

Appendix D

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Acoustic Assessments

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WEST MOKOAN SOLAR FARM PROJECT

Benalla-Yarrawonga Rd, Benalla, VIC, 3672

Operational Noise Impact Assessment

Lightsource bp

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CONTENTS

1.	Introduction	1
2.	Study Area Description	3
3.	Proposed Development	5
4.	Noise Criteria	6
4.1	Introduction	6
4.2	Relevant Zoning	6
4.3	Rural Areas: Sensitive Receivers R1 and R8	6
4.4	Criteria Summary	10
5.	Noise Assessment	11
5.1	Overview	11
5.2	Meteorology	11
5.3	Topography	11
5.4	Assumptions and Noise Source Data	11
5.5	Predicted Noise Levels	11
5.6	Noise Mitigation Options	11
5.7	Low Frequency Noise Assessment	13
5.8	Cumulative Noise Impact Assessment	14
5.9	Assessment of Reasonable and Practical Mitigation Measures	16
6.	Recommendations and Conclusion	18

APPENDICES

Appendix A	Glossary
Appendix B	Drawings
Appendix C	Tonality Assessment

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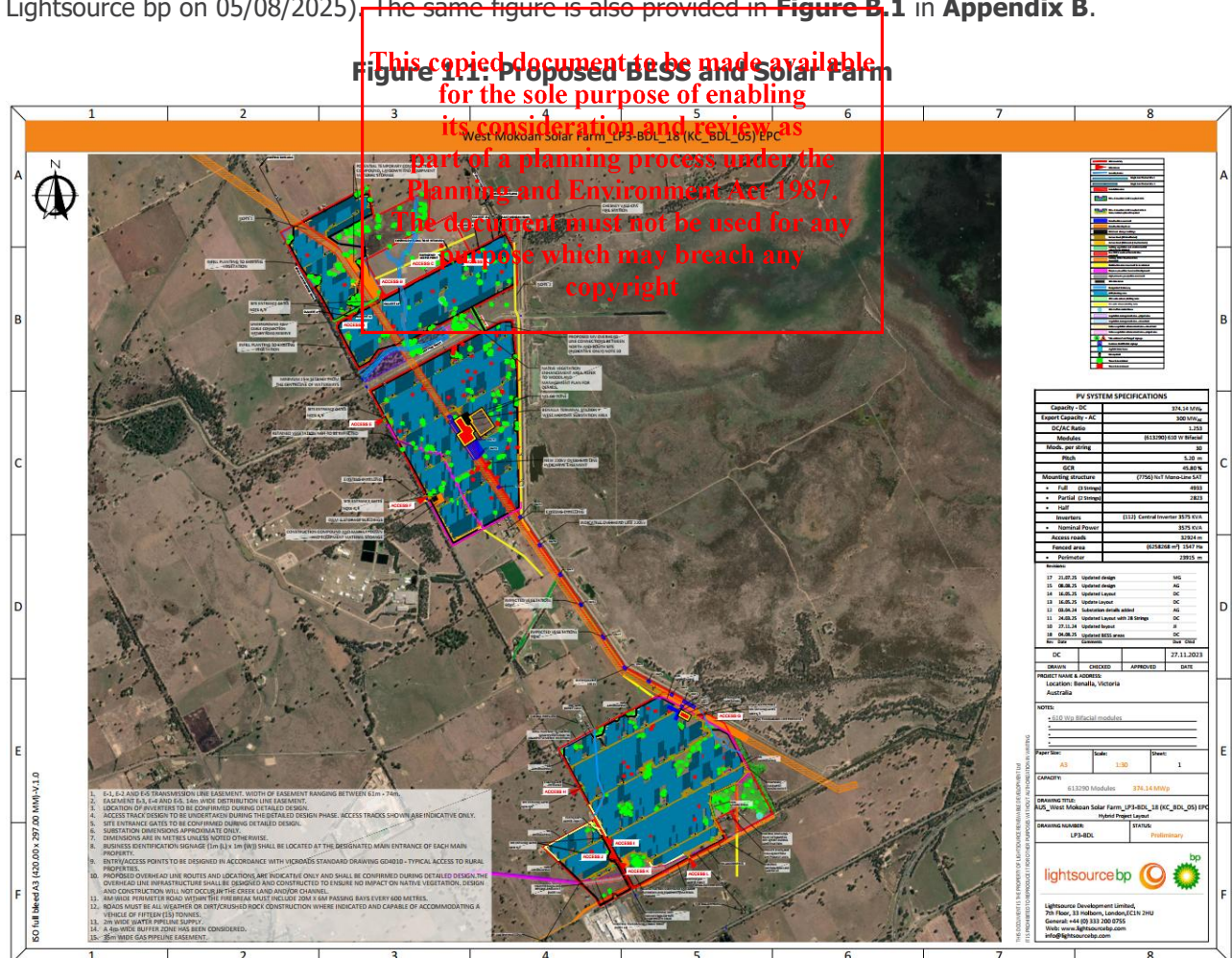
1. INTRODUCTION

Trinity Consultants Australia (Trinity) was commissioned by Lightsource bp to undertake a noise impact assessment for the proposed West Mokoan solar farm development at Benalla-Yarrowonga Rd, Benalla, VIC, 3672. The proposed solar farm will also include BESS (battery energy storage system) infrastructure. Operational noise from the solar farm component (excluding BESS) was assessed previously in Report "West Mokoan Solar Farm Operational Noise Assessment" prepared by AECOM Australia Pty Ltd on 17 September 2021.

Since completion of the original noise assessment, BESS technology has been widely commercialised and Trinity Consultants Australia prepared noise impact assessment reports with BESS, referring to reports 237401.0183.R01V02, dated 10 July 2024, 237401.0183.R02V02, dated 10 July 2024 and 237401.0183.R03V01, dated 5 August 2025. Subsequently, Lightsource bp has sought to update the noise impact assessment to incorporate the following new information and design requirements:

- Use of significantly quieter DC-DC converters.
- Minimum 4-metre setback distance between noise barriers and BESS unit
- Noise barriers designed without return sections to support fire safety requirements

The proposal is to distribute BESS stations over the solar farm area as shown in **Figure 1.1** (source: Lightsource bp on 05/08/2025). ~~The same figure is also provided in **Figure B.1** in **Appendix B**.~~



The purpose of this report is as follows:

- Describe the project with respect noise

- Outline the relevant project noise criteria.
- Predict and assess the noise emissions from the development.
- Describe noise mitigation requirements, if any.

To aid in the understanding of the terms in this report a glossary is included in **Appendix A**.

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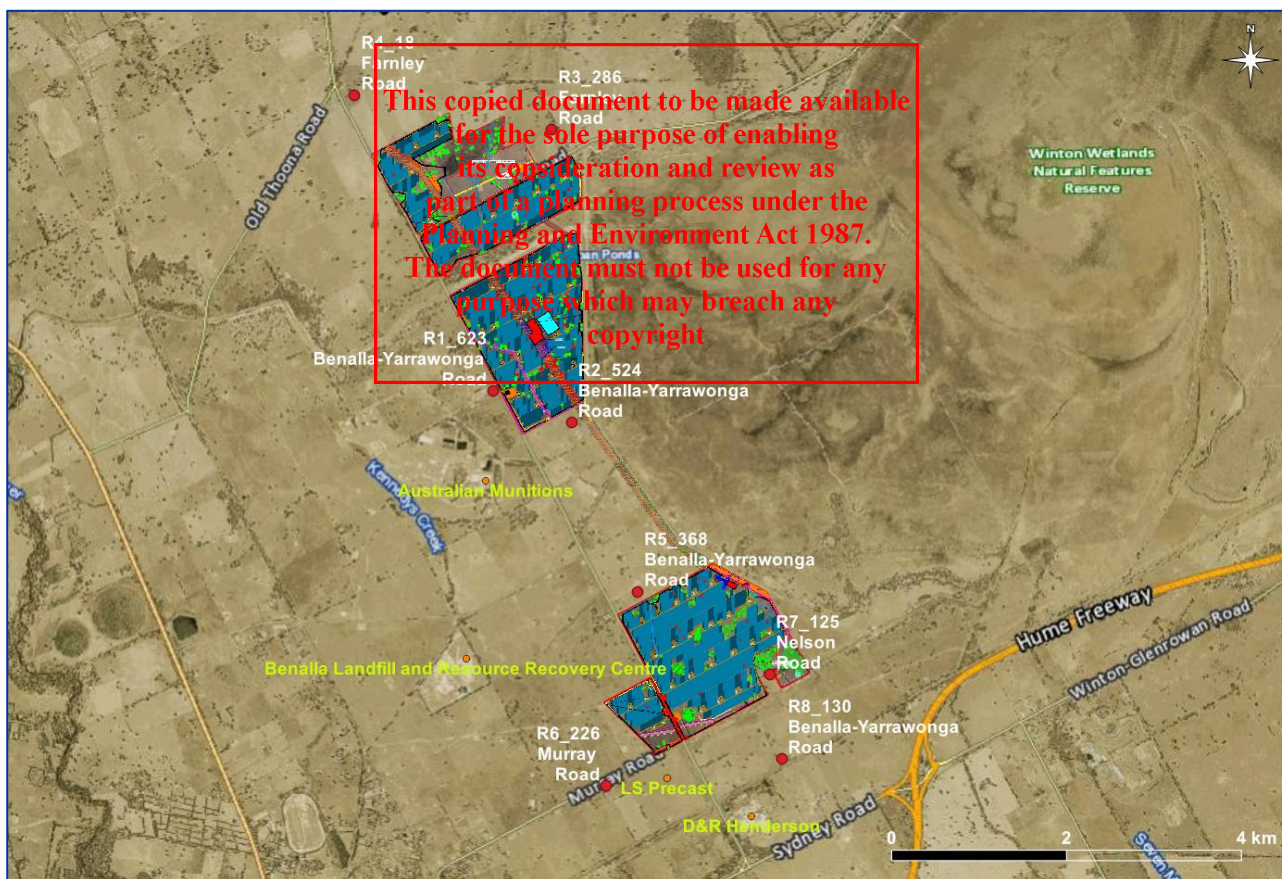
2. STUDY AREA DESCRIPTION

The proposed development is approximately ten kilometres north-east of Benalla, as shown in **Figure 2.1**. The site encompasses various parcels of land, including 892 Benalla-Yarrowonga Road in Goorambat, Benalla-Yarrowonga Road in Benalla, Crown Land, 616 Benalla-Yarrowonga Road, 51 Nelson Road, 67 Nelson Road and 284 Benalla-Yarrowonga Road in Benalla. This group of properties, collectively referred to as the subject site, is formally identified by the following lot numbers:

- Lot 1 PS625748F
- Lot 1 TP173518C
- Lot 1 TP104377
- Lot 1 LP206524H
- 98B PP2704
- Lots 2-5 LP206524H
- Lot 3 PS318659S
- Lot 4 PS318659S
- Lot 6 PS627741K
- Lot 7 PS627741K
- Lot 2 PS803108D
- Lot 3 PS715932M

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Figure 2.1: Site Location



The subject site is situated on the eastern side of Benalla-Yarrowonga Road, with frontages to Benalla-Yarrowonga Road, Lake Mokoan Road, and Nelson Road. The solar farm is divided into two portions i.e. the northern portion and the southern portion, with approximately 2,300 metres distance between. They are connected with a 220kV overhead power transmission line, which is not a noise source. The solar farm covers an approximate area of 712 hectares.

The nearest residential locations are as follows:

- (R1) 623 Benalla-Yarrowonga Road, west of the site, approximately 70 metres from the site boundary.
- (R2) 524 Benalla-Yarrowonga Road, south of the site, approximately 150 metres from the site boundary.
- (R3) 286 Farnley Road, north of the site, approximately 350 metres from the site boundary.
- (R4) 18 Farnley Road, north of the site, approximately 700 metres from the site boundary.
- (R5) 368 Benalla-Yarrowonga Road, north of the site, approximately 140 metres from the site boundary.
- (R6) 226 Murray Road, west of the site, approximately 660 metres from the site boundary.
- (R7) 125 Nelson Road, south of the site, approximately 30 metres from the site boundary.
- (R8) 130 Benalla-Yarrowonga Road, south of the site, approximately 720 metres from the site boundary.

There are three additional noise-sensitive receivers (houses) located between the northern and southern portions of the proposed solar farm (i.e. between receivers R2 and R5). However, the distance from these receivers to the solar farm is substantial, exceeding 900 meters. Additionally, both the solar farm and these receivers fall within the same zoning classification, which does not require any distance adjustment to the noise criteria. Therefore, it was deemed that if the predicted noise levels from the proposed solar farm operations comply with the noise criteria at the closer receivers R2 and R5, the noise levels at the intermediate receivers would also comply. As a result, these additional noise-sensitive receivers were not considered further in this assessment.

It should be noted that multiple industrial premises operate in the surrounding area, as shown in **Figure 2.1**. These are:

- Australian Munitions, a defence facility.
- Benalla Landfill and Resource Recovery Centre, a landfill.
- LS Precast, a precast concrete element factory.
- D&R Henderson, a softwood timber and particleboard manufacturer.

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3. PROPOSED DEVELOPMENT

The development will include the following elements as noise sources:

- 56 of BESS stations. Each BESS station includes:
 - 4 of container type BESS Unit
 - 2 of Aux. MV Transformer
 - 16 of DC converters
 - 1 of PCU (power conversion unit)
 - Each PCU includes a transformer and two inverters
 - The main noise sources are a cooling system associated with each BESS unit (battery cooling system), converters and inverters.
- 3 of HV transformers.
- Approx. 7,760 of tracker motors for solar panels
 - Tracker motors are not considered a significant noise source (but have still been included in the noise modelling due the large volume of sources).

Construction works will be required for all supporting infrastructure and amenities, including concrete finished floor for each BESS stations.

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4. NOISE CRITERIA

4.1 Introduction

The environmental obligations with respect to noise for the operation of the facility are found in the Environmental Protection Regulations 2021 S.R. No. 47/2021. Part 5.3 of the regulation presents noise requirements. For the purpose of the planning application, the Noise Protocol for deriving noise criteria as referred to in Paragraph 113 of the regulation is particularly relevant to this assessment. The Noise Protocol refers to *EPA Victoria Publication 1826.4 Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*. This protocol is adopted in Victoria and aims to protect people from the effects of commercial, industrial and trade noise.

Noise limits are established by first defining of type of 'Receiving Zone' and 'Generating Zone'. 'Receiving Zone' and 'Generating Zone' land uses are defined in the Annex A and Annex B of the Noise Protocol. 'Receiving Zone' and 'Generating Zone' land uses must be determined using the relevant local planning scheme zoning.

The Noise Protocol also defines different limits based on whether the sensitive receptor is in a rural area or a major urban area (which is land within the urban growth boundary). Furthermore, noise from the source under consideration is measured or predicted to determine its impact over a continuous 30-minute period (using the L_{Aeq} parameter). Adjustments to the noise level are then applied to account for the effects of duration, tonality, intermittency and impulsiveness. The resultant noise level is called the Effective Noise Level.

The following sections present the derivation of noise criteria for the different receptor groups surrounding the development site.

4.2 Relevant Zoning

Noise limits for rural areas are established by first defining of type of 'Receiving Zone' and 'Generating Zone'. 'Generating Zone' land uses are defined in the Annex B of the Noise Protocol, and 'Generating Zone' land use must be determined using the relevant local planning scheme zoning.

The proposed solar farm development is located within a Farming Zone (FZ) (Generating Zone). The nearest noise sensitive receivers outlined in **Section 2**, are located in the following zones:

- (R1) 623 Benalla-Yarrowonga Road: Special Use Zone (SUZ1) (Defence Industries Benalla)
- (R2) 524 Benalla-Yarrowonga Road: Farming Zone (FZ)
- (R3) 286 Farnley Road: Farming Zone (FZ)
- (R4) 18 Farnley Road: Farming Zone (FZ)
- (R5) 368 Benalla-Yarrowonga Road: Farming Zone (FZ)
- (R6) 226 Murray Road: Industrial 1 Zone (IN1Z)
- (R7) 125 Nelson Road: Farming Zone (FZ)
- (R8) 130 Benalla-Yarrowonga Road: Farming Zone (FZ)

Noise limits for the above noise sensitive receptors are outlined in the following chapters.

4.3 Rural Areas: Sensitive Receivers R1 and R8

Locations of the nearest noise sensitive receivers to the proposed solar farm development and receiving zones as defined in the previous section are shown in **Figure 4.1**. It should be noted that the subject site is deemed not to be a background-relevant area as there is no nearby freeway or highway with a significant vehicle traffic or any other significant noise source. Background-relevant area is defined in EPA Victoria Publication 1826.4 Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues as follows:

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“Background-relevant area’ means a noise-sensitive area where background levels may be higher than usual for a rural area. This includes areas where freeway or highway traffic is a significant audible background noise source. It also includes coastal areas, where representative background levels are elevated by surf.”

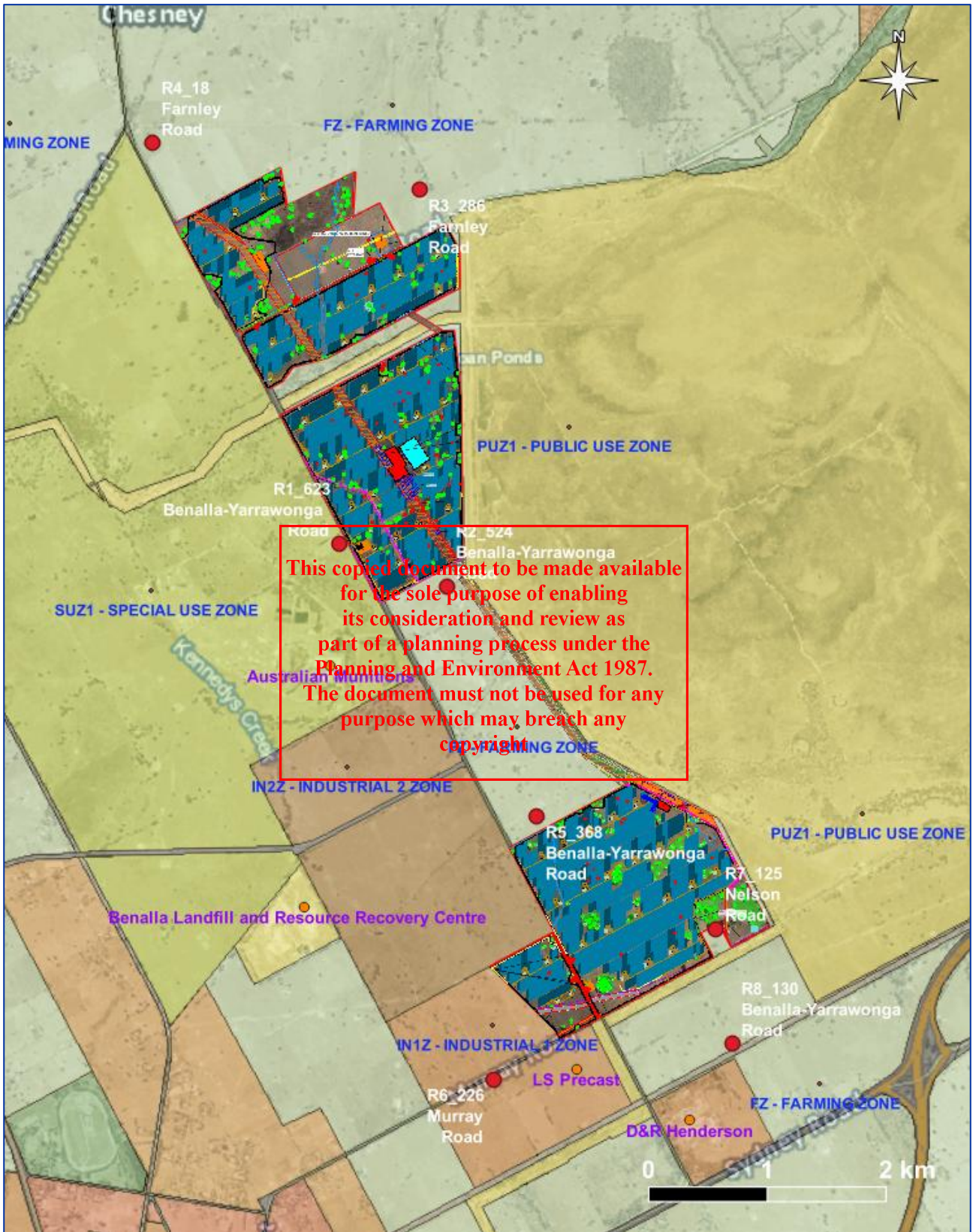
According to “Annex B Zone levels for rural area method for commercial, industrial and trade premises - Table B.1”, relevant Zone Criteria for noise sensitive receivers are presented in **Table 4.1**. After determining the Zone Criteria, if the noise generator and receiver are not located in land use zones with the same zone code, 1 dB is subtracted from the Zone Criteria for every 100 metres of source zone boundary-to-receiver distance. This rule also applies if the noise generator and receiver are separated by an intervening zone (if they are in the same zone as each other). The total dB subtracted cannot be higher than 9 dB. The Distance Adjusted Zone Criteria is then compared to existing background levels plus an allowable increment to derive the noise criteria. Where considering an area not deemed to be in a background relevant area, the distance adjusted levels are compared to base noise levels specified in Victorian Environmental Protection Regulations 2021 – Reg 118 Clause 2. The following rules for establishing noise limits are:

- for the day period, the noise limit is the greater of:
 - the distance-adjusted level or base noise level; or
 - the day background level plus 8 dB (applicable for background relevant areas).
- for the evening period, the noise limit is the greater of:
 - the distance-adjusted level or base noise level; or
 - the evening background level plus 5 dB (applicable for background relevant areas).
- for the night period, the noise limit
 - is the greater of –
 - the distance-adjusted level or base noise level; or
 - the night background level plus 5 dB (applicable for background relevant areas).
 - must not be greater than 55 dBA.

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Figure 4.1: Noise Sensitive Receivers and Receiving Zones



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Table 4.1 presents the noise criteria derived for the noise sensitive receivers R1 to R8 based on zoning. It should be noted that the closest portion of proposed solar farm to individual receivers was considered to drive noise criteria.

Table 4.1: Noise Criteria for Sensitive Receptor R1 to R8

Period	Zone Criteria (L_{eq} dBA)	Distance Adjusted Noise Criteria (L_{eq} dBA)	Base Noise Limits (L_{eq} dBA)	Noise Criteria (L_{eq} dBA)
Sensitive Receptor R1: Less than 100m from the boundary of FZ, 0 dB distance adjustment				
Day	54	54	45	54
Evening	49	49	37	49
Night	44	44	32	44
Sensitive Receptor R2 to R4: Both "Generating Zone" and "Receiving Zone" are in the same zone of FZ				
Day	46	46	45	46
Evening	41	41	37	41
Night	36	36	32	36
Sensitive Receptor R5 : Both "Generating Zone" and "Receiving Zone" are in the same zone of FZ				
Day	46	46	45	46
Evening	41	41	37	41
Night	36	36	32	36
Sensitive Receptor R6: Both "Generating Zone" and "Receiving Zone" are in the same zone of IN1Z				
Day	58	58	45	58
Evening	53	53	37	53
Night	48	48	32	48
Sensitive Receptor R7: Both "Generating Zone" and "Receiving Zone" are in the same zone of FZ				
Day	46	46	45	46
Evening	41	41	37	41
Night	36	36	32	36
Sensitive Receptor R8: Both "Generating Zone" and "Receiving Zone" are in the same zone of FZ Intervening zone: PUZ1, 720m to the site, therefore -7 dB distance adjustment				
Day	46	39	45	45
Evening	41	34	37	37
Night	36	29	32	32

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4.4 Criteria Summary

The adopted noise criteria are summarized in **Table 4.2**.

Table 4.2: Noise Limits

Noise Sensitive Receiver	Noise Criteria (L_{eq} dBA)		
	Day	Evening	Night
R1 – 623 Benalla-Yarrowonga Road	54	49	44
R2 – 524 Benalla-Yarrowonga Road	46	41	36
R3 – 286 Farnley Road	46	41	36
R4 – 18 Farnley Road	46	41	36
R6 - 368 Benalla-Yarrowonga Road	46	41	36
R7 - 226 Murray Road	58	53	48
R8 - 125 Nelson Road	46	41	36
R9 - 130 Benalla-Yarrowonga Road	45	37	32

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5. NOISE ASSESSMENT

5.1 Overview

For the purposes of assessing impacts associated with noise emissions from the proposed development, noise modelling of key noise sources from the subject site was completed using a proprietary computer modelling software SoundPLAN 8.2.

SoundPLAN 8.2 incorporates the influence of meteorology, existing terrain, ground type and air absorption in addition to source characteristics to predict noise impacts at receiver locations. The prediction method incorporated into SoundPLAN 8.2 is CONCAWE.

The following sections discuss the inputs, assumptions, and results of the noise modelling.

5.2 Meteorology

All predictions have been undertaken in accordance with CONCAWE methodology. For the purpose of the assessment, calm and noise-enhancing conditions have been considered as follows:

- Calm:
 - Calm & isothermal conditions (acoustically neutral) – no wind and no temperature inversion.
- Noise-enhancing:
 - Slight to gentle breeze – D class with 3 m/s wind velocity at 10m from ground level between each noise source and each noise receiver. Wind direction was based on wind travelling from the source to the receiver.

5.3 Topography

5 metre DEM data for the area surrounding the development was obtained from the VIC Government Vicmap. It is assumed that proposed equipment is located on natural ground topography.

5.4 Assumptions and Noise Source Data

Noise modelling was conservatively based on all noise sources within the proposed solar farm site operating continuously and simultaneously at all times. With regard to the BESS stations, which include batteries, transformers, inverters and converters, these will be discharged simultaneously to minimize overall system degradation, resulting in simultaneous noise generation. However, it should be noted that, in reality, noise from the BESS stations is not expected to persist continuously since the system may remain idle for up to 10 hours per day, depending on the daily operational profile.

Furthermore, depending on the specific daily operational profile, the occurrence of noise generated by the BESS stations may or may not coincide with the night hours, which is the time period subject to the most stringent noise criteria. It is important to consider this operational context when drawing conclusions on potential noise impacts; nonetheless, it was conservatively assumed that noise emissions coincide with night hours.

Table 5.1 presents noise source data information provided by Lightsource bp. Predicted 1/3 octave noise levels at noise sensitive receiver locations were reviewed to determine tonal and low frequency noise impacts in accordance with *EPA Victoria State Government Publication 1826.4 Noise Limits and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues* and *EPA Victoria State Government Publication 1996 Noise Guidelines : Assessing Low Frequency Noise*, respectively. Regarding intermittency and impulsiveness adjustments, no modifying factor is considered necessary as it is expected that noise from the site would be continuous when BESS stations are in use.

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It should be noted that while transformers, converters and inverters were modelled as point sources, BESS units were modelled as 3D building noise sources (with vertical and horizontal facades) based on information given by Lightsource bp. Tracker motors were modelled as an area source covering solar farm area.

Furthermore, due to ambient temperature differences between day and night times, different sound power levels have been adopted for inverters, converters and transformers according to the time of day.

With regards to modifying factors, the following have been considered based on the EPA Victoria guidelines:

- Tonal noise:
 - Given that 1/3 octave noise spectrum for noise sources is available, a plus 2 dB correction has been applied to predicted noise levels at receiver locations, where necessary, in accordance with the tonality adjustment methodology outlined in EPA Victoria Publication 1997, June 2021. Tonality assessment steps in accordance with EPA Victoria Publication 1997, June 2021 are given **Appendix C**.
- Intermittent/Impulsive noise:
 - No modifying factor is considered necessary. With the proposed power and energy storage systems, it is expected that noise from the site would be continuous.

According to EPA Victoria Publication 1996, June 2021, low frequency noise impact should also be reviewed based on low frequency noise spectrum between 10 Hz to 160 Hz. No low frequency noise exceedance was predicted. Low frequency noise assessment is further detailed in **Section 5.7**.

As the noise criteria for residential areas is based on a 30-minute period, the modelling assumes that all activity is occurring continuously over a 30-minute period.

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Table 5.1: Modelled Noise Source Data – 1/3 Octave Sound Power Levels

Equipment	Sound Power Level (SWL Linear) at 1/3 Frequency Spectra (Hz)																						Total	Ref.	Modelled Height			
	50	63	80	100	125	160	200	250	315	400	500	630	800	1.0k	1.25k	1.6k	2.0k	2.5k	3.15k	4.0k	5.0k	6.3k				8.0k	10.0k	Lin
BESS Chiller Fan	68	78	67	68	69	71	72	70	72	71	73	69	72	70	70	70	66	66	69	69	71	67	58	59	84	81	LSbp	- ^a
BESS Chiller Outtake	68	75	64	67	68	70	71	70	71	69	71	70	70	68	70	67	62	62	63	63	60	64	58	57	82	78	LSbp	- ^a
BESS Other Surfaces	56	57	51	51	50	51	52	51	51	49	50	51	48	48	50	47	42	41	44	43	40	43	37	42	64	58	LSbp	- ^a
Inverter (day)	85	82	81	89	83	85	82	82	84	81	81	81	80	78	80	77	76	76	82	71	69	73	66	65	95	90	LSbp	2m
Inverter (evening and night)	81	75	75	83	74	72	75	81	75	76	72	72	71	69	69	67	66	70	78	61	58	68	60	61	89	83	LSbp	2m
DC Converter (day)	55	54	53	68	67	63	67	64	66	70	77	71	73	72	69	69	68	68	68	66	63	61	58	55	83	81	LSbp	1.5m
DC Converter (evening and night)	55	54	53	50	65	61	66	62	66	69	67	69	67	66	66	63	62	62	62	59	56	53	42	40	77	75	LSbp	1.5m
LV/MV Transformer	40	44	44	64	44	40	59	46	57	58	53	49	42	42	41	35	33	31	29	25	26	29	26	26	67	58	LSbp	2m
Aux MVT	43	47	47	67	47	43	62	49	60	61	56	52	45	45	44	38	36	34	32	28	29	32	29	29	70	61	LSbp	2m
MV/HV Transformer (day)	68	72	72	92	72	68	87	74	85	86	81	77	70	70	69	63	61	59	57	53	54	57	54	54	95	86	LSbp	2m
MV/HV Transformer (evening and night)	65	69	69	89	69	65	84	71	82	83	78	74	67	67	66	60	58	56	54	50	51	54	51	51	92	83	LSbp	2m
Tracker Motors ^b	-	-	-	-	-	-	-	-	-	93	93	93	-	-	-	-	-	-	-	-	-	-	-	-	98	95	LSbp	1.5m

LSbp : Lightsource bp

^a BESS container modelled as 3D noise emitting source, 2.4m x 2.9m x 6.1m

^b Tabulated values represent $L_{Aeq,30min}$ equivalent sound power level of all tracker motors (combined). For modelling purpose based on advice from Lightsource bp on 4th August 2025, it is assumed that tracker motors work 20 seconds every 30 minutes, during day time period only.

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5.5 Predicted Noise Levels

As discussed in **Section 5.4**, BESS units as well as all other noise sources are assumed to be running 24/7. It should be noted that the night time limit is the most stringent limit and, furthermore, noise-enhancing adverse weather conditions are assumed to occur during all time periods.

Predicted noise levels, including modifying factors as previously outlined, at noise sensitive receivers are given in **Table 5.2** below. Predicted 1/3 spectrum noise levels and calculation steps for tonality correction in accordance with EPA Victoria Publication 1997, June 2021, are also given in **Table C.1** and **Table C.2**, in **Appendix C**, for calm and adverse weather conditions, respectively.

Exceedances of up to 4 dBA have been predicted at two of eight residential receivers, R5 and R7, under downwind weather conditions. Under neutral weather conditions, no exceedance was predicted.

The dominant noise sources were identified as inverters and converters¹. Furthermore, the least dominant noise sources are transformers and tracking motors. Therefore, the noise mitigation strategies outlined in following chapters mostly focus on converters and inverters.

Table 5.2: Predicted Noise Levels

Predicted levels including +2 dBA tonality correction are underlined.

Predicted exceedances are marked with **bold red**.

Receiver	Noise Criteria (L _{eq} dBA)			Predicted (L _{eq} dBA) Calm Weather Condition			Predicted (L _{eq} dBA) Downwind Weather Condition		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
R1	54	49	<u>41</u>	<u>41</u>	<u>36</u>	<u>36</u>	46	<u>41</u>	<u>41</u>
R2	46	41	<u>36</u>	<u>36</u>	<u>25</u>	<u>25</u>	41	<u>35</u>	<u>35</u>
R3	46	41	<u>36</u>	<u>30</u>	<u>25</u>	<u>25</u>	36	<u>31</u>	<u>31</u>
R4	46	41	<u>36</u>	<u>25</u>	<u>18</u>	<u>18</u>	31	24	24
R5	46	41	<u>36</u>	<u>40</u>	<u>35</u>	<u>35</u>	45	<u>40</u>	40
R6	58	53	48	<u>26</u>	<u>20</u>	<u>20</u>	32	<u>26</u>	<u>26</u>
R7	46	41	36	<u>39</u>	<u>33</u>	<u>33</u>	44	<u>38</u>	38
R8	45	37	32	24	<u>20</u>	<u>20</u>	30	<u>26</u>	<u>26</u>

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5.6 Noise Mitigation Options

Further modelling has been undertaken to identify reasonable and practicable noise mitigation measures for the site. The approach for noise mitigation is outlined below:

- First level: Controlling noise at the source by choosing quieter equipment, changing operational methodology, reducing the number of noise sources etc.
 - After a comprehensive review of readily available equipment, Lightsource bp have chosen quieter inverters and converters. The Lightsource bp design team also optimised lower fan speeds for nighttime operations where possible, taking into account the lower ambient temperatures at night.
- Second level: Controlling the transmission of noise with noise barriers, acoustic louvres, relocating noise sources etc.
 - 4 m noise barriers were modelled at 9 of the BESS stations, primarily to shield converters as these are the dominant noise sources. In addition to noise barriers, 3 of these BESS stations were rotated to maximise shielding from the noise barriers. Noise barriers are more effective if they are placed

¹ Converters are not the components within BESS stations that produce the highest individual sound power levels. However, since each station contains 16 converters, their cumulative noise is the most dominant overall.

close to a noise sources, and directly between a noise source and sensitive receivers. Therefore, some of the BESS stations have been rotated to bring noise barriers directly between converters and the closest noise-sensitive receiver

- Locations and extents of noise barriers are shown in **Drawing B.1** in **Appendix B**.

Predicted noise levels, including +2 dBA modifying factor for tonality where necessary, at noise sensitive receivers with the Level 1 and Level 2 mitigation in place are given in **Table 5.3** and **Table 5.4**. Predicted 1/3 spectrum noise levels and calculation steps for tonality correction in accordance with EPA Victoria Publication 1997, June 2021, are also given in **Table C.3** and **Table C.4**, in **Appendix C**, for calm and adverse weather conditions, respectively.

With 4 m noise barriers, full compliance at noise sensitive receivers, under both neutral and downwind (adverse) weather conditions, was predicted. As highlighted previously, assuming all noise sources, especially inverters and converters, working full capacity during the nighttime period and adverse downwind weather conditions is a very conservative assessment approach. Even with these conservative assumptions, no exceedance was predicted.

The locations of proposed noise barriers are shown in **Drawing B.1**, in **Appendix B**. **Drawing B.1** also identifies which BESS stations have been rotated.

Table 5.3: Predicted Noise Levels with Mitigation – Calm Weather Condition

Predicted levels including +2 dBA tonality correction are underlined.

Receiver	Noise Criteria (L _{eq} dBA)			Predicted (L _{eq} dBA) Calm Weather Condition			Difference (Predicted minus Criteria)		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
R1	54	49	44	<u>41</u>	<u>36</u>	<u>36</u>	-13	-13	-8
R2	46	41	36	<u>35</u>	<u>29</u>	<u>29</u>	-11	-12	-7
R3	46	41	36	<u>30</u>	<u>25</u>	<u>25</u>	-16	-16	-11
R4	46	41	36	<u>25</u>	<u>19</u>	<u>19</u>	-21	-23	-18
R5	46	41	36	<u>35</u>	<u>28</u>	<u>28</u>	-11	-13	-8
R6	58	53	48	<u>26</u>	<u>21</u>	<u>21</u>	-32	-33	-28
R7	46	41	36	<u>36</u>	<u>30</u>	<u>30</u>	-10	-11	-6
R8	45	37	32	24	<u>19</u>	<u>19</u>	-21	-18	-13

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Table 5.4: Predicted Noise Levels with Mitigation – Adverse Weather Condition

Predicted levels including +2 dBA tonality correction are underlined.

Receiver	Noise Criteria (L _{eq} dBA)			Predicted (L _{eq} dBA) Adverse Weather Condition			Difference (Predicted minus Criteria)		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
R1	54	49	44	<u>46</u>	<u>41</u>	<u>41</u>	-8	-8	-3
R2	46	41	36	<u>41</u>	<u>35</u>	<u>35</u>	-5	-6	-1
R3	46	41	36	<u>36</u>	<u>31</u>	<u>31</u>	-10	-10	-5
R4	46	41	36	<u>31</u>	24	24	-15	-17	-12
R5	46	41	36	<u>41</u>	34	34	-5	-7	-2
R6	58	53	48	<u>32</u>	<u>26</u>	<u>26</u>	-26	-27	-22
R7	46	41	36	<u>41</u>	<u>36</u>	<u>36</u>	-5	-5	-0
R8	45	37	32	30	<u>25</u>	<u>25</u>	-15	-12	-7

In this assessment, it is assumed that the proposed equipment, i.e. batteries, inverters, converters and transformers, will not cause any significant vibration on the proposed noise barriers. During subsequent design phases, the proposed noise barriers should be reviewed further taking into consideration:

- Reverberant noise levels between the equipment and noise barriers (where they are located in close proximity). Absorptive lining on barriers may need to be considered to prevent a build-up of noise on the source side of the barrier.
- The possibility of structure born vibration associated with noise barriers, noting that on-site noise sources can potentially turn noise barriers into additional noise sources.

Furthermore, an acoustic barrier is defined as a solid, gap free barrier with a minimum wall mass density of 12.5kg/m².

5.7 Low Frequency Noise Assessment

Low frequency noise can be described as rumbling or droning noise. It can be generated by machinery such as compressors, fans and power (electric) equipment, which are noise sources relevant to the proposed solar farm. In *Noise Guidelines: Assessing Low Frequency Noise (EPA Victoria Publication 1996, June 2021)*, low frequency noise is defined as noise with significant acoustic energy in one-third octave bands ranging between 10 Hz to 160 Hz.

It should be noted the low frequency noise assessment using the guideline is separate from an assessment for compliance with the regulatory noise limits discussed in previous sections.

The human range of hearing is within the frequency range of 20 Hz to 20,000 Hz (20 kHz). However, low frequency sound at frequencies less than 20 Hz can still be audible depending on the sound pressure level measured in decibels (dB), background levels and the hearing sensitivity of an individual. An outdoor low frequency threshold criterion is defined in *EPA Victoria Publication 1996* as shown in **Table 5.5**.

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Table 5.5: Outdoor 1/3 Octave Low Frequency Noise Threshold Levels

	Outdoor 1/3 Octave Spectrum, Hz												
	10	12.5	15	20	25	31.5	40	50	63	80	100	125	160
L _{eq} (dB)	92	89	86	77	69	61	54	50	50	48	48	46	44

Predicting low frequency noise levels at noise sensitive receivers is problematic and of limited accuracy due to available noise source spectrum bandwidth (from 50Hz) and due to the nature of propagation of low frequency noise. Due to this, calculations should only be used as a screening tool to assess the risk of low frequency noise.

The 1/3 octave frequency noise data provided for the equipment only reaches down to 50 Hz. Therefore, while it is possible to predict down to 50 Hz, assumptions need to be made for frequencies 40 Hz and below. For the purpose of the assessment, 1/3 octave noise levels at noise sensitive receivers between 10 Hz to 40 Hz were conservatively extrapolated from the predicted levels between 50 Hz to 160 Hz, by selecting the highest predicted value from 50 Hz to 160 Hz. The highest value was then compared to each 1/3 octave limit from 10 Hz to 40 Hz.

The SoundPLAN 8.2 predicted, under adverse weather condition, and extrapolated 1/3 octave low frequency noise levels at noise sensitive receivers are outlined in **Table 5.6**. These predicted levels include noise mitigation previously discussed.

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Table 5.6: Predicted and Extrapolated Low Frequency Noise Levels

Outdoor Predicted Low Frequency Levels (L_{eq}), 1/3 Octave Spectrum, Hz													
Receiver	Extrapolated, dB							SoundPLAN Predicted, dB					
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
R1	42	42	42	42	42	42	42	39	38	35	42	36	38
R2	39	39	39	39	39	39	39	35	34	31	39	33	34
R3	31	31	31	31	31	31	31	31	30	27	32	27	28
R4	28	28	28	28	28	28	28	26	26	22	28	23	24
R5	38	38	38	38	38	38	38	36	35	31	38	32	34
R6	30	30	30	30	30	30	30	28	29	27	24	30	24
R7	38	38	38	38	38	38	38	36	35	31	38	33	34
R8	30	30	30	30	30	30	30	28	27	24	30	24	25
Criteria	92	89	86	77	69	61	54	50	50	48	48	46	44

No predicted or extrapolated 1/3 octave noise level between 10 Hz to 160 Hz is expected to be above the criteria. Therefore, it is concluded that there is a limited risk of low frequency noise impacts from the proposed facility.

While the potential risk is low, it is recommended that low frequency noise components should be compared to the modelled noise sources given in **Table 6.1** during the commissioning of the solar farm.

5.8 Cumulative Noise Impact Assessment

The environmental obligations with respect to noise for the operation of multiple industrial premises are found in Clause 119 of the Environmental Protection Regulations 2021 S.R. No. 47/2021 as follows:

(1) If 2 or more commercial, industrial or residential premises (whether existing or proposed) emit, or are likely to emit, noise that contributes to the overall noise level, a person in management or control of one or more of those premises must take all reasonable steps to ensure that the contribution from each of the premises, when combined, does not exceed the noise limit for the noise sensitive area.

A review of the type of industry currently operational or most likely to locate in the area has been undertaken. The following industrial premises have been identified (refer to **Figure 2.1**):

- Australian Munition, a defence force factory manufacturing bullets
- Benalla Landfill and Resource Recovery Centre
- LS Precast, a precast concrete manufacturing facility
- D&R Henderson, a softwood timber and particleboard manufacturer

Cumulative noise impacts are reviewed for noise sensitive receivers as follows:

- (R1) 623 Benalla-Yarrowonga Road: R1 is located to the southwest of the northern portion of solar farm site, approximately 100m away. The existing Australian Munition factory to the south west is 1km away.
 - Under neutral meteorological conditions, the solar farm noise level at R1 is 8 dBA lower than the limit. Therefore, given the large buffer to compliance, the likelihood of cumulative impacts is limited.
 - The predicted noise level at R1 is 3 dBA under the limit under adverse meteorological conditions. If the munition facility were to contribute a level of noise higher than the solar farm, a marginal exceedance would occur. However, it is unlikely that the munition factory would generate the same level of noise as measured at R1 due to the separation distance (approx. 1 km) and fully enclosed/indoor manufacturing operations as a defence-related factory. Furthermore, under easterly winds, the munition factory would be downwind, with wind propagating noise away from R1.

- (R2) 524 Benalla-Yarrowonga Road: R2 is located to the south of the northern portion of the development , approximately 175 metres from the site boundary. The existing Australian Munition factory to the west is 1.1km away.
 - Under neutral meteorological conditions, the predicted noise level at R2 due to the solar farm operation is 7 dBA below the night-time limit. Therefore, given the large buffer to compliance, the likelihood of cumulative impacts is limited.
 - Under downwind (adverse) weather conditions (northerly winds), the noise level from the solar farm at R2 is 1 dBA below the night-time noise limit. Under this specific wind condition from the north, noise from the munition factory is directed away from R2. Furthermore, it is unlikely that the munition factory would generate cumulative noise at R2 due to the separation distance (1.1 km) and fully enclosed/indoor manufacturing operations as a defence-related factory.
- (R3) 286 Farnley Road: R3 is located to the north east of the northern portion of the development, approximately 375 metres from the site boundary, and 3.5 km away from Australian Munition.
 - Under neutral meteorological conditions, the solar farm noise level at R1 is 11 dBA lower than the limit. Therefore, given the large buffer to compliance, the likelihood of cumulative impacts is limited.
 - The predicted noise level is 5 dBA limit under the modelled worst case meteorological conditions. Further, the Australian Ammunition to the south are approximately 3.5km away, such that its noise impact at R3 is likely to be minimal. If the noise level from the existing industry was high enough to contribute to cumulative non-compliance at R3, then it is likely that the noise from it would be significantly in excess of its own noise limits at its nearest receptors, namely R1 and R2. This is an unlikely scenario.
- (R4) 18 Farnley Road: R4 is situated to the north of the site, approximately 700 metres from the site boundary, and 3.7 km away from the Australian Ammunition.
 - The predicted noise level is well below the limit (margin of 12 dB) under the modelled worst case meteorological conditions. Further, the munitions factory to the south is approximately 3.7km away, such that its noise impact at R4 is likely to be minimal. A 12 dBA margin to the limit provides enough buffer to render cumulative noise impacts as negligible.
- No cumulative noise impact from other nearby industrial facilities onto noise sensitive receivers R1 to R4 is expected due to excessive separation distances, being a minimum of 3 km.
- (R5) 368 Benalla-Yarrowonga Road: This receptor is located to the north of the southern portion of solar farm site. The two existing industries to the south are 2km (LS Precast) and 2.5km (D&R Henderson) away. There are two additional existing industrial facilities 2km away to the northwest (Australian Munitions) and 2km away to the west (landfill).
 - The predicted noise level at R5 is 8 dBA under the limit under neutral meteorological conditions. This buffer to compliance provides flexibility to each industry (two to the south; one to the north-west; one to the west) to contribute to total noise levels without causing an exceedance. It is unlikely that the existing industries would generate sufficient noise at R5 to cause cumulative exceedances due to the large separation distances.
 - Under downwind meteorological conditions favouring noise propagation from the south, noise levels from the proposed solar farm are 2 dBA below the night-time noise limit at R5. Even under southerly wind conditions propagating noise towards R5, it is unlikely that cumulative impacts from the two southern industries would occur, given their large separation distance (2-2.5 km away) and given that they would need to achieve compliance with their relevant limits at closer receptors (R2, R6 and R8). If the noise levels from these existing industries to the south were high enough to contribute to cumulative non-compliance at R5, then it is likely that the noise from these industries would be significantly in excess of their own noise limits at their nearest receptors (R6 and R8). This is an unlikely scenario and therefore, cumulative impacts at R5 are unlikely, assuming all nearby industrial facilities already comply with their noise limits.
- (R6) 226 Murray Road: R6 is located to the west of the southern portion, approximately 660 metres from the site boundary.

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- R6 is potentially affected by noise from the existing two industries to the east (LS Precast and D&R Henderson) and the landfill to the north-west. However, the predicted noise levels at R6 due to the solar farm operation are more than 22 dBA under the relevant criteria. Therefore, the contribution from the solar farm would not affect cumulative compliance at R6.
- (R7) 125 Nelson Road: R7 is located to the south of the site, approximately 30 metres from the site boundary.
 - The predicted noise level is at the limit during the night under the modelled worst case meteorological conditions (i.e. northerly). However, such wind conditions would also significantly reduce the noise propagation from the existing industrial premises to this location (i.e. the nearest industries LS Precast and D&R Henderson are located south). Further, the two industries to the south are approximately 1.4km away, such that their noise impacts at R7 are likely to be minimal. If the noise levels from the existing industries were high enough to contribute to cumulative non-compliance at R6, then it is likely that the noise from these industries would be significantly in excess of their own noise limits at their nearest receptors (R6 and R8). This is an unlikely scenario and therefore, cumulative impacts at R7 are unlikely.
- (R8) 130 Benalla-Yarrowonga Road: R8 is situated to the south of the site, approximately 720 metres from the site boundary.
 - The predicted solar farm noise levels at R8 are 13 dB below the limit under neutral meteorological conditions, such that the proposed solar farm would make a negligible contribution to any possible cumulative impacts at this location. Under downwind wind conditions favouring noise propagation from the solar farm site to this receiver, the predicted level is at least 7 dB below the limit, which would enable each of the two industries to the south to contribute the same levels of noise as the solar farm and still achieve overall cumulative compliance.

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In summary, cumulative noise impacts are unlikely based on the direction and location of existing industry relative to noise sensitive receivers and assuming existing industrial facilities are operating within acceptable noise levels.

It is important to note that the noise impacts from the existing industrial premises and their current compliance status have not been quantified in this assessment. It is assumed that the facilities are operating at acceptable noise levels and complying with any relevant noise limits. As a further study, it is recommended to obtain details about the operating conditions of existing industries, including their allowable noise limits, compliance status and noise monitoring. This information is crucial for confirming whether cumulative impacts will meet the noise limits. It is further noted that there are vacant industrial lots to the south of the Australian Munition site. A review of the relevant planning websites have not identified any proposed/approved industry on these lots. Any proposed/approved industry will also need to be considered in cumulative assessments.

5.9 Assessment of Reasonable and Practical Mitigation Measures

After investigating possible noise mitigation solutions, the most practical and applicable noise mitigation strategy was identified, as outlined in **Section 5.6**, which involves selecting quieter equipment first, and then proposing noise barriers at the most effective locations. Further background details on the adopted measures are summarised below:

Use of quieter equipment: After iterative noise modelling, noisier equipment options were identified and excluded from the proposal. Lightsource bp chose quieter inverters, converters, and batteries readily available in the market. However, it has been identified that choosing quieter equipment alone is not sufficient to reduce predicted noise impacts at receiver locations below noise limits. This approach has been adopted to reduce the extents and heights of noise barriers.

Acoustic screening around BESS stations: After choosing quieter equipment, converters were identified as the most dominant noise sources due to the number of units, e.g., 16 converters per BESS station. 4 m

noise barriers were proposed between BESS stations and noise sensitive receivers, where required. Considering that noise barriers are more effective when they are in close proximity to either noise sources or receivers, noise barriers were proposed as close as possible to the converters. 4 metre setback distance between converters and noise barriers were provided. Only nine of the BESS stations were identified to be screened by noise barriers.

Additional noise mitigation measures have also been considered during the design process as outlined below, however, after further review these were not deemed practical for implementation at the development.

Acoustic enclosures around converters and inverters: The Lightsource bp engineering team has advised that their suppliers are unable to apply acoustic enclosures to units due to cooling and maintenance requirements during the operational phase of the proposed solar farm project. Given that noise exceedances were eliminated by 4 m noise barriers proposed at only 9 of the 56 BESS stations, even if acoustic enclosures were an available option, they wouldn't be more practical or economical than noise barriers.

Locating BESS stations away from noise sensitive receivers: This would be an effective solution to manage noise exceedances and eliminate or reduce the need for noise barriers. However, this would require moving PCUs over large distances together with Battery stations. This is not feasible, as each PCU must be situated in close proximity to the solar panel array it services to ensure efficient electrical power distribution.

Given that noise barriers offer a practical and effective solution, relocating PCUs was not considered a reasonable alternative. Additionally, Battery Energy Storage System (BESS) equipment must also be positioned as close as possible to the PCUs to maintain system efficiency and integration. As the solution with noise barriers is both effective and practical, relocating PCUs was not deemed reasonable. It should be noted that BESS equipment also needs to be located as close as possible to PCUs.

Earth mound at solar farm boundary: For some projects over extensive areas such as mines, an earth mound at the site boundary is a potential noise mitigation solution. This is a cost-effective solution when the required amount of material is available at the subject site (e.g. obtained from excavation material associated with earthworks). However, West Mokoan Solar Farm has been proposed on a flat terrain, and it would be difficult to source enough earth from the same site to construct an earth mound. In addition to this, an earth mound at the site boundary would have a negative impact on visual amenity. It is likely that higher than 4 m mounds would be required since a potential mound is likely to be located at the solar farm boundary rather than directly adjacent to the noise sources (i.e. barrier/mound heights are minimised close to the source, and increase in height at further distances to provide the same level of noise attenuation).

Full enclosure over BESS stations: A large warehouse with acoustic walls, roof, and access doors could be proposed to install over each of BESS stations. However, this would be a very costly investment and would create additional engineering challenges, such as designing a heavy, acoustically insulated roof and silent air ventilation. Furthermore, the proposed BESS layout as a decentralized, or distributed, system is not suitable for this solution. The layout would need to be redesigned as a centralized system.

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6. RECOMMENDATIONS AND CONCLUSION

A noise impact assessment has been conducted for the proposed West Mokoan Solar Farm at Benalla-Yarrowonga Rd, Benalla, VIC, 3672. The results and recommendations of the assessment are as follows:

- The scope of the proposed development is outlined in **Section 3**. 56 BESS stations were proposed. Each of BESS stations is proposed to include 4 container type BESS units, 16 converters, 2 inverters and 3 transformers.
- The noise criteria are outlined in **Section 4**. The most stringent noise criteria of 32 dBA for night periods, from 10 pm to 7 am. Noise limits are tabulated in **Table 4.2**.
- A noise assessment has been undertaken for the proposed site in **Section 5**, and noise impact levels are predicted under neutral and downwind (adverse) weather conditions. Tonality, intermittency, impulsiveness and low frequency noise are also reviewed in accordance with relevant EPA Victoria guidelines.
 - Predicted noise levels, including modifying factors, at noise sensitive receivers are given in **Table 5.2**. Noise exceedances of up to 4 dBA have been predicted at two of eight residential noise sensitive receivers, R5 and R7, under downwind weather conditions. Under neutral weather conditions, no exceedance was predicted.
 - Compliance is predicted at all noise sensitive receiver locations, assuming 4 m noise barriers (to primarily shield converters) are implemented to 9 of the BESS stations and 3 of these 9 stations are rotated to maximise the shielding provided by the barriers. Location of proposed noise barriers and rotated BESS stations are shown in **Drawing B.1**, in **Appendix B**.
 - Predicted noise levels after proposed noise mitigation are given in **Table 5.3** for calm weather condition and **Table 5.4** adverse weather condition, which demonstrate compliance.
- Low frequency noise impact is reviewed in **Section 5.7**. It is concluded that there is a minimal risk of low frequency noise impacts from the proposed solar farm under the **Planning and Environment Act 1987**.
- Cumulative noise impact is reviewed in **Section 5.8**. In summary, cumulative noise impacts are unlikely based on the direction and separation distance of the nearest existing industrial premises relative to noise sensitive receivers and assuming the existing industrial facilities are operating within acceptable levels.
 - It is important to note that the noise emissions from the existing industrial facilities and their current compliance statuses have not been quantified in this evaluation. It is assumed that these facilities are operating within acceptable noise levels and complying with any relevant noise limits. As a further study, it is recommended to obtain details about the operating conditions of existing industries, including allowable noise limits, compliance status and noise monitoring. This information is crucial for confirming whether cumulative impacts will meet the noise limits.
- An assessment of reasonable and practical mitigation measures is provided in **Section 5.9**. The noise mitigation solution, which includes 4 m noise barriers proposed in this assessment, was identified as the most practical and reasonable solution.
- Within this assessment, only locations, extents and heights of noise barriers are defined. It is assumed that proposed equipment, i.e. batteries, inverters, converters and transformers, will not cause any significant vibration on proposed noise barriers or there is no build up of reverberant noise on the source side of the barriers. During later design phases, proposed noise barriers should be reviewed by structural and vibration engineers to prevent structure born vibration and absorptive linings may need to be considered to prevent reverberant noise.

Based on the outcomes of the assessment, it is concluded that the site represents a suitable location for the proposed development provided the mitigation measures detailed in this report are implemented.

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APPENDIX A GLOSSARY

Parameter or Term	Description
dB	The decibel (dB) is the unit measure of sound. Most noises occur in a range of 20 dB (quiet rural area at night) to 120 dB (nightclub dance floor or concert).
dBA	Noise levels are most commonly expressed in terms of the 'A' weighted decibel scale, dBA. This scale closely approximates the response of the human ear, thus providing a measure of the subjective loudness of noise and enabling the intensity of noises with different frequency characteristics (e.g. pitch and tone) to be compared.
Day	VIC Environment Protection Regulations 2021 (Clause 116): <ul style="list-style-type: none"> the period between 7am and 6pm (excluding public holidays and Sunday)
Evening	VIC Environment Protection Regulations 2021 (Clause 116): <ul style="list-style-type: none"> Monday to Saturday – the period between 6pm and 10pm. Sunday and public holidays – 7 am to 10 pm.
Night	VIC Environment Protection Regulations 2021 (Clause 116): <ul style="list-style-type: none"> the period between 10pm and 7am.
Free-field	The description of a noise receiver or source location which is away from any significantly reflective objects (e.g. buildings, walls).
L ₁₀	The noise level exceeded for 10% of the measurement period. It is sometimes referred to as the average maximum noise level.
L ₉₀	The noise level exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.
L _{eq}	The equivalent continuous sound level, which is the constant sound level over a given time period, which is equivalent in total sound energy to the time-varying sound level, measured over the same time period.
L _{eq,1hour}	As for L _{eq} except the measurement intervals are defined as 1 hour duration.
L _{max}	Maximum A-weighted sound pressure level.
R _w	Weighted Sound Reduction Index – is a single number evaluation of the property of a partition to attenuate sounds. For the majority of partitions, the value of R _w will be similar to the value for STC. Partitions with particularly poor performance at 100 Hz may have lower values for R _w than for STC. Conversely, partitions with poor performance at 4000 Hz may have higher R _w than for STC. (As per AS1276.1-1999).
Acoustically screened	The source of noise is completely screened from view of habitable rooms (including balconies, patios, decks and verandas) of an adjoining sensitive use by solid, gap free material and construction e.g. acoustic fence, building, or enclosure.
Acoustic fence / barrier	Solid, gap free fence with minimum panel surface density of 12.5 kg/m ² .

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APPENDIX B DRAWINGS

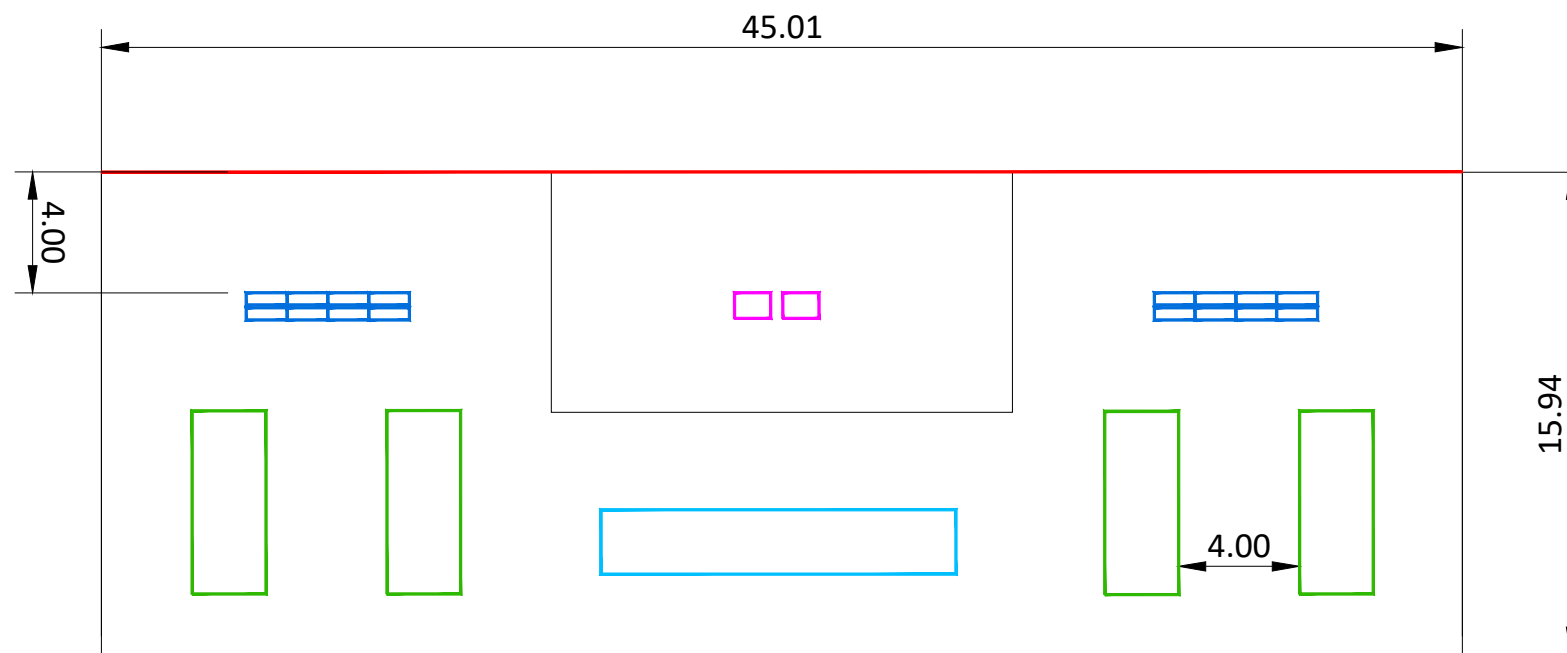
Figure B.1: Site Layout with Proposed Noise Barriers

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	Battery
	DCDC Converter
	Power Conversion Station (PCS)
	Auxiliary Transformer
	4 m Wall Noise Barrier

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4 BESS containers per PCS
 2 Inverters per PCS
 16 DC-DC converter per PCS
 2 Aux Tx per PCS

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METERS



Rev	Date	Comments	Dwn	Chkd
06	20.02.26	Wall noise barrier updated	AG	KZ
04	27.03.25	Aux Tx added	AG	PC
03	23.02.24	Quantities updated	AG	
02	22.02.24	Updated distances between equipment	EPG	
01	22.02.24	Quantities updated	AG	

DA			06.04.2023
DRAWN	CHECKED	APPROVED	DATE

PROJECT NAME & ADDRESS:
 Location: Benalla, Victoria
 Australia

NOTES:
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Paper Size: A3	Scale: Custom	Sheet: 1
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CAPACITY:

DRAWING TITLE:
 AUS_West Mokoan_DC Coupled BESS Station_06






DRAWING NUMBER: BESS_LYT	STATUS: Preliminary
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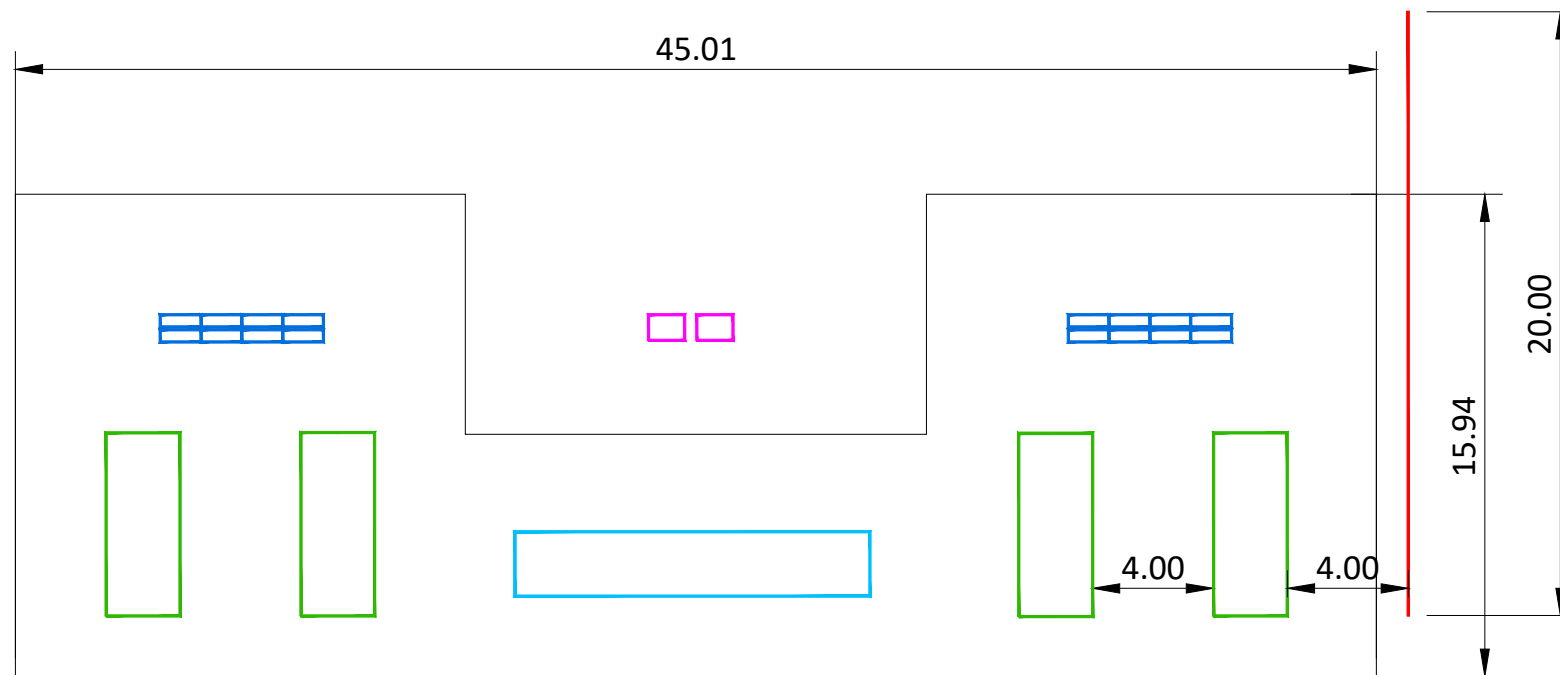
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	Battery
	DCDC Converter
	Power Conversion Station (PCS)
	Auxiliary Transformer
	4 m Wall Noise Barrier

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4 BESS containers per PCS
 2 Inverters per PCS
 16 DC-DC converter per PCS
 2 Aux Tx per PCS

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METERS



Rev	Date	Comments	Dwn	Chkd
07	20.02.26	Wall noise barrier update	AG	KZ
06	06.02.26	Wall noise barrier updated	AG	KZ
04	27.03.25	Aux Tx added	AG	PC
03	23.02.24	Quantities updated	AG	
02	22.02.24	Updated distances between equipment	EPG	
01	22.02.24	Quantities updated	AG	

DA			06.04.2023
DRAWN	CHECKED	APPROVED	DATE

PROJECT NAME & ADDRESS:
 Location: Benalla, Victoria
 Australia

NOTES:
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CAPACITY:

DRAWING TITLE:
 AUS_West Mokoan_DC Coupled BESS Station_07

DRAWING NUMBER: BESS_LYT	STATUS: Preliminary
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APPENDIX C TONALITY ASSESSMENT AND LOW FREQUENCY

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Table C.1. Predicted 1/3 Octave Noise Levels, Calculation Steps for Tonality Correction and Low Frequency Impact Check - Unmitigated & Calm Weather Conditions

Receiver Parameters				Time slot	Frequency Bands (Hz)																						
SR	CR	CR	CR		50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000
SR	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
CR	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Tonality Check - VC PER PUBLICATION 484				Time slot	Frequency Bands (Hz)																					
SR	CR	CR	CR		50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300
SR	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
CR	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Tonality Check - VC PER PUBLICATION 484				Time slot	Frequency Bands (Hz)																					
SR	CR	CR	CR		50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300
SR	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
CR	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Tonality Check - VC PER PUBLICATION 484				Time slot	Frequency Bands (Hz)																					
SR	CR	CR	CR		50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300
SR	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
CR	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Low Freq Check - 20A VC PUBLICATION 484				Time slot	Frequency Bands (Hz)																					
SR	CR	CR	CR		50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300
SR	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
CR	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Low Freq Check - 20A VC PUBLICATION 484				Time slot	Frequency Bands (Hz)																					
SR	CR	CR	CR		50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300
SR	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
CR	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

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Refer to Clause 148:
For one-third octave bands where
the band level is 25 dB or more
below the highest band level, the
tonal factor TF1 is set to zero,
otherwise use 1 as multiplicative

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Table C.4. Predicted 1/3 Octave Noise Levels, Calculation Steps for Tonality Correction and Low Frequency Impact Check - Mitigated & Adverse Weather Conditions

Reference Prediction				1/3 Octave Bands																			
Time slot	1/3 Octave Band	LAeq,1h	LAmax,1h	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	
01	1/3 Octave Band	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
02	1/3 Octave Band	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Tonality Check - VC PER PUBLICATION 484				1/3 Octave Bands																			
Time slot	1/3 Octave Band	LAeq,1h	LAmax,1h	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band
01	1/3 Octave Band	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
02	1/3 Octave Band	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Tonality Check - VC PER PUBLICATION 484				1/3 Octave Bands																			
Time slot	1/3 Octave Band	LAeq,1h	LAmax,1h	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band
01	1/3 Octave Band	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
02	1/3 Octave Band	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Tonality Check - VC PER PUBLICATION 484				1/3 Octave Bands																			
Time slot	1/3 Octave Band	LAeq,1h	LAmax,1h	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band
01	1/3 Octave Band	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
02	1/3 Octave Band	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Low Freq Check - 1/3 VC PER PUBLICATION 484				1/3 Octave Bands																			
Time slot	1/3 Octave Band	LAeq,1h	LAmax,1h	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band
01	1/3 Octave Band	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
02	1/3 Octave Band	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

Low Freq Check - 1/3 VC PER PUBLICATION 484				1/3 Octave Bands																			
Time slot	1/3 Octave Band	LAeq,1h	LAmax,1h	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band	1/3 Octave Band
01	1/3 Octave Band	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
02	1/3 Octave Band	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

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