-59	7231	
Pre-amplifier		NH-25	43485	
Sound Level Meter	Brüel & Kjær	2250	2626233	10/01/2020
½" Pre-Polarised microphone		4189	2621212	
Pre-amplifier		ZC0032	11992	
Sound Calibrator	Brüel & Kjær	4231	2619373	13/01/2021

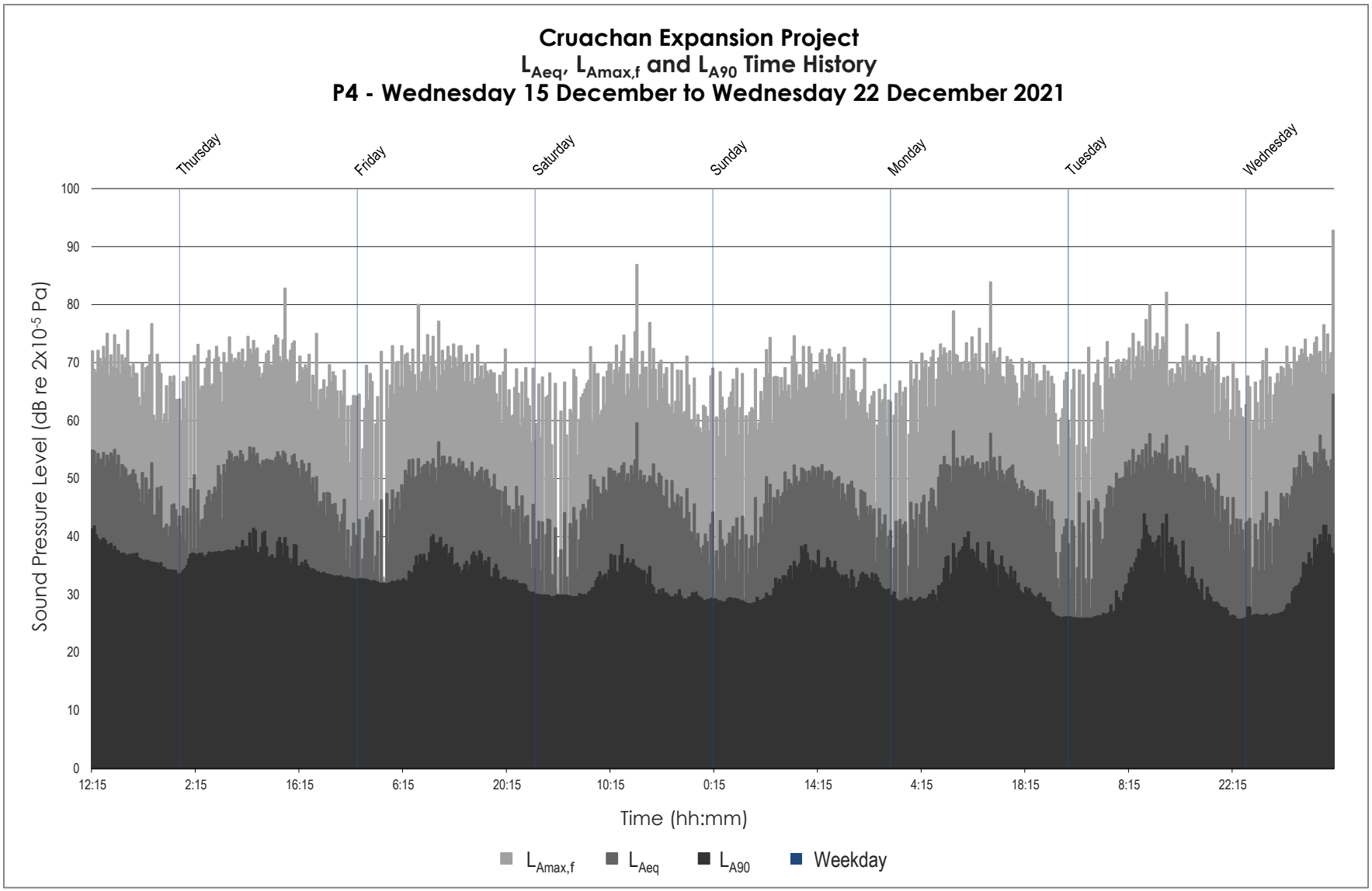
* Laboratory Calibration Dates correct at time of environmental sound survey.

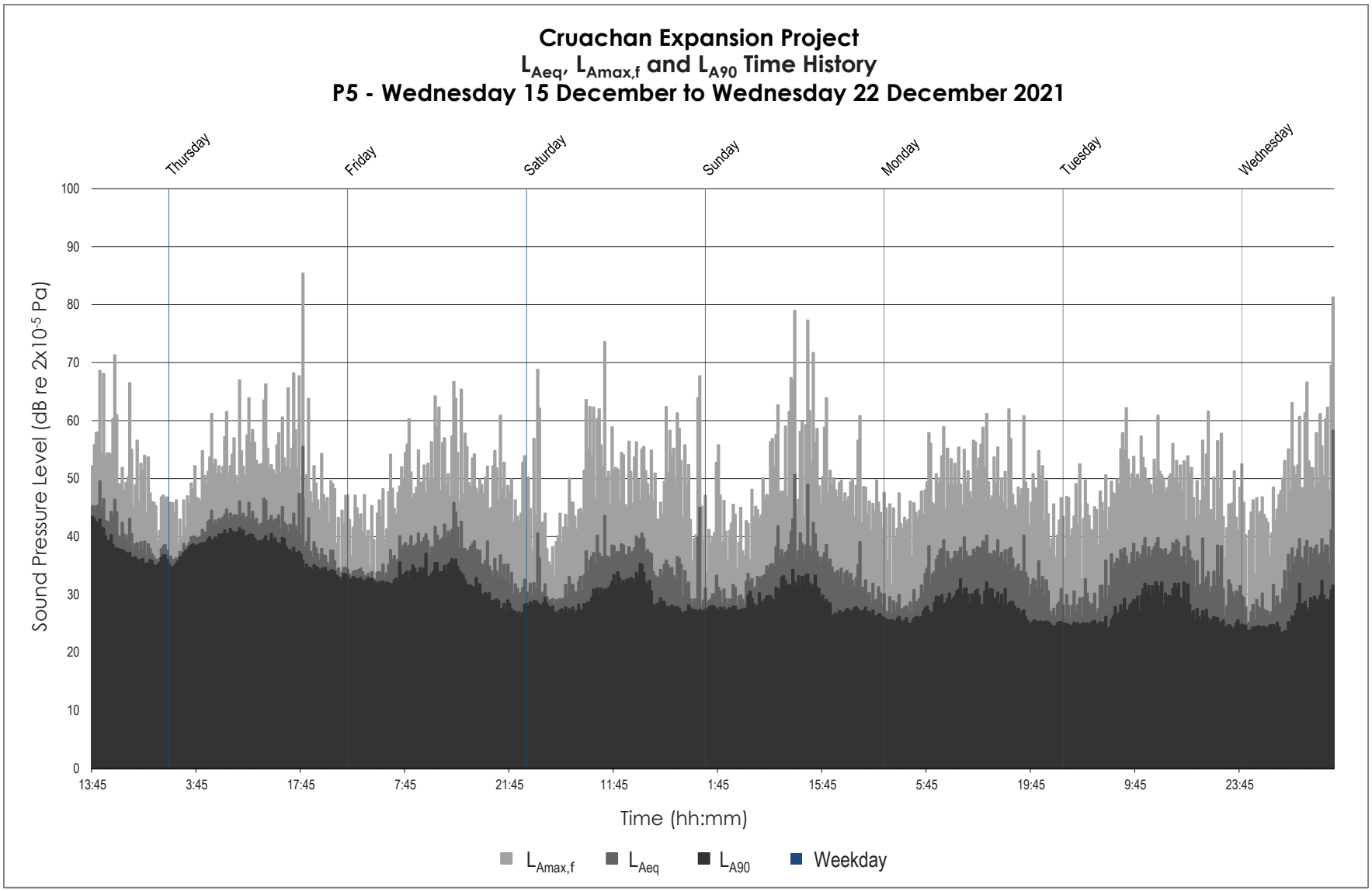
Appendix 10.4 Sound Time History Graphs

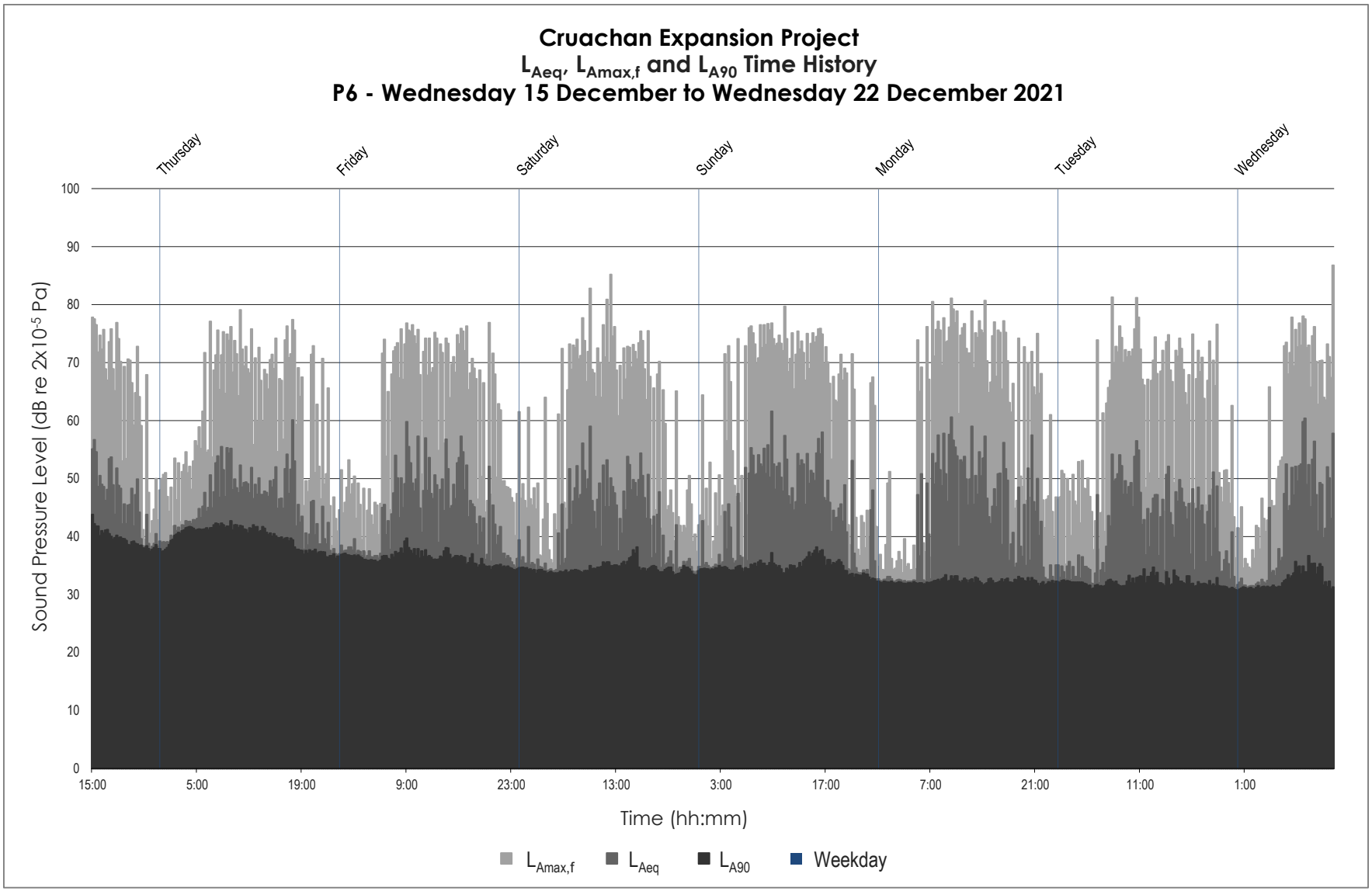

Cruachan Expansion Project
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
P1 - Wednesday 15 December to Wednesday 22 December 2021
Thursday
Friday
Saturday
Sunday
Monday
Tuesday
Wednesday
Sound Pressure Level (dB re 2x10-5 Pa)
100
90
80
70
60
50
40
30
20
10
0
9:15
23:15
13:15
3:15
17:15
7:15
21:15
11:15
1:15
15:15
5:15
19:15
9:15
Time (hh:mm)
$L_{Amax,f}$
L_{Aeq}
L_{A90}
Weekday

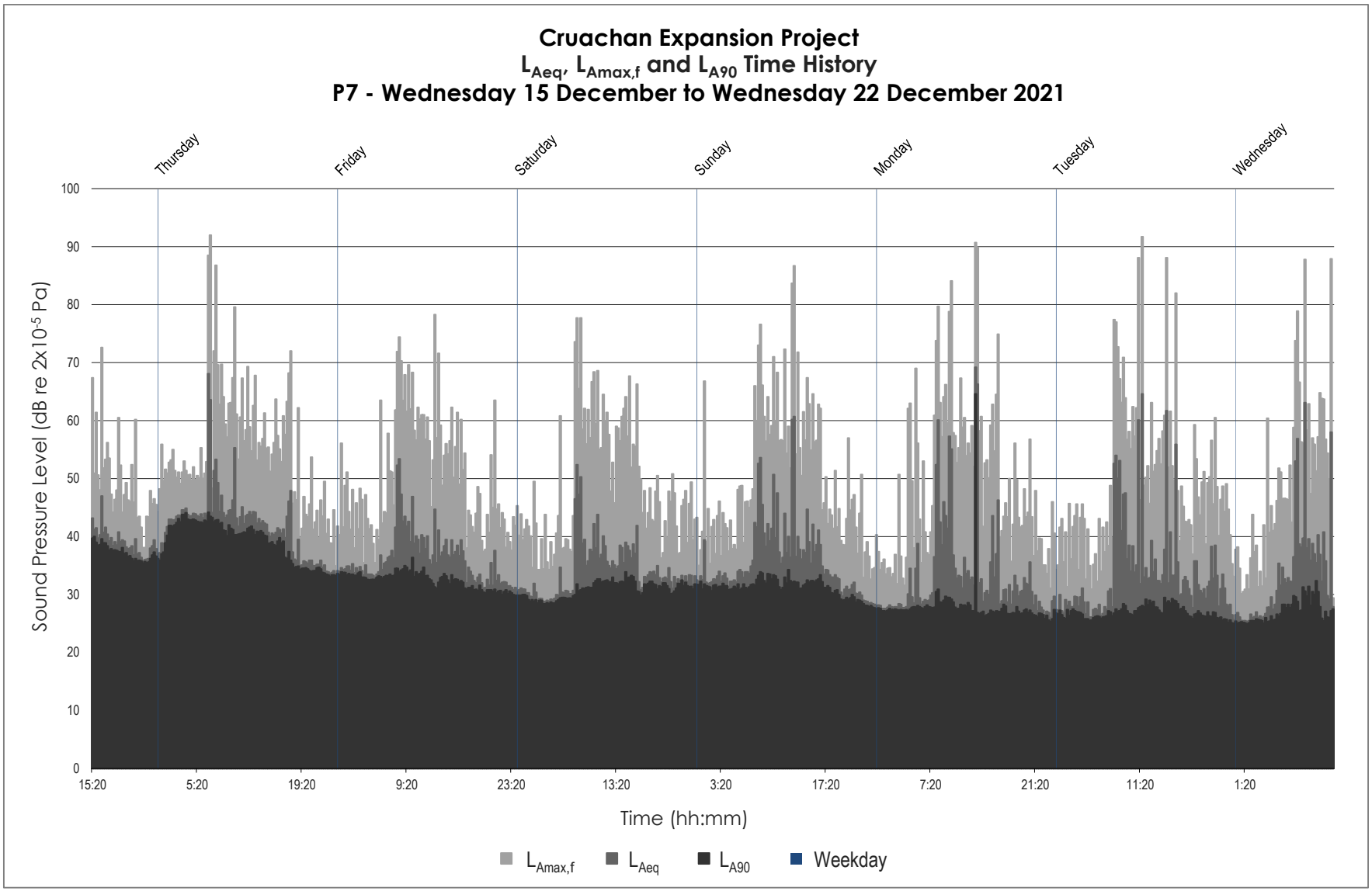

Cruachan Expansion Project
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
P2 - Wednesday 15 December to Wednesday 22 December 2021
Thursday
Friday
Saturday
Sunday
Monday
Tuesday
Wednesday
Sound Pressure Level (dB re 2x10-5 Pa)
100
90
80
70
60
50
40
30
20
10
0
10:23
0:23
14:23
4:23
18:23
8:23
22:23
12:23
2:23
16:23
6:23
20:23
10:23
Time (hh:mm)
$L_{Amax,f}$
L_{Aeq}
L_{A90}
Weekday

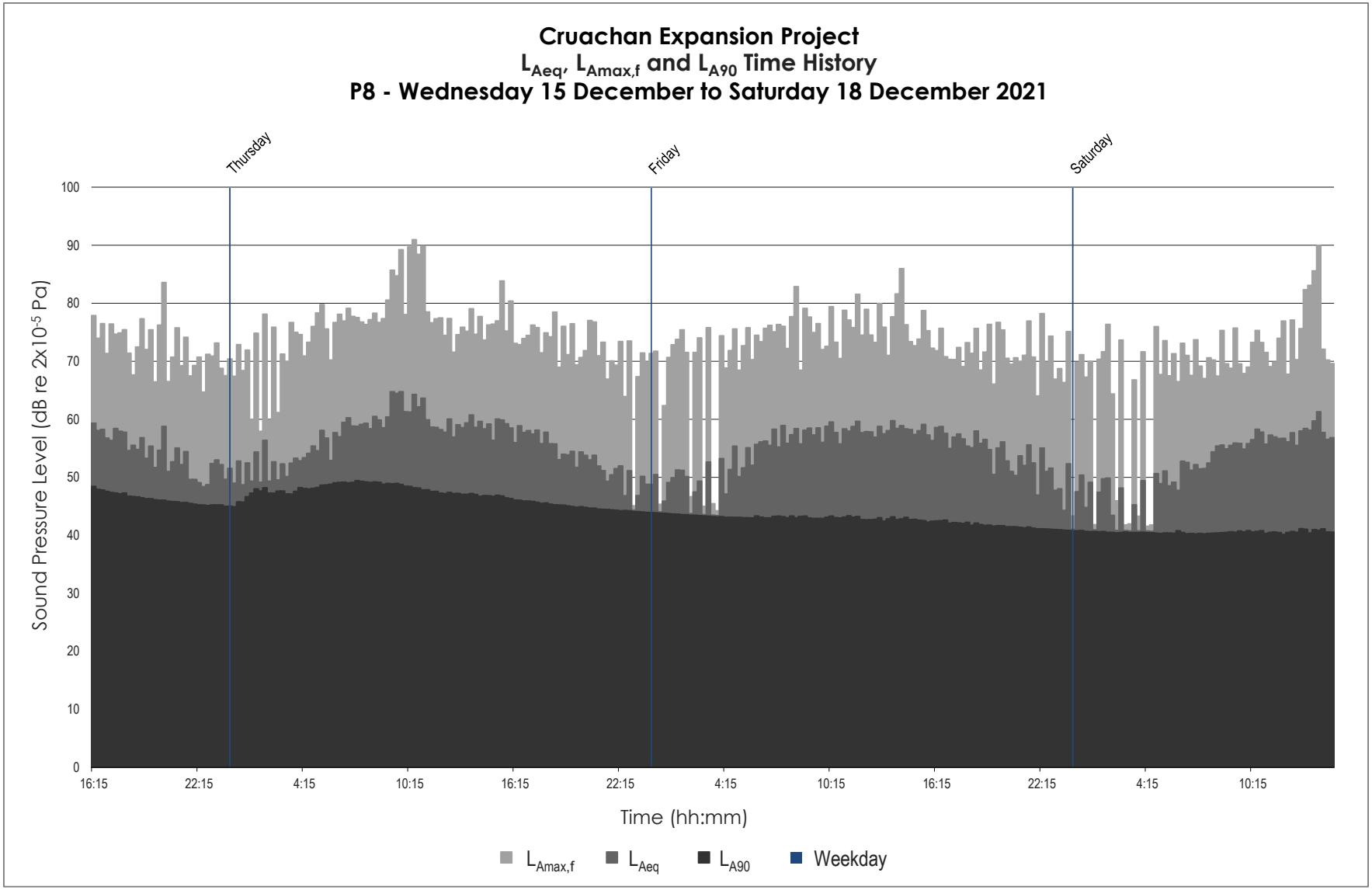

Cruachan Expansion Project
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
P3 - Wednesday 15 December to Wednesday 22 December 2021
Thursday
Friday
Saturday
Sunday
Monday
Tuesday
Wednesday
Sound Pressure Level (dB re 2x10-5 Pa)
100
90
80
70
60
50
40
30
20
10
0
11:00
1:00
15:00
5:00
19:00
9:00
23:00
13:00
3:00
17:00
7:00
21:00
11:00
Time (hh:mm)
$L_{Amax,f}$
L_{Aeq}
L_{A90}
Weekday


Cruachan Expansion Project
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
P4 - Wednesday 15 December to Wednesday 22 December 2021
Thursday
Friday
Saturday
Sunday
Monday
Tuesday
Wednesday
Sound Pressure Level (dB re 2x10-5 Pa)
100
90
80
70
60
50
40
30
20
10
0
12:15
2:15
16:15
6:15
20:15
10:15
0:15
14:15
4:15
18:15
8:15
22:15
Time (hh:mm)
$L_{Amax,f}$
L_{Aeq}
L_{A90}
Weekday


Cruachan Expansion Project
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
P5 - Wednesday 15 December to Wednesday 22 December 2021
Thursday
Friday
Saturday
Sunday
Monday
Tuesday
Wednesday
Sound Pressure Level (dB re 2x10-5 Pa)
100
90
80
70
60
50
40
30
20
10
0
13:45
3:45
17:45
7:45
21:45
11:45
1:45
15:45
5:45
19:45
9:45
23:45
Time (hh:mm)
$L_{Amax,f}$
L_{Aeq}
L_{A90}
Weekday


Cruachan Expansion Project
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
P6 - Wednesday 15 December to Wednesday 22 December 2021
Thursday
Friday
Saturday
Sunday
Monday
Tuesday
Wednesday
Sound Pressure Level (dB re 2x10-5 Pa)
100
90
80
70
60
50
40
30
20
10
0
15:00
5:00
19:00
9:00
23:00
13:00
3:00
17:00
7:00
21:00
11:00
1:00
Time (hh:mm)
$L_{Amax,f}$
L_{Aeq}
L_{A90}
Weekday


Cruachan Expansion Project
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
P7 - Wednesday 15 December to Wednesday 22 December 2021
Thursday
Friday
Saturday
Sunday
Monday
Tuesday
Wednesday
Sound Pressure Level (dB re 2x10-5 Pa)
100
90
80
70
60
50
40
30
20
10
0
15:20
5:20
19:20
9:20
23:20
13:20
3:20
17:20
7:20
21:20
11:20
1:20
Time (hh:mm)
$L_{Amax,f}$
L_{Aeq}
L_{A90}
Weekday


Cruachan Expansion Project
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
P8 - Wednesday 15 December to Saturday 18 December 2021
Thursday
Friday
Saturday
Sound Pressure Level (dB re 2x10^{-5} Pa)
100
90
80
70
60
50
40
30
20
10
0
16:15
22:15
4:15
10:15
16:15
22:15
4:15
10:15
16:15
22:15
4:15
10:15
Time (hh:mm)
$L_{Amax,f}$
L_{Aeq}
L_{A90}
Weekday

Appendix 10.5 Construction Plant and Equipment Source Sound Levels

Plant and Equipment	Power Rating, kW	BS5228:2009 Reference	Assumed On-Time (%)	Sound Pressure Level at 10 m, (dB $L_{Aeq,T}$)
Site Preparation Works				
Dozer	142	BS 5228-1:2009+A1:2014 Table C.2:1	60	75
Tracked excavator	102	BS 5228-1:2009+A1:2014 Table C.2:3	55	78
Tracked excavator (idling)	102	BS 5228-1:2009+A1:2014 Table C.2:4	25	52
Wheeled loader	209	BS 5228-1:2009+A1:2014 Table C.2:26	50	79
Dump truck (tipping fill)	306	BS 5228-1:2009+A1:2014 Table C.2:30	40	79
Dump truck	306	BS 5228-1:2009+A1:2014 Table C.2:31	40	87
Roller (rolling fill)	145	BS 5228-1:2009+A1:2014 Table C.2:37	40	79
Roller	145	BS 5228-1:2009+A1:2014 Table C.2:38	40	73
Grader	205	BS 5228-1:2009+A1:2014 Table C.6:31	30	86
Foundation Works and Substructure				
Dozer	239	BS 5228-1:2009+A1:2014 Table C.2:10	60	80
Tracked excavator	226	BS 5228-1:2009+A1:2014 Table C.2:14	55	79
Tracked excavator (idling)	125	BS 5228-1:2009+A1:2014 Table C.2:20	25	68
Wheeled loader	209	BS 5228-1:2009+A1:2014 Table C.2:26	50	79
Cement mixer truck (discharging)	N/A	BS 5228-1:2009+A1:2014 Table C.4:18	20	75
Cement mixer truck (idling)	N/A	BS 5228-1:2009+A1:2014 Table C.4:19	40	71
Poker vibrator	N/A	BS 5228-1:2009+A1:2014 Table C.4:33	40	78
Building Erection Works and Superstructure				
Dumper	81	BS 5228-1:2009+A1:2014 Table C.4:3	60	76
Large concrete mixer	167	BS 5228-1:2009+A1:2014 Table C.4:22	40	76
Wheeled mobile telescopic crane	610	BS 5228-1:2009+A1:2014 Table C.4:38	60	78
Lorry with lifting boom	50	BS 5228-1:2009+A1:2014 Table C.4:53	40	77
Tracked excavator	223	BS 5228-1:2009+A1:2014 Table C.4:63	20	77

Plant and Equipment	Power Rating, kW	BS5228:2009 Reference	Assumed On-Time (%)	Sound Pressure Level at 10 m, (dB $L_{Aeq,T}$)
Mini tracked excavator	N/A	BS 5228-1:2009+A1:2014 Table C.4:67	50	74
Circular bench saw (petrol-cutting concrete blocks)	N/A	BS 5228-1:2009+A1:2014 Table C.4:71	30	85
Hand-held circular saw (petrol-cutting concrete blocks)	3	BS 5228-1:2009+A1:2014 Table C.4:72	60	79
Diesel generator	6.5	BS 5228-1:2009+A1:2014 Table C.4:76	90	61
Underground Construction Works				
Tracked mobile drilling rig	317	BS 5228-1:2009+A1:2014 Table C.9:1	40	90
Wheeled loader	597	BS 5228-1:2009+A1:2014 Table C.9:7	20	90
Excavator mounted rock breaker	125	BS 5228-1:2009+A1:2014 Table C.9:11	40	93
Rigid dump truck	544	BS 5228-1:2009+A1:2014 Table C.9:23	20	85
Lorry	310 to 350	BS 5228-1:2009+A1:2014 Table C.9:25	20	82
Wheeled loader	320	BS 5228-1:2009+A1:2014 Table C.9:26	20	87
Mobile Telescopic Crane	315	BS 5228-1:2009+A1:2014 Table C.4:40	50	66
Road Works				
Road planer	185	BS 5228-1:2009+A1:2014 Table C.5:7	30	82
Road planer (idling)	185	BS 5228-1:2009+A1:2014 Table C.5:8	30	62
Bulldozer	250	BS 5228-1:2009+A1:2014 Table C.5:14	50	86
Articulated dump truck	194	BS 5228-1:2009+A1:2014 Table C.5:16	50	81
Road roller	95	BS 5228-1:2009+A1:2014 Table C.5:19	75	80
Asphalt paver (+ tipper lorry)	112	BS 5228-1:2009+A1:2014 Table C.5:30	50	75
Vibratory roller	95	BS 5228-1:2009+A1:2014 Table C.5:21	50	80
Vibratory roller	98	BS 5228-1:2009+A1:2014 Table C.5:20	50	75
Grader	205	BS 5228-1:2009+A1:2014 Table C.6:31	30	86
Landscaping Works				
Lorry with lifting boom	50	BS 5228-1:2009+A1:2014 Table C.4:53	40	77

Plant and Equipment	Power Rating, kW	BS5228:2009 Reference	Assumed On-Time (%)	Sound Pressure Level at 10 m, (dB $L_{Aeq,T}$)
Tracked excavator	223	BS 5228-1:2009+A1:2014 Table C.4:63	20	77
Mini tracked excavator	N/A	BS 5228-1:2009+A1:2014 Table C.4:67	50	74