Kingswood BESS EIS

EIS Amendment Operational Noise Assessment

S230482RP3 Revision 0

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Resonate

Document Information

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Revision Table

Report revision	Date	Description	Author	Reviewer
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Glossary

BESS	Battery Energy Storage System
EPA	Environment Protection Authority
EIS	Environmental Impact Statement
NPI	Noise Policy for Industry
NSW	New South Wales
Project Area	Refers to the BESS site, substation and electrical transmission line
SPL	Sound Pressure Level
SWL	Sound Power Level

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1 Introduction

The purpose of this report is to assess the operational noise impacts for the Amended Kingswood BESS EIS. An initial Noise and Vibration Assessment, document S230482RP1 Revision B (reference S230482RP1B), dated 27 May 2024, was undertaken to inform the Kingswood BESS EIS.

There has since been a change of indicative BESS equipment supplier which has resulted in an update to sound power levels assumed relative to the EIS noise assessment. The areas assigned for potential battery and transformer location remain unchanged from the EIS.

This operational noise impact assessment predicts noise levels based on the updated indicative equipment supplier sound power levels and indicative battery layout. The noise assessment framework is consistent with the EIS and is in accordance with the final SEARs.

The detailed project description, baseline noise survey and details on noise policies remain unchanged since the EIS and can be found in report S230482RP1B, dated 27 May 2024. The proposed operation of the BESS remains the same, 24 hours a day, seven days a week and would be monitored remotely, with maintenance infrastructure onsite.

No assessment for operational vibration impacts is required as the statement from report S230482RP1B describing that no vibration impacts are anticipated remains true.

An overview of the Project site as shown in the Amendment Report is shown in Figure 1-1.

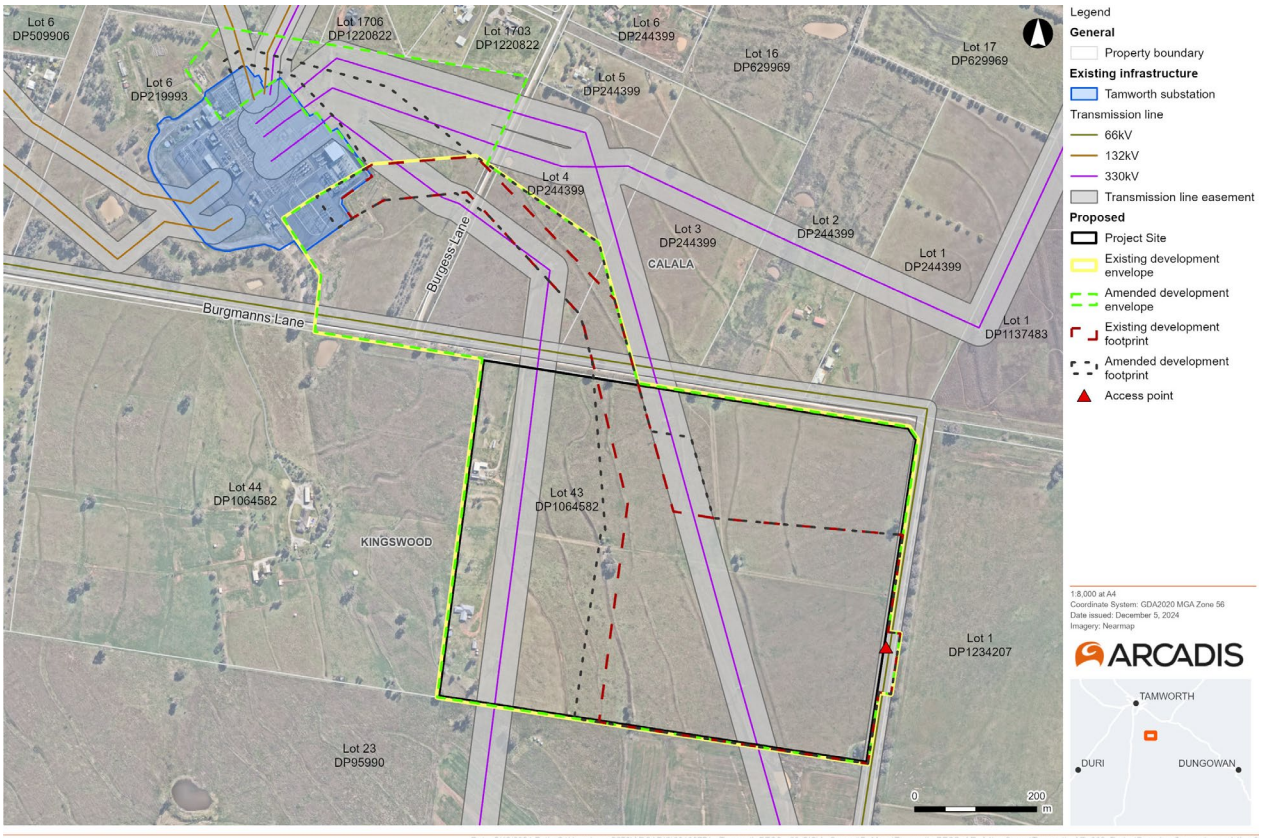

Figure 1-1 Project Site location

2 Operational noise criteria

2.1 Project specific noise criteria NPI

The Noise Policy for Industry (NPI) noise criteria that were established in report S230482RP1B are reiterated in Table 2-1. The Project Noise Trigger Level (PNTL) is the lowest value of the intrusiveness or amenity noise level for each period.

Table 2-1 NPI noise criteria (rural amenity area)

Receiver Type	PNTL $L_{eq,\ 15minute}$ dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Residential	40	35	35

2.2 Annoying noise characteristics corrections

Sources of industrial noise can cause greater annoyance when they contain certain characteristics, such as tonality, impulsiveness, intermittency, irregularity, or dominant low-frequency content and are to be applied as shown in report S230482RP1B.

2.3 Sleep disturbance criteria

During normal operation of the BESS, the operational noise of the battery racks, inverters and transformers will be assessed against the sleep disturbance and night-time noise criteria.

In accordance with the NPI, the sleep disturbance noise criteria for assessing the Project are presented in Table 2-2 below.

Table 2-2 Sleep disturbance noise criteria

Receiver type	$L_{eq,\ 15minute}$ dB(A)	L_{max} dB(A)
Residential receivers	40	52

The noise emissions from the BESS operations do not emit peak noise levels for an instant or very short period. Therefore, the operational noise from the Project will only be assessed against the sleep disturbance L_{Aeq} criterion and not the L_{Amax} criterion. Compliance of the operational 35dB(A) night-time criterion would also result in compliance with the 40 dB(A) sleep disturbance L_{Aeq} criterion.

3 Operational noise assessment

Operational noise levels predicted at the nearest residential receivers have been assessed against the adopted NPI noise criteria.

The refined layout is based on an arrangement to the west of the Project Site with indicative noise walls up to eight metres high which is consistent with the EIS. However, the battery equipment could be located anywhere within the indicative development envelope shown in the EIS as long as they meet the criteria.

The predicted noise levels include a 3 dB(A) allowance for potential cumulative noise impacts noting that there is an existing substation located to the north of the site and there is a potential for cumulative impacts from adjacent BESS facilities currently in the planning phase.

To determine the project's noise impact, a computer model incorporating all significant noise sources, the closest potentially affected residential properties, and the intervening terrain has been prepared. The computer model was prepared using the SoundPLAN noise propagation modelling software (Version 9.0) Industrial Module, which allows the use of various internationally recognised noise prediction algorithms. The CONCAWE algorithm, suitable for the assessment of large industrial plants, has been selected for this assessment because it also enables the assessment of meteorological influences.

This assessment uses the operational noise modelling parameters from report S230482RP1B.

Results that include the effects of noise-enhancing meteorological conditions are presented as they represent the controlling scenario for the development.

3.1 BESS operational noise sources

Updated operational noise source levels for the indicative battery technology supplier are presented in Table 3-1. These noise source levels and the number of plant items (i.e., the number of enclosures and inverters) will be validated during the detailed design phase once a supplier has been finalised.

Table 3-1 Estimated equipment sound power levels

Equipment	Number of plant items	Sound power level Leq – dB(A) (Individual plant item)
Battery enclosure[1]	142	82 – 96
MV transformer	71	75
HV transformer	2	88

(1) The battery enclosure SWL is variable, depending on temperature and period.

Cooling system fan speed duties are driven by a combination of battery utilisation (charge and discharge rate) as well as ambient temperature. Typical charge and discharge rates of a BESS facility generally do not occur at the rated capacity of the BESS but at a lower value.

3.2 Modifying factors

Table 3-2 shows that the predicted noise levels of the Project at the nearest sensitive receivers have been assessed for annoying noise characteristics.

Table 3-2 Modifying factor corrections

Modifying factor	Applicable	Justification
Tonal noise	No for BESS battery enclosure Yes for HV and MV Transformers	• **BESS Equipment:** the assessment of the 1/3 octave data of the battery enclosure test data showed that tonal noise at the sensitive receivers is unlikely. Therefore, no penalty has been applied to the battery enclosure noise sources. • **MV / HV Transformers:** One-third octave band noise level data for the transformers was not available to determine annoying characteristics. Based on past project experiences, noise from transformers could potentially be tonal. Therefore, a 5 dB penalty is applied to the overall noise levels of the transformers in the noise model to account for tonality from this source.
Low-frequency noise	No	• The difference in C weighted minus A weighted source contribution level is predicted to be less than 15 dB. • The noise spectrum at the nearest sensitive receivers does not exceed any of the one-third octave low-frequency noise threshold levels shown in NPI Table C2. Noise data for the equipment was limited to 50 Hz and above, but due to the size and type of equipment, it is unlikely that frequencies below 50 Hz could exceed the noise levels shown in NPI Table C2.
Intermittent noise	No	• Minimal intermittent noise is predicted due to the nature of the steady operation of the equipment. Hence, No correction for intermittent noise was applied.
Duration	No	• Conservatively it has been assumed that the site is operating continuously. Hence, no correction factor was applied.

As per the justifications in Table 3-2 it was determined that no modifying factors, other than tonal noise from HV and MV transformers, were required to be applied.

3.3 Predicted operational noise levels with mitigation measures

Noise mitigation measures were considered in report S230482RP1B Section 7.4 and included optimisation of the location and orientation of the BESS and noise barriers surrounding the noise-emitting equipment. The originally (EIS) proposed silencer mitigation measure is not an option with the updated indicative supplier.

However, reduced noise levels would be achieved by adjusting the battery enclosures' cooling system duty factor. The indicative equipment supplier could allow for the baseline NPI criteria to be achieved under typical environmental conditions (temperature). It was determined that at higher temperatures, fan cooling system duty factors would need to be increased to allow for safe and efficient operation of the batteries. Therefore, two scenarios are presented, including the typical scenario (occurring for 90% of the time during any season) and the worst-case scenario that could occur up to 10% of the time during any season. The worst-case scenario is expected to happen when temperatures are very high and the battery cooling systems are required to run at a high duty factor to allow for sufficient battery cooling.

The following SWLs for the BESS enclosures have been used to predict the different operational scenarios.

Table 3-3 Battery enclosure SWL

Period	BESS enclosure Sound power level Leq – dB(A)	
	During 90% of any season	During 10% of any season
Day	91	96
Evening	82	88
Night	82	82

3.3.1 Results - typical operation during 90% of any season

Based on the presented SWL in Table 3-3, the noise levels predicted at sensitive receivers are shown in Table 3-6.

A review of the predicted noise levels in Table 3-4 indicates that compliance with the baseline NPI criteria is expected for the typical scenario (up to 90% of any season).

Table 3-4 Typical operation with varying Battery duty factors during noise-enhancing meteorological conditions with noise mitigation measures

Receiver ID	Daytime period, Battery L_{WA} 91 dB(A)				Evening period, Battery L_{WA} 82 dB(A)				Night-time period, Battery L_{WA} 82dB(A)			
	Predicted dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)	Predicted dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)	Predicted dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)
R2	40	40	0	Yes	35	35	0	Yes	35	35	0	Yes
R3	38	40	0	Yes	33	35	0	Yes	33	35	0	Yes
R4	28	40	0	Yes	21	35	0	Yes	21	35	0	Yes
R5	32	40	0	Yes	27	35	0	Yes	27	35	0	Yes
R6	31	40	0	Yes	26	35	0	Yes	26	35	0	Yes
R7	31	40	0	Yes	26	35	0	Yes	26	35	0	Yes
R8	31	40	0	Yes	26	35	0	Yes	26	35	0	Yes
R9	36	40	0	Yes	28	35	0	Yes	28	35	0	Yes
R10	31	40	0	Yes	25	35	0	Yes	25	35	0	Yes
R11	30	40	0	Yes	25	35	0	Yes	25	35	0	Yes
R12	30	40	0	Yes	25	35	0	Yes	25	35	0	Yes
R13	30	40	0	Yes	25	35	0	Yes	25	35	0	Yes
R14	30	40	0	Yes	25	35	0	Yes	25	35	0	Yes
R15	30	40	0	Yes	25	35	0	Yes	25	35	0	Yes
R16	34	40	0	Yes	27	35	0	Yes	27	35	0	Yes
R17	30	40	0	Yes	24	35	0	Yes	24	35	0	Yes
R18	29	40	0	Yes	24	35	0	Yes	24	35	0	Yes
R19	29	40	0	Yes	24	35	0	Yes	24	35	0	Yes
R20	29	40	0	Yes	24	35	0	Yes	24	35	0	Yes

Receiver ID	Daytime period, Battery L_{WA} 91 dB(A)				Evening period, Battery L_{WA} 82 dB(A)				Night-time period, Battery L_{WA} 82dB(A)			
	Predicted dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)	Predicted dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)	Predicted dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)
R21	20	40	0	Yes	13	35	0	Yes	13	35	0	Yes
R22	28	40	0	Yes	23	35	0	Yes	23	35	0	Yes
R23	29	40	0	Yes	23	35	0	Yes	23	35	0	Yes
R24	25	40	0	Yes	21	35	0	Yes	21	35	0	Yes
R25	32	40	0	Yes	25	35	0	Yes	25	35	0	Yes
R26	29	40	0	Yes	23	35	0	Yes	23	35	0	Yes
R27	28	40	0	Yes	23	35	0	Yes	23	35	0	Yes
R28	28	40	0	Yes	22	35	0	Yes	22	35	0	Yes
R29	24	40	0	Yes	18	35	0	Yes	18	35	0	Yes
R30	28	40	0	Yes	23	35	0	Yes	23	35	0	Yes
R31	28	40	0	Yes	22	35	0	Yes	22	35	0	Yes
R32	27	40	0	Yes	21	35	0	Yes	21	35	0	Yes
R33	25	40	0	Yes	21	35	0	Yes	21	35	0	Yes
R34	28	40	0	Yes	22	35	0	Yes	22	35	0	Yes
R35	28	40	0	Yes	22	35	0	Yes	22	35	0	Yes
R36	27	40	0	Yes	22	35	0	Yes	22	35	0	Yes
R37	27	40	0	Yes	21	35	0	Yes	21	35	0	Yes

3.3.2 Results - worst case operation during 10% of any season

Based on the presented SWL in Table 3-3, the noise levels predicted at sensitive receivers for the worst-case during 10% of any season are shown in Table 3-6.

A review of the predicted noise levels in Table 3-5, shows criteria exceedances of up to 5 dB(A) during the daytime and up to 3 dB(A) during the evening for the worst-case temperature conditions (up to 10% of any season).

It is for this reason, and noting that all other reasonable and feasible measures have been considered, that an approach to relax the operational noise criteria during the daytime and evening periods for the worst case scenario is proposed as described in Section 3.4.

Table 3-5 Operation during peak temperature days (up to 10% of any season) with varying Battery duty factors during noise-enhancing meteorological conditions with noise mitigation measures

Receiver ID	Daytime period, Battery L_{WA} 96 dB(A)				Evening period, Battery L_{WA} 88 dB(A)				Night-time period, Battery L_{WA} 82dB(A)			
	Predicted dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)	Predicted dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)	Predicted dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)
R2	45	40	5	No	38	35	3	No	35	35	0	Yes
R3	43	40	3	No	36	35	1	No	33	35	0	Yes
R4	33	40	0	Yes	26	35	0	Yes	21	35	0	Yes
R5	38	40	0	Yes	30	35	0	Yes	27	35	0	Yes
R6	37	40	0	Yes	29	35	0	Yes	26	35	0	Yes
R7	37	40	0	Yes	29	35	0	Yes	26	35	0	Yes
R8	37	40	0	Yes	29	35	0	Yes	26	35	0	Yes
R9	42	40	2	No	33	35	0	Yes	28	35	0	Yes
R10	36	40	0	Yes	28	35	0	Yes	25	35	0	Yes
R11	36	40	0	Yes	28	35	0	Yes	25	35	0	Yes
R12	36	40	0	Yes	28	35	0	Yes	25	35	0	Yes
R13	36	40	0	Yes	28	35	0	Yes	25	35	0	Yes
R14	36	40	0	Yes	28	35	0	Yes	25	35	0	Yes
R15	36	40	0	Yes	28	35	0	Yes	25	35	0	Yes
R16	40	40	0	Yes	32	35	0	Yes	27	35	0	Yes
R17	36	40	0	Yes	27	35	0	Yes	24	35	0	Yes
R18	35	40	0	Yes	27	35	0	Yes	24	35	0	Yes

Receiver ID	Daytime period, Battery L_{WA} 96 dB(A)				Evening period, Battery L_{WA} 88 dB(A)				Night-time period, Battery L_{WA} 82dB(A)			
	Predicted dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)	Predicted dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)	Predicted dB(A)	Criteria dB(A)	Exceedance dB(A)	Compliance? (Yes / No)
R19	35	40	0	Yes	27	35	0	Yes	24	35	0	Yes
R20	35	40	0	Yes	27	35	0	Yes	24	35	0	Yes
R21	25	40	0	Yes	18	35	0	Yes	13	35	0	Yes
R22	34	40	0	Yes	26	35	0	Yes	23	35	0	Yes
R23	35	40	0	Yes	27	35	0	Yes	23	35	0	Yes
R24	30	40	0	Yes	24	35	0	Yes	21	35	0	Yes
R25	38	40	0	Yes	30	35	0	Yes	25	35	0	Yes
R26	34	40	0	Yes	26	35	0	Yes	23	35	0	Yes
R27	34	40	0	Yes	26	35	0	Yes	23	35	0	Yes
R28	34	40	0	Yes	26	35	0	Yes	22	35	0	Yes
R29	29	40	0	Yes	21	35	0	Yes	18	35	0	Yes
R30	34	40	0	Yes	26	35	0	Yes	23	35	0	Yes
R31	34	40	0	Yes	26	35	0	Yes	22	35	0	Yes
R32	33	40	0	Yes	25	35	0	Yes	21	35	0	Yes
R33	29	40	0	Yes	23	35	0	Yes	21	35	0	Yes
R34	34	40	0	Yes	26	35	0	Yes	22	35	0	Yes
R35	33	40	0	Yes	25	35	0	Yes	22	35	0	Yes
R36	33	40	0	Yes	25	35	0	Yes	22	35	0	Yes
R37	33	40	0	Yes	24	35	0	Yes	21	35	0	Yes

3.4 Operational noise limits during infrequent peak temperature days

Grid-scale Battery Energy Storage System is a relatively new technology that is evolving rapidly and continuously improving in terms of battery and inverter technology performance.

The battery cells that are part of the BESS are required to maintain an acceptable temperature level in order to operate efficiently and preserve their lifespan. As such, when the system has a high level of utilisation and when the ambient conditions are hot, the system will require more cooling, which translate in the thermal system fans to run harder and for longer. The primary noise emissions of a BESS come from those cooling fans.

Peak temperature days are however limited and usually do not exceed 10% of the time in any season.

It is during those peak temperature days that BESS deliver their best value to the NSW energy consumers by providing critical services to the grid, which in turn enable a higher level of renewable and an overall cheaper electricity for consumers. Having considered reasonable and feasible mitigation measures, this is why the proponent is asking for some relief during the daytime and evening time, only for up to 10% of the time during any season.

Compared to other grid-scale assets, BESS are very flexible and adaptable, and the fan speed can be managed. However, limiting the fan speed impacts the battery's performance and, therefore, the value it can provide to the NSW consumers.

A reasonable and feasible approach to assessing the operation of the Project during extremely hot days is to allow for less stringent day and evening criteria. To account for these infrequent meteorological conditions, when temperatures are extremely high, the following criteria shown in Table 3-6 have been recommended and applied for the Project.

Table 3-6 Operational noise criteria during peak temperature days (up to 10% in any season)

Receiver	Noise criteria in dB(A)		
	Day, $L_{Aeq\ 15min}$	Evening, $L_{Aeq\ 15min}$	Night, $L_{Aeq\ 15min}$
Residential receivers during 10% of any season	45	38	35

It should be noted that these criteria would be used for less than 10% in any season and the criteria in Section 2.1 will apply at other times.

The daytime criterion would be temporarily relaxed by 5 dB(A) to allow for increased fan duty during peak temperature days. Most commonly, this will allow the batteries to charge when renewable energy is sufficiently available and/or provide critical ancillary services.

The evening criterion from 6 pm – 10 pm would be temporarily relaxed by 3 dB(A) to allow for increased fan duty during peak temperature evenings. Most commonly, this will allow the project to provide electricity during the evening peak demand and/or provide critical ancillary services. This particular relief will also ensure that the asset will be able to sufficiently cool down during the evening period such that we can ensure no exceedances during the night period.

No relaxed criterion is proposed for the night-time period.

This proposed peak temperature criteria relaxation would allow for the BESS to better operate throughout the year and increase the value it provides to consumers.

It is recommended that an initial temporary period of noise monitoring between the source and the most affected receivers be conducted after the commencement of operation to confirm the noise level predictions. The monitoring will include day, evening, and night periods and meteorological conditions that would represent typical worst-case scenarios where reasonable and feasible. If it is observed that the noise levels exceed the noise predictions in this report, the operator would have the ability to adjust the equipment to a lower duty factor that allows for compliance with the noise limits to be achieved and/or implement other mitigation measures. It should be noted that the assessed layout already includes consideration of perimeter and internal dividing noise walls, optimisation of fan speeds and orientation of battery enclosures to minimise noise levels insofar as possible. Following the application of adjusted noise criteria for worst case temperature conditions, the proponent could then consider direct negotiations with all impacted landowners, for example, this could include at property treatment.

4 Conclusion

This report presents the results of the operational noise assessment with an updated BESS equipment selection and layout. This assessment has been carried out in accordance with NSW regulatory requirements identified in the SEARs issued for the development.

Noise mitigation options have been developed based on the information provided in report S230482RP1B Section 7.4 and variable battery enclosure sound power levels presented in Section 3.3. The reasonable and feasible operational noise mitigation measures would consist of:

- Optimised layout and orientation of battery enclosures.
- Installation of noise walls around the BESS equipment based on indicative heights presented in report S230482RP1B.
- Implementation of limitations of fan speed duty in the equipment firmware for the daytime, evening and night-time periods to achieve compliance with the baseline NPI noise criteria at all noise-sensitive receivers during periods of typical operations (up to 90% of any season) and compliance with the adjusted criteria during periods of high temperature operations (up to 10% of any period).

It is noted that the indicative mitigation measures including battery and transformer orientations and noise barrier locations and heights will be further developed during the detailed design stage of the Project when the equipment selection for the Project is finalised.

A period of temporary noise monitoring could be conducted between the noise source and the most affected receivers after the commencement of operation to verify predicted noise levels. This monitoring would cover daytime, evening, and night-time periods, as well as typical worst-case meteorological conditions where reasonable and feasible.