MOTT MACDONALD

Noise and Vibration Impact Assessment

Acoustic Advice

Project:	Project Hive – Williamtown Site		
Our reference:	703100925	**Revision:**	1
Prepared by:	Jacob McGrath	**Date:**	04/12/2023
Approved by:	Lindsay Speyers	**Checked by:**	Tom Krikke
Subject:	Acoustic Advice – Noise and Vibration Impact Assessment		

1 Purpose

The purpose of this advice is to provide a Noise Impact Assessment for the BESS (Battery Energy Storage System) site located in Williamtown, NSW that is associated with the Project Hive energy network project by the Clean Energy Transfer Fund, for which Mott MacDonald are the owner's engineer for the delivery of the project.

Project Hive integrates ten (10) sub-5MW BESS in the Hunter Valley regional area, resulting in a co-ordinated 200MWh capacity. This innovative concept enables rapid deployment of coordinated and cost-effective energy storage solutions, while deferring electrical network investment and promoting more renewable energy sources on the grid.

The Project Hive development in Williamtown, NSW is located at 103 Cabbage Tree Road (Lot 1 DP 996491) in the Port Stephens Council Local Government Area (LGA) and proposes a single BESS site with a connection point to the existing grid infrastructure.

The site features equipment with noise-generating potential which are in the vicinity of sensitive receivers, requiring an assessment of noise/vibration impacts in accordance with the NSW Environmental Protection Authority (EPA) and other local requirements.

For the purposes of preparing a Noise and Vibration Impact Assessment (NVIA) outlining the noise and vibration opportunities and constraints, the relevant noise and vibration criteria have been included within this report and are discussed in further detail. Acoustic criteria are applicable for both the operation and the construction of the project.

Recommendations for the acoustic design and treatment of the project have provided to minimise the acoustical impact of the development to surrounding receivers, based on the relevant noise and vibration criteria applicable within the Port Stephens Council LGA and the State of NSW.

Specific acoustic designs/solutions are still being investigated by the project team and have not yet been finalised. Several options are being considered including but not limited to the provision of quieter equipment selections, quieter alternative components like fans in the selected equipment and specific treatments like acoustic attenuators, lining, enclosures and barriers.
To this end, this NVIA doesn't propose a specific acoustic design/solution and instead presents a performance-specification approach, which clearly states the criteria/treatment requirements but allows for the specific solutions to be developed in future as the design progresses.

2 Site

2.1 Site Overview

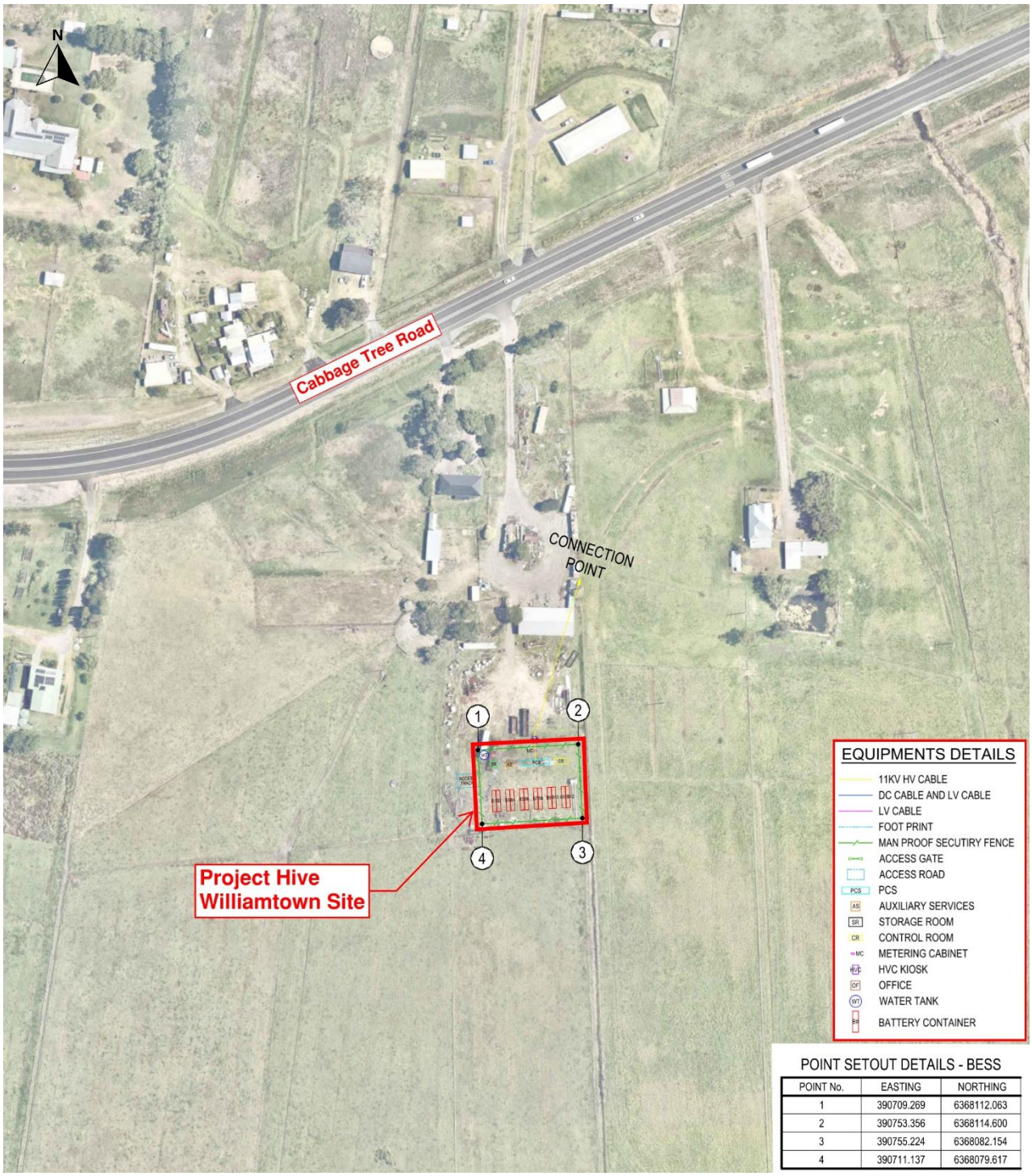
The Project Hive development at 103 Cabbage Tree Road, Williamtown NSW (Lot 1 DP 996491) proposes a single BESS site. The Williamtown site comprises a total land area of approximately 1,400m^2. The Williamtown site is considered to be in the Hunter Valley regional area and is specifically located in the Port Stephens Council LGA.

The site comprises the following equipment with noise-generating potential:

- Twelve (12) individual BESS battery containers
- One (1) Power Conversion System (PCS) inverter container, which also contains one (1) transformer

The Williamtown site is surrounded by:

- Cabbage Tree Road to the north, which features one (1) lane of 80km/h traffic in each direction
- Rural/residential properties with detached dwellings, located to the north, east and west
- Other non-residential rural uses such as agricultural and livestock farming
- A large greenhouse hydroponic farming property located to the south-west



POINT No.	EASTING	NORTHING
1	390709.269	6368112.063
2	390753.356	6368114.600
3	390755.224	6368082.154
4	390711.137	6368079.617

Figure 1: Site Overview and Equipment Layout `

2.2 Site Location and Sensitive Receivers

The Williamtown site and the surrounds are located in RU2 - Rural Landscape zoning. Cabbage Tree Road to the north and Nelson Bay Road to the east are designated as SP2 – Infrastructure – Classified Road zoning.

The site is within proximity to the following sensitive receivers, with their respective zoning sourced from NSW Planning Portal Spatial Viewer and included in Figure 2. The description of each identified receiver and its classification per the NSW Noise Policy for Industry (NPfI) is summarised in Table 1.

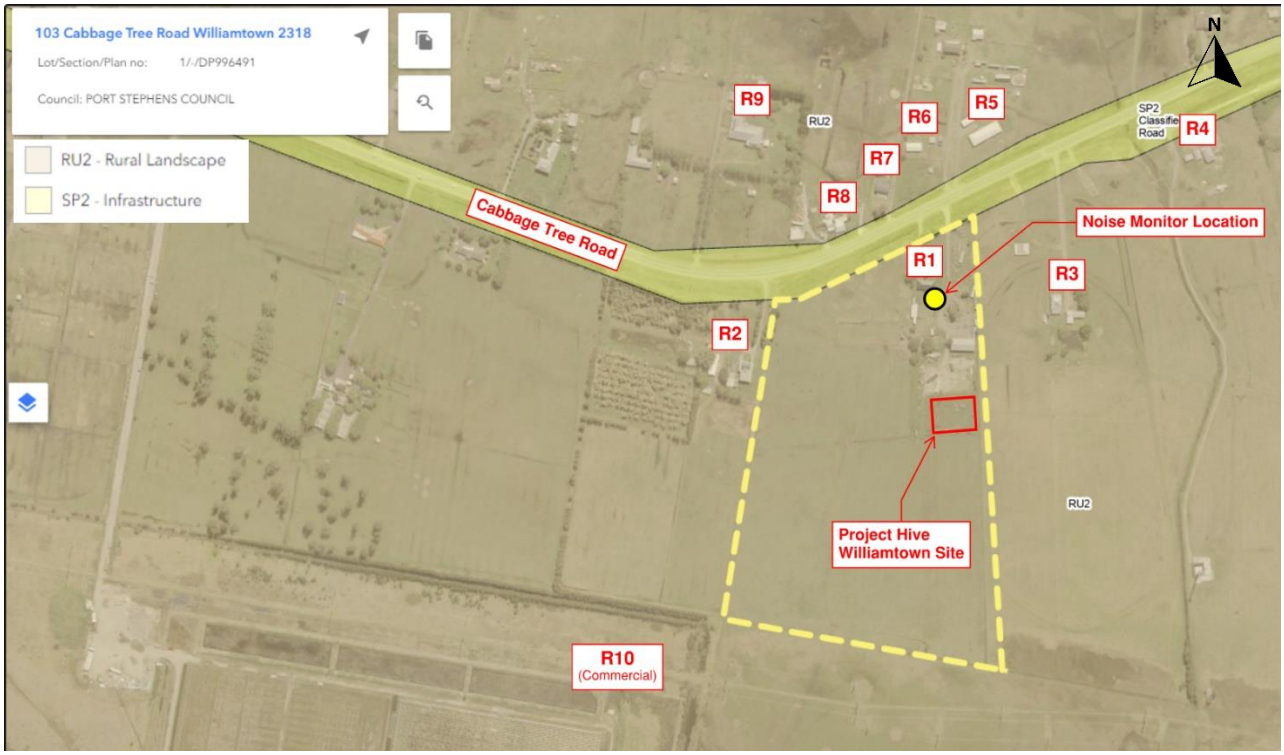


Figure 2: Site Location, Surrounding Sensitive Receivers and Respective Zoning, Including Noise Monitor Location

Table 1: Sensitive Receiver Details

Receiver ID	Type of Receiver [1]	Description	Min. Distance [2]
R1	Suburban residential	Detached dwelling at same site 103 Cabbage Tree Road	110m
R2	Suburban residential	Detached dwelling at 121 Cabbage Tree Road	190m
R3	Suburban residential	1st detached dwelling at 89 Cabbage Tree Road	110m
R4	Suburban residential	Detached dwelling at 75 Cabbage Tree Road	320m
R5	Suburban residential	1st detached dwelling at 98 Cabbage Tree Road	260m
R6	Suburban residential	1st detached dwelling at 100 Cabbage Tree Road	260m
R7	Suburban residential	Detached dwelling at 106A Cabbage Tree Road	230m
R8	Suburban residential	1st detached dwelling at 112 Cabbage Tree Road	220m
R9	Suburban residential	1st detached dwelling at 128 Cabbage Tree Road	340m

Receiver ID	Type of Receiver [1]	Description	Min. Distance [2]
R10	Commercial prem.	Large greenhouse hydroponic farming property with commercial operations, located at 183 Cabbage Tree Road and referred to previously as “Maria’s Farm Veggies”	380m

Note 1: Receiver types have been assigned in accordance with the NSW NPfI based on existing noise environment. Refer to Section 4.1.2.2.

Note 2: The minimum distances between the Project Hive Williamtown site and the surrounding sensitive receivers in this table are approximations. Precise equipment layouts and distances between individual plant/equipment items have been considered in the assessment in the sections below.

3 Existing Noise Environment

3.1 Unattended Noise Survey

Unattended noise monitoring was undertaken to determine existing ambient and background noise levels over the long-term.

Noise monitoring was conducted between Thursday 5 October 2023 and Friday 20 October 2023. The noise monitor was installed near an existing residence at the 103 Cabbage Tree Road site as presented in Figure 2.

The noise monitoring was conducted at the most-affected noise sensitive receiver and the measured noise levels are summarised in Table 2.

Table 2: Summary of unattended noise monitoring

Location	Rated Background Levels dB(A) L_{90}			Measured Ambient Levels dB(A) $L_{eq,Period}$		
	Daytime	Evening	Night-time	Daytime	Evening	Night-time
R1 Detached dwelling at the same site 103 Cabbage Tree Road	42	37	32	62	61	50

Note 1: Time of day is defined as per the Noise Policy for Industry 2017 and are day – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays, evening – the period from 6pm to 10pm, night – the remaining periods.

Further details of the unattended noise monitoring including logger graphs is included as Appendix A.

3.2 Attended Noise Survey

An attended noise survey was undertaken to verify existing ambient and background noise levels over the short-term.

Attended noise measurements were conducted on Friday 20 October 2023. The measurements were conducted in accordance with Australian Standard AS 1055-2018 “Acoustics - Description and measurement of environmental noise”.

The noise measurements were conducted at the most-affected noise sensitive receiver and the measured noise levels are summarised in Table 3.

Table 3: Summary of attended noise survey

Location	Date, Start Time & Weather	Measured Levels, dB(A), 15 min			Description of Noise Environment and dB(A), L_{max} Levels due to Specific Events
		L_{eq}	L_{90}	L_{max}	
R1 Detached dwelling at the same site 103 Cabbage Tree Road	20/10/2023 9:05 am Wind: 1.5m/s (S) Temp: 19°C Cloud: 0 okta	50	40	70	Birds: 36-70 Insects: 42-45 Road Traffic: 47-65

4 Noise and Vibration Criteria

4.1 Operational Environmental Noise Emission Criteria

The close proximity of sensitive receptors, in particular residential properties, requires criteria for noise emissions from the project to be established. Noise emissions from the operation of the project to nearby noise sensitive receivers have been assessed.

4.1.1 Port Stephens Council

As the development is located on land that is zoned as RU2 - Rural Landscape per the NSW Planning Portal Spatial Viewer, the Port Stephens Local Environmental Plan 2013 and the associated Port Stephens Development Control Plan (DCP) 2014 does not establish any specific noise emission criteria for this land use.

However, the DCP notably refers to the NSW Industrial Noise Policy 2000 (INP) which has been superseded by the NSW Noise Policy for Industry 2017 (NPfI) to protect the amenity of surrounding receivers to the development.

As per the guidance notes in the NPfI, compliance with the NPfI is expected to result in compliance with the DCP. Therefore, this assessment will adopt the criteria and recommendations of the NPfI which is further discussed below.

4.1.2 Noise Policy for Industry 2017

The NSW NPfI sets out NSW EPA requirements for assessment and management of noise from industry in NSW. The NSW NPfI prescribes methods for determining the statutory environmental noise limits that apply to noise sensitive receivers with regards to individual noise sources only.

The assessment procedure for industrial noise sources has three components:

- Controlling intrusive noise impacts in the short term for residential receivers
- Maintaining noise level amenity for particular land uses for residences and other land uses; and
- Maximum noise level assessment for the potential of sleep disturbance during night-time.

In assessing the noise impact of industrial sources, all components must be considered for residential noise sensitive receivers. In most cases, only one will become the limiting criterion and form the project-specific noise levels for the industrial source under assessment. The intrusive noise and sleep disturbance criteria do not apply to non-residential receivers, instead the amenity criterion is applicable to these receivers.

For a residence, the project noise trigger level and maximum noise levels are to be assessed at the reasonably most-affected point on or within the residential property boundary or, if that is more than 30 metres from the residence, at the reasonably most-affected point within 30 metres of the residence, but not closer than 3 metres to a reflective surface and at a height of between 1.2–1.5 metres above ground level.

4.1.2.1 Project Intrusiveness Noise Level

The assessment requirements for intrusive noise due to industrial sources state:

> *The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold.*

The prescribed intrusiveness criterion for residential receivers may be summarised as:

> **$L_{Aeq,\ 15\text{-}minute}$ ≤ Rating Background Level (RBL, L_{A90}) + 5 dB**

Minimum assumed RBLs apply in this policy. These result in minimum intrusiveness noise levels as follows:

Table 4: Minimum assumed RBLs and project intrusiveness noise levels – Sourced from NSW NPfI

Time of Day [1]	Minimum Assumed RBL, dB(A)	Minimum Project Intrusiveness Noise Levels, dB(A), $L_{eq,15\ min}$
Day	35	40
Evening	30	35
Night	30	35

Note 1: Time of day is defined as per the Noise Policy for Industry 2017 and are day – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays, evening – the period from 6pm to 10pm, night – the remaining periods.

An acoustic site survey has been undertaken, and a summary of the results is included in Section 3.1. Subsequently, the intrusiveness criterion is established and captured in Table 6.

4.1.2.2 Project Amenity Noise Level

To limit continuing increases in noise levels from application of the intrusiveness level criteria alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels prescribed in the NSW NPfI where feasible and reasonable.

The recommended amenity noise levels (ANL) represent the objective for total industrial noise at a receiver location, whereas the project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

Based on the surrounding receivers and their respective zoning as identified in Figure 2 and Table 1, the relevant amenity noise levels outlined in Table 2.2 of the NPfI are summarised in Table 5 below.

It should be noted that the project amenity noise level is based on a generally recommended amenity deemed suitable for a given area as defined by the EPA. These recommendations should be validated with site-specific long-term unattended noise measurements and any discrepancies identified and adjusted accordingly.

Table 5: Amenity Noise Levels – Sourced from NSW NPfI

Receiver	Noise Amenity Area	Time of Day	Recommended Amenity Noise Level, dB(A), $L_{eq,\ period}$	Project Amenity Noise Level [2], dB(A), $L_{eq,15\ min}$
Residential	Suburban [1]	Day	55	53
		Evening	45	43
		Night	40	38
Commercial premises	All	When in use	65	63

Note 1: The NSW NPfI defines a Suburban residential receiver category as being an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity.
Typical existing Rating Background Levels (RBLs) would be:

- Daytime: <45 dB(A)
- Evening: <40 dB(A)
- Night: <35dB(A)

Note 2: The NSW NPfI defines the project amenity noise level for industrial developments to be equal to the recommended amenity noise level minus 5 dB. In addition, to standardise the time periods for the intrusiveness and amenity noise levels, the policy assumes that the $L_{Aeq,15min}$ will be taken to be equal to the $L_{Aeq,period}$ + 3 dB.

4.1.2.3 Project Noise Trigger Level

Based on the measured noise levels and the derived project amenity noise levels, site-specific project noise trigger levels are derived and summarised in Table 6.

Table 6: Project amenity and intrusiveness noise levels and the subsequently derived project noise trigger levels

Location	Time of Day[1]	Project Amenity Noise Level, dB(A), $L_{eq,15\ min}$	Project Intrusiveness Noise Level, dB(A), $L_{eq,15\ min}$	Project Noise Trigger Level, dB(A), $L_{eq,15\ min}$
Receivers R1 to R9 – Suburban Residential	Day	53	47	**47**
	Evening	43	42	**42**
	Night	38	37	**37**
Receiver R10 – Commercial Premises	When in use	63	-	**63**

Note 1: Time of day is defined as per the Noise Policy for Industry 2017 and are day – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays, evening – the period from 6pm to 10pm, night – the remaining periods.

4.1.2.4 Maximum Noise Level Event Assessment

The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Where the night-time noise emission levels due to industrial sources at a residential receiver exceed the following criteria, a detailed maximum noise level event assessment should be undertaken:

- $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater.

Sleep disturbance criteria has been derived for each critical receiver and are included in Table 7.

Table 7: Project sleep disturbance criteria

Location	Project Sleep Disturbance	
	dB(A) $L_{eq,15min}$	dB(A) L_{Fmax}
Receivers R1 to R9 – Suburban Residential	40	52

4.2 Construction Noise and Vibration Criteria

4.2.1 Construction Noise

The NSW Interim Construction Noise Guideline 2009 (ICNG) has been adopted to establish the relevant noise criteria to protect the amenity of surrounding receivers due to construction related noise emissions.

4.2.1.1 Residential Receivers

Noise Management Levels (NML) are the level of noise above which receivers are considered to be 'noise affected'. They are based on the measured background noise level (RBL) plus an additional allowance of 10 dB during standard hours and 5 dB outside of standard hours.

Where construction noise levels are above 75 dB(A) at residential receivers during standard hours, they are considered 'highly noise affected' and require additional considerations to mitigate potential impacts.

Table 8: Construction noise management levels for residential receivers and working hours (Source: Table 2 of the NSW ICNG)

Time of Day (per NSW ICNG)	NML, dB(A), $L_{eq,15\ min}$ [1,2]	How to Apply
Recommended standard hours: Monday – Friday: 7:00 am – 6:00 pm Saturday: 8:00 am – 1:00 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB (**= 52 dB(A)**)	The noise affected level represents the point above which there may be some community reaction to noise. – Where the predicted or measured dB(A) $L_{eq;15\ min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. – The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected **75 dB(A)**	The highly noise affected level represents the point above which there may be strong community reaction to noise. – Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences). 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB **(Evening = 42 dB(A))** **(Night = 37 dB(A))**	– A strong justification would typically be required for works outside the recommended standard hours. – The proponent should apply all feasible and reasonable work practices to meet the noise affected level. – Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Note 2: The RBL is the overall background noise level representing each assessment period (NSW ICNG day/evening/night) over the whole monitoring period. The term RBL is described in detail in the NSW NPfI.

4.2.1.2 Other Sensitive Land Uses

The NSW ICNG provides maximum noise levels for premises other than residential receivers as summarised in Table 9. External noise levels are to be assessed at the most affected point within 50 m of the area boundary.

Table 9: Construction noise management levels at sensitive land uses (other than residences) (Source: Table 3 of the NSW ICNG)

Receiver (applies when properties are being used)	**NML, dB(A), $L_{eq;15\ minute}$**
Office, retail outlets (Commercial)	70 (external)

4.2.2 Construction Traffic Noise

The RNP provides guidance on the assessment of noise impacts from road traffic noise on sensitive receivers.

It is anticipated that construction traffic would access the site via Cabbage Tree Road, therefore the local road criteria would apply for additional traffic from construction works. Table 10 presents a summary of the applicable criteria for residential receivers.

Table 10: Road traffic noise criteria for residential receivers on existing roads affected by additional traffic from land use developments

Road Type	**Road Traffic Noise Criteria, dB(A), $L_{eq\ 1hr}$**	
	Day (7am to 10pm)	**Night (10pm to 7am)**
Local roads	**55 (external)**	**50 (external)**

4.2.3 Construction Vibration

Vibration associated with construction activities can result in impacts on human comfort or the damage of physical structures such as dwellings. These two impacts have different criteria, with the effects of vibration on human comfort having a lower threshold.

Importantly, cosmetic damage is regarded as minor in nature; it is readily repairable and does not affect a building's structural integrity. If there is no significant risk of cosmetic damage, then structural damage is not considered a risk. Additionally, due to the development's location within proximity to surrounding receivers, it is unlikely that structural damage is to occur to the surrounding receivers.

4.2.3.1 Human Comfort (Amenity)

Table 11 presents the limits (vibration dose values) above which there is considered to be a risk that the amenity and comfort of people occupying buildings would be affected by intermittent vibration from construction works. These limits are sourced from *Assessing Vibration: A Technical Guideline* (AVTG) (NSW DEC, 2006).

Table 11: Human comfort (amenity) guideline vibration limits (intermittent work and continuous vibrations)

Location	**Assessment Period**	**Vibration Dose Value, $m/s^{1.75}$**		**Weighted Rms Values For Continuous Vibration Acceleration (m/s^2) 1-80 Hz**			
		Preferred values	**Maximum values**	**Preferred z-axis values**	**Preferred x&y - axes values**	**Max. z-axis values**	**Max. x&y -axes values**
Residences	Daytime	0.20	0.40	0.010	0.0071	0.020	0.014
	Night time	0.13	0.26	0.007	0.005	0.014	0.010
Workshops	Day- or night-time	0.80	1.60	0.040	0.029	0.080	0.058

4.2.3.2 Cosmetic Building Damage and Structural Integrity

There are no vibration limits for building damage and structural integrity in the AVTG. Therefore, the limits set out in *British Standard BS 7385-2: Evaluation and Measurement for Vibration in Buildings Guide to Damage Levels from Ground-borne Vibration* are typically adopted in NSW.

A summary of the limits is provided in Table 12. These peak vibration limits are set so that the risk of cosmetic damage is minimal. They have been placed at the lowest level above which damage has been credibly demonstrated. The limits also assume that the equipment causing the vibration is only used intermittently.

Table 12: BS 7385-2 Guideline vibration limits for cosmetic damage

Group	Type Of Structure	Peak Component Particle Velocity, mm/s [1]		
		4–15 Hz	**15–40 Hz**	**40 Hz and above**
1	Reinforced or framed structures Industrial or heavy commercial buildings	50		
2	Un-reinforced or light framed structures Residential or light commercial buildings	15 – 20[2]	20 – 50	50

Note 1: Values referred to are at the base of the building, on the side of the building facing the source of vibration (where feasible).

Note 2: At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

5 Operational Noise Impact Assessment

5.1 Input Parameters and Assumptions

Environmental noise emissions from the noise-generating plant/equipment associated with the Project Hive site at Williamtown have been assessed.

Noise modelling has been conducted using the software SoundPLAN Version 8.2. The noise model considered multiple factors, including local terrain, geometrical spreading and shielding from the terrain.

This noise modelling has been conducted as a desktop study; no noise monitoring or noise model verification has been undertaken for this assessment. The specific inputs to the noise model are summarised in Table 13.

Table 13: Noise model inputs

Item	Description
Calculation method	ISO9613-2:1996 - Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation
Ground topography	From existing topographical maps provided by ELVIS Spatial Data (1m resolution).
Ground absorption	BESS Site Bounds: Set at 0% absorption (hard ground) due to the BESS site areas mostly consisting of primarily concrete, gravel or other hard surfaces. Surrounding Areas to Receivers: Set at 60% (partially absorptive ground) due to presence of existing grassy fields and other vegetation beyond the BESS site areas.
Receiver locations	All the relevant receivers are single-storey buildings and no consideration of multi-storey buildings was required. For the ground-level receivers the assessment points have been modelled as being the most-affected point on or within the residential property boundary or, if that is more than 30 metres from the residence, at the reasonably most-affected point within 30 metres of the residence, and at a height of between 1.5 metres above ground level. This is in accordance with the NSW NPfI.
Plant/equipment selections	Plant/equipment acoustic data in the form of Sound Power Levels (SWLs) have been provided by the project team and from the BESS/Inverter manufacturer Sungrow – these SWLs are presented in Table 14.
Plant/equipment heights	BESS Battery Containers: 2.6 metres PCS Inverter Containers: 2.9 meters
Plant/equipment operation	The noise-generating plant/equipment, being the BESS battery containers and PCS inverter containers, have all been assumed to be operating at 100% duty/speed/noise-output on continual basis (24 hours, 7 days a week), with the exception of the PCS inverter containers which are “running as a 5MW generator with 72.5% of rated power”. This was advised by the project team.

In accordance with the NSW NPfI, the noise impact assessment has been conducted with 1/3 octave band acoustic data to allow for the assessment of the “tonal noise” and “low-frequency noise” modifying factor corrections (adjustments) and determine if the selected plant/equipment items have such “annoying” characteristics that must be penalised in the assessment.

Table 14: Selected plant/equipment sound power level spectra, dB

1/3 Octave Band Frequency (Hz)	BESS Battery Containers (Selected Model: Sungrow ST2752UX)	PCS Inverter Containers (Selected Model: Sungrow SC6900UD, running as a 5MW generator with 72.5% of rated power and including a transformer)
25	82	86
32	81	88
40	82	88
50	85	87
63	78	86
80	77	85
100	82	87
125	81	84
160	78	86
200	83	83
250	95 [1]	87
315	86	92
400	85	85
500	85	82
630	82	82
800	80	80
1000	80	77
1250	76	76
1600	78	76
2000	77	75
2500	74	76
3150	73	74
4000	71	67
5000	69	85 [1]
6300	75 [1]	73
8000	62	70
10000	61	68
12500	60	67
16000	56	63
20000	59	56
Overall dB(A)	**91**	**92**

Note 1: It has been calculated that this plant/equipment selection has a tonality characteristic at this 1/3 octave band that may require a +5dB modifying factor corrections in accordance with the NSW NPfI. Actual assessment is based on noise emission levels at the receivers rather than being based on the source noise levels above. Refer to the assessment results presented in Section 5.4.

Note: The assessment of low-frequency characteristics is calculated based on the noise emission levels at the receivers. Refer to the assessment results presented in Section 5.4. A full low-frequency Modifying Factor Correction assessment per NSW NPfI couldn't be conducted as Mott MacDonald were only provided 1/3 octave band Sound Power Level data for the selected plant/equipment in the range from 25Hz to 20000Hz, whilst the NSW NPfI calls for low-frequency assessment down to the 10Hz 1/3 octave band. If the selected plant/equipment has noise emission contributions at these low frequency octave bands then these should be highlighted and further detailed equipment acoustic data provided for additional acoustic assessment.

5.2 Modelling Scenarios and Acoustic Treatments

In developing the noise impact assessment and through discussions with the project team, Mott MacDonald have determined and present the following two (2) modelling/design scenarios:

- Scenario 1: Currently Selected Plant/Equipment – Only Acoustic Treatment as Acoustic Barrier Fence
- Scenario 2: Currently Selected Plant/Equipment – Acoustic Barrier Fence PLUS Additional Acoustic Treatments on the BESS Battery Containers and PCS Inverter Containers (per Table 15 below)

Both Scenario 1 and Scenario 2 give consideration to a nominal 3.0m tall acoustic barrier around the perimeter of the BESS site (i.e. a single barrier system enclosing all plant/equipment). These approximately 3.0m tall fences are understood to be required on the project for visual screening and security, but they have the added benefit of providing a noise reduction if appropriately designed.

The following specific requirements are provided for this acoustic barrier fence:

- Constructed to a nominal height of 3.0 metres above the ground level where BESS equipment will be located, however the specific height shall be based on the highest point of the plant/equipment contained within:
  - Based on the equipment heights provided and listed in Table 13, where the tallest equipment is the PCS Inverter Containers at 2.9 metres tall, the barrier shall be detailed to extend at least 0.1 metres above the top of this equipment to ensure shielding and noise reduction.
  - The required final heights of these acoustic barriers shall also consider the site ground levels, slab levels, top of unit treatments like attenuators (if considered) and any other structures or footings which could increase the highest point of the plant/equipment and require a barrier taller than the nominal 3.0 metres.
- Constructed around the perimeter of the BESS site such that a blocked line of sight between the residential neighbours and plant/equipment items is always maintained.
- Constructed to be free of gaps and holes along the entire specified length and height.
- Constructed using solid materials that are rigid and achieve a minimum surface density of at least 12.5kg/m^2. Acceptable materials that could be considered include:
  - 50mm thick masonry (e.g. precast concrete, concrete blockwork, brickwork)
  - 1.6mm thick steel
  - 9mm compressed fibre cement sheet
  - 10mm thick Perspex; or,
  - Other alternatives could be considered provided they meet the recommended minimum surface density requirements
- Note that the required height of the noise barrier could be achieved through the combination of earth mounding and acoustic fencing – the lower portion may be earth mound whilst the upper portion may be fencing to the required minimum height above the top of the plant/equipment.

It should be noted from the Scenario 1 results presented in Table 16 that this already allowed for nominal 3.0m tall acoustic barrier was not a sufficient acoustic treatment on its own to achieve the applicable noise criteria at the sensitive residential receivers.

For Scenario 2, consideration was given to developing and incorporating additional acoustic treatments on the BESS Battery Containers and PCS Inverter Containers to achieve the required compliance.

Specific acoustic treatment solutions have not been included in this report. Several options are still being considered and assessed by the project team and client. The final selected acoustic treatments are

recommended to achieve the minimum noise reduction in Table 15 (which considers the equipment Sound Power Levels and tonal components documented in Table 14) to allow for achieving noise emission compliance at the surrounding receivers.

Table 15: Additional acoustic treatment recommendations for the BESS Battery Containers and PCS Inverter Containers (in the form of a minimum noise reduction)

Plant/Equipment	Minimum Noise Reduction, dB(A)
BESS Battery Containers	13
PCS Inverter Containers	14

5.3 Allowance for Alternative Assessments/Solutions

It is recommended that an alternative assessment and additional acoustic designs/solutions could be presented, provided that the alternative assessments/solutions comply with the site-specific operational noise criteria identified in Section 4.1.

The recommended minimum noise reduction in Table 15 above, can be achieved by a range, or combination, of acoustic treatment solutions including, but not limited to:

- Providing acoustically treated ventilation paths e.g. acoustic attenuators, acoustic louvres, lined ductwork
- Replacement or modification of noise emitting equipment e.g. alternative fans, compressors, transformers etc.
- Providing additional acoustic barriers/fencing, including additional localised barriers around the equipment
- Providing acoustic enclosures such as localised hoods to place over the equipment or providing an arrangement with acoustically rated air paths

This Noise Impact Assessment conducted by Mott MacDonald and the additional acoustic treatment recommendation presented in Table 15 has been somewhat simplified to allow for a singular recommended reduction that could be applied to all the key noise plant/equipment items (being the BESS containers and PCS Inverter containers) and lead to noise emission compliance at the surrounding receivers.

An alternative assessment could be developed that refines the acoustic treatment recommendations – an alternative assessment may consider reduced treatments for plant/equipment that is located away from the sensitive receivers and increased treatments for plant/equipment that face or are located closer to the sensitive receivers.

5.4 Results

Noise emissions from the operation of the identified plant/equipment has been modelled at the surrounding receivers. The noise impacts and any applicable Modifying Factor Corrections from the NSW NPfI have been assessed at each receiver and are summarised in Table 16.

Table 16: Calculated noise levels at the identified sensitive residential receivers, $L_{eq,15min}$, dB(A)

Receiver	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**
Scenario 1: ***Currently Selected Plant/Equipment – Only Treatment as Acoustic Barrier Fence***									
Most Stringent Criteria per NSW NPfI	Night: 37								
Modelled Noise Levels at Receivers	45	42	45	36	38	38	40	39	34
Modifying Factor Correction – Tonal Noise	+5	+5	+5	+5	+5	+5	+5	+5	+5
Modifying Factor Correction – Low-Frequency Noise	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Calculated Noise Levels at Receivers inc. Corrections	50	47	50	41	43	43	45	44	39
Complies?	**NO (+13)**	**NO (+10)**	**NO (+13)**	**NO (+4)**	**NO (+6)**	**NO (+6)**	**NO (+8)**	**NO (+7)**	**NO (+2)**
Scenario 2: ***Currently Selected Plant/Equipment – Acoustic Barrier Fence PLUS Additional Acoustic Treatments on the BESS Battery Containers and PCS Inverter Containers (per Table 15)***									
Most Stringent Criteria per NSW NPfI	Night: 37								
Modelled Noise Levels at Receivers	32	29	32	23	25	25	27	26	21
Modifying Factor Correction – Tonal Noise	+5	+5	+5	+5	+5	+5	+5	+5	+5
Modifying Factor Correction – Low-Frequency Noise	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Calculated Noise Levels at Receivers inc. Corrections	37	34	37	28	30	30	32	31	26
Complies?	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**

Additionally, Table 17 summarises the calculated noise levels for non-residential receivers for the same design/modelling scenarios.

Table 17: Calculated noise levels at the identified non-residential receivers, $L_{eq,15min}$, dB(A)

Receiver	**R10 – Commercial Premises**
Scenario 1: ***Currently Selected Plant/Equipment – Only Treatment as Acoustic Barrier Fence***	
Most Stringent Criteria per NSW NPfI	When in use: 63
Modelled Noise Levels at Receivers	35
Modifying Factor Correction – Tonal Noise	+5
Modifying Factor Correction – Low-Frequency Noise	n/a
Calculated Noise Levels at Receivers inc. Corrections	40
Complies?	**YES**
Scenario 2: ***Currently Selected Plant/Equipment – Acoustic Barrier Fence PLUS Additional Acoustic Treatment on BESS Battery Containers and PCS Inverter Containers (per Table 15)***	
Most Stringent Criteria per NSW NPfI	When in use: 63
Modelled Noise Levels at Receivers	22
Modifying Factor Correction – Tonal Noise	+5
Modifying Factor Correction – Low-Frequency Noise	n/a
Calculated Noise Levels at Receivers inc. Corrections	27
Complies?	**YES**

Sleep Assessment:

It is noted that an assessment of sleep disturbance impacts and comparison to the L_{max} maximum noise criteria stated in Table 7 has not been undertaken as:

- The continuous noise emissions from the equipment on the site and comparison to the NSW NPfI Project Noise Trigger Level ($L_{eq,15\ min}$) would dictate the assessment.
- It is anticipated that there would be little to no intermittent, impulsive maximum noise event emissions from the plant/equipment, such as sudden bangs, knocks, beeps etc., that would require assessment and all noise emissions would be continuous and regular per the point above – if there would be any such maximum event noise sources on the BESS site then these should be highlighted for further acoustic assessment.

5.5 Discussion

From the results presented in Table 16 and Table 17 above it has been determined that additional acoustic treatments are required on the BESS Battery Containers and PCS Inverter Containers (which are the predominant sources of noise) to achieve noise emission compliance.

It can be seen from Table 16 that in both Scenario 1 and Scenario 2 the highest noise impacts occur at the receivers located in closest proximity to the BESS site – these are Receiver R1 (Detached dwelling at same site 103 Cabbage Tree Road) and Receiver R3 (1st detached dwelling at 89 Cabbage Tree Road). It follows that if compliance is achieved at these closest receivers then compliance would follow at the receivers located further away, where additional noise attenuation with distance is afforded.

A specific acoustic treatment solution hasn't been provided as several options are still being considered and assessed by the project team – refer to Section 5.3 for a list of indicative acoustic treatments (e.g. attenuators, equipment/fan reselections) that could be considered to achieve the compliance stated in Scenario 2 above.

It should be noted that acoustic treatment may affect the mechanical performance of the selected equipment (e.g. ventilation, temperatures). Any nominated acoustic treatments shall be reviewed for mechanical suitability (and by other disciplines e.g. fire engineering) and accepted by the equipment supplier/manufacturer.

It has been recommended that an alternative assessment and additional acoustic designs/solutions could be presented, provided that the alternative assessments/solutions comply with the site-specific operational noise criteria identified in Section 4.1. Refer to commentary provided in Section 5.3.

6 Construction Noise and Vibration Impact Assessment

Before commencement of construction works, the contractor should prepare a Construction Noise and Vibration Management Plan (CNVMP) per the requirements of the NSW Interim Construction Noise Guideline 2009 (ICNG). The CNVMP would consider measures for reducing the source noise levels of construction equipment by construction planning and equipment selection where practicable. The CNVMP should include a detailed noise assessment updated to consider potential noise impacts at all affected properties.

7 Conclusion

Mott MacDonald have been engaged to undertake a Noise Impact Assessment for the single BESS site located in Williamtown, NSW that is associated with the Project Hive energy network project by the Clean Energy Transfer Fund.

The existing noise environment at the site/surrounds has been quantified and the sensitive receivers (i.e. existing residences) surrounding the site have been identified. This included unattended long-term noise monitoring was undertaken between Thursday 5 October 2023 and Friday 20 October 2023, with supplementary attended noise measurements conducted on Friday 20 October 2023.

The relevant site-specific noise and vibration criteria have been defined for the construction and operational phases in accordance with the NSW EPA's NPfI and other local requirements from the Port Stephens Council, based on the results of the unattended long-term noise monitoring.

Noise modelling has been completed to assess operational noise emission impacts. Two (2) scenarios were considered and the following notable outcomes are listed below:

- Scenario 1: Currently Selected Plant/Equipment – Only Acoustic Treatment as Acoustic Barrier Fence
- Scenario 2: Currently Selected Plant/Equipment – Acoustic Barrier Fence PLUS Additional Acoustic Treatments on the BESS Battery Containers and PCS Inverter Containers (per Table 15)

Several acoustic suppression options are available including, but not limited, to the provision of quieter equipment selections, quieter alternative components such as fans in the selected equipment and specific treatments such as acoustic attenuators, lining, enclosures and barriers.

It is considered that during the finalisation of the detailed design for the Construction Certificate the noise suppression options would be proven. The plant would not be able to operate unless it was certified as adhering to the mandated noise levels.

It has been recommended that an alternative assessment and additional acoustic designs/solutions could be presented, provided that the alternative assessments/solutions comply with the site-specific operational noise criteria identified in Section 4.1. Refer to commentary provided in Section 5.3.

The construction noise and vibration criteria have been established in accordance with the NSW ICNG and other relevant standards to allow for compliance for construction related noise emissions and vibration in terms of human comfort and cosmetic building damage. Once the construction methodology/staging is known then a specific construction phase noise/vibration assessment can be developed. It is recommended that before commencement of construction works, the relevant contractor should prepare a CNVMP per the requirements of the NSW ICNG.

From this Noise Impact Assessment, no major constraints have been identified for either the operational or construction acoustic impacts of this project and it is anticipated that compliance with applicable noise and vibration criteria can be achieved provided appropriate acoustic controls are put in place.

Appendix A – Noise Monitoring Details

Appendix A.1 – Installation Location

The unattended noise monitor was installed near an existing residence at the at the 103 Cabbage Tree Road site as presented in Figure 2 in the report body and in Figure 3 below.

Figure 3: Unattended Noise Monitoring Installation Location

Appendix A.2 – Weather Data

Local weather data for the site area was obtained from the Bureau of Meteorology – specifically from the Williamtown RAAF Weather Station (ID: 061078). This weather data has been integrated and periods of adverse weather conditions (e.g. wind speeds exceeding 5m/s and/or rain volumes greater than 0.5 mm per the NSW NPfI) have been excluded from the results of the unattended noise monitoring.

Appendix A.3 – Instrumentation

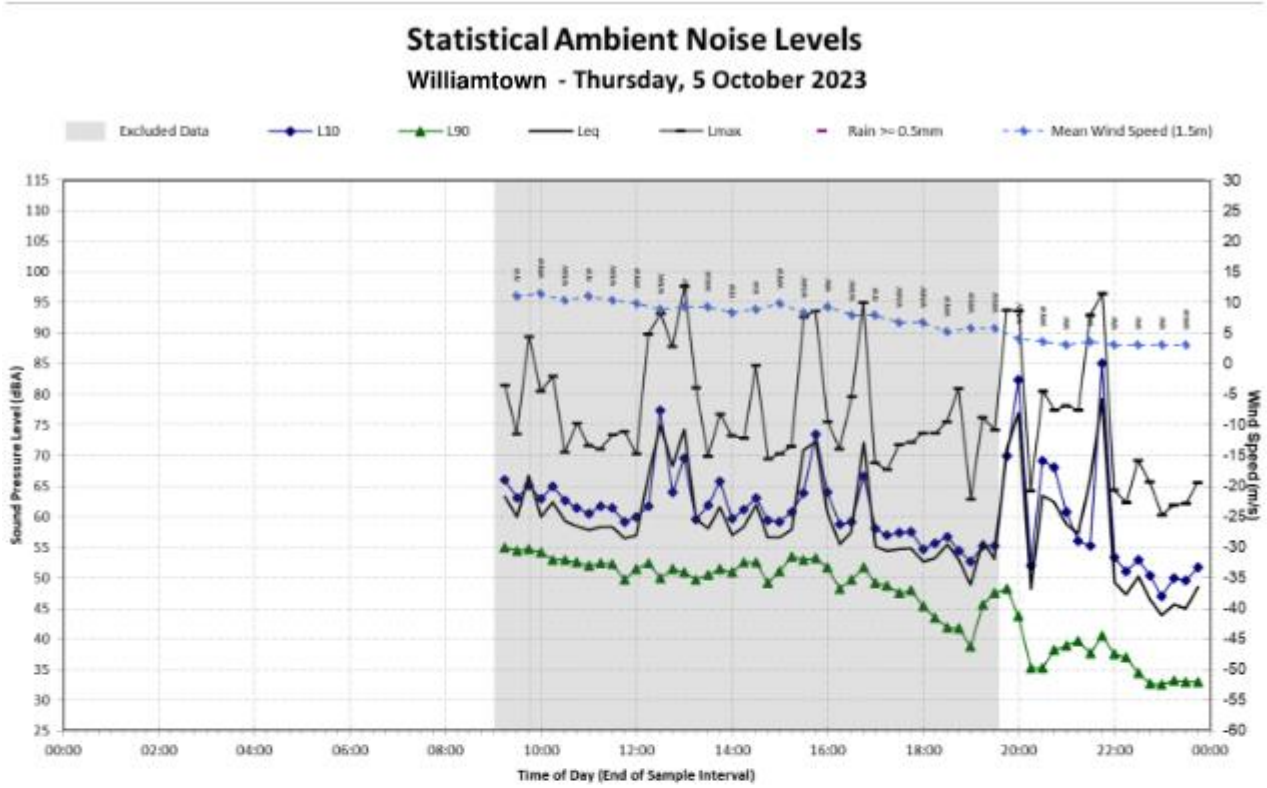
The acoustic instrumentation utilised throughout the site noise monitoring adheres to requirements of Section B1.1 of the NSW NPfI and carries current manufacturer or relevant calibration certificates. A schedule of the instrumentation utilised, including information on makes/models and calibration, is presented in Table 18.

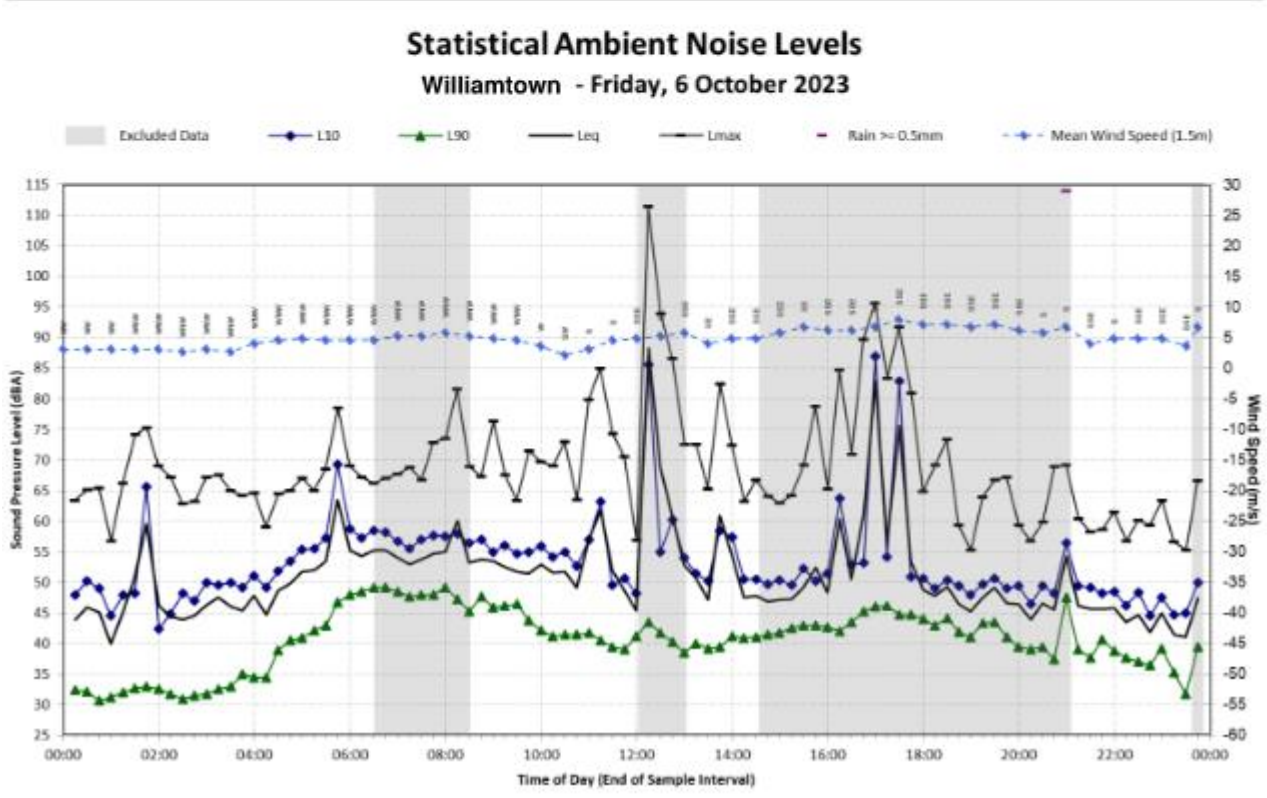
Table 18: Schedule of acoustic instrumentation utilised

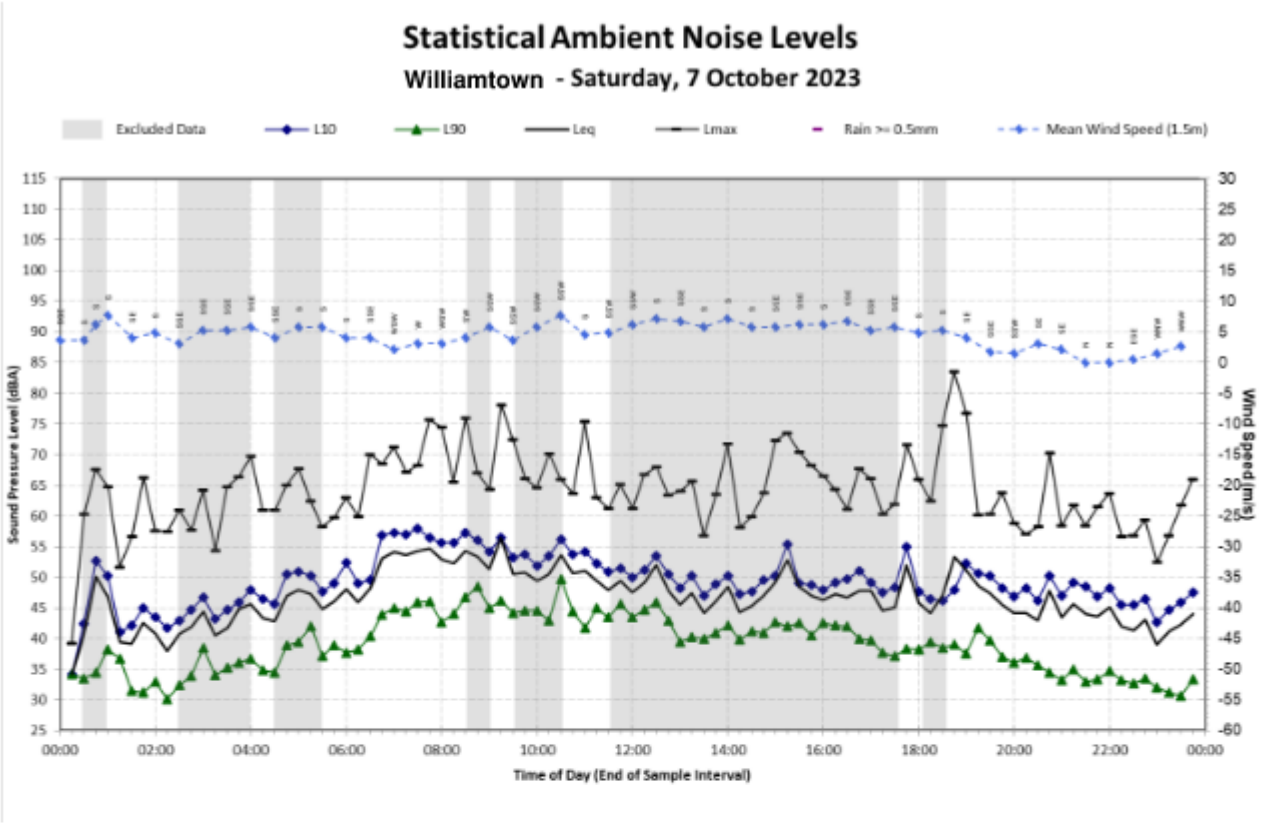
Instrumentation	Make/Model	Type/Class	Serial No.	Date of Last Calibration
Noise Monitor (Unattended)	BSWA Tech. 309	Class 2	600050	28 November 2022
Sound Level Meter (Attended)	Bruel & Kjaer 2250	Class 1	3024546	28 April 2023
Acoustic Calibrator	Svantek SV30A	Class 1	24889	22 May 2023

All logging instrumentation was programmed to continuously record statistical noise level indices in 15-minute intervals. Instrument calibration was checked before and after each measurement survey, with calibration found to be within the acceptable tolerance of ±0.5dB.

Appendix A.4 – Logger Graphs



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Williamtown - Saturday, 7 October 2023
Excluded Data
L10
L90
Leq
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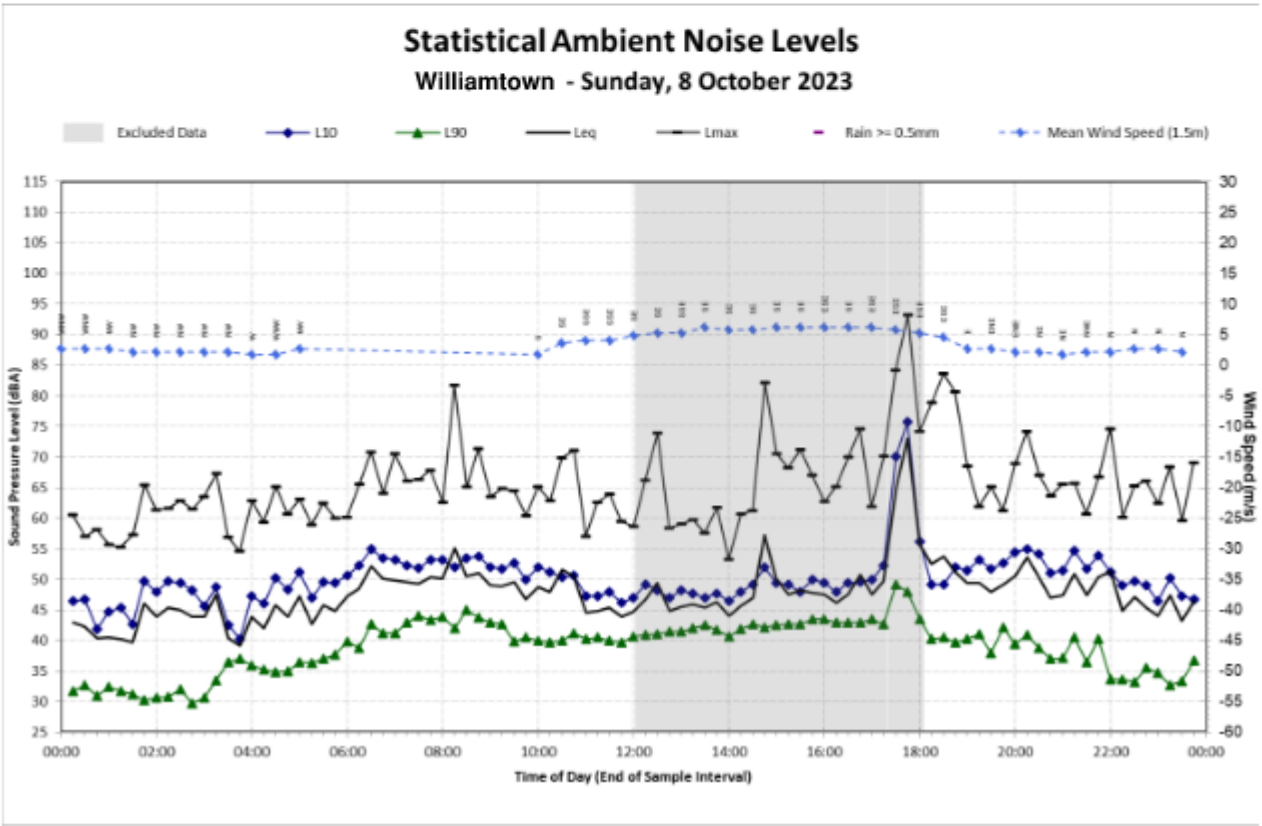
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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Williamtown - Sunday, 8 October 2023
Excluded Data
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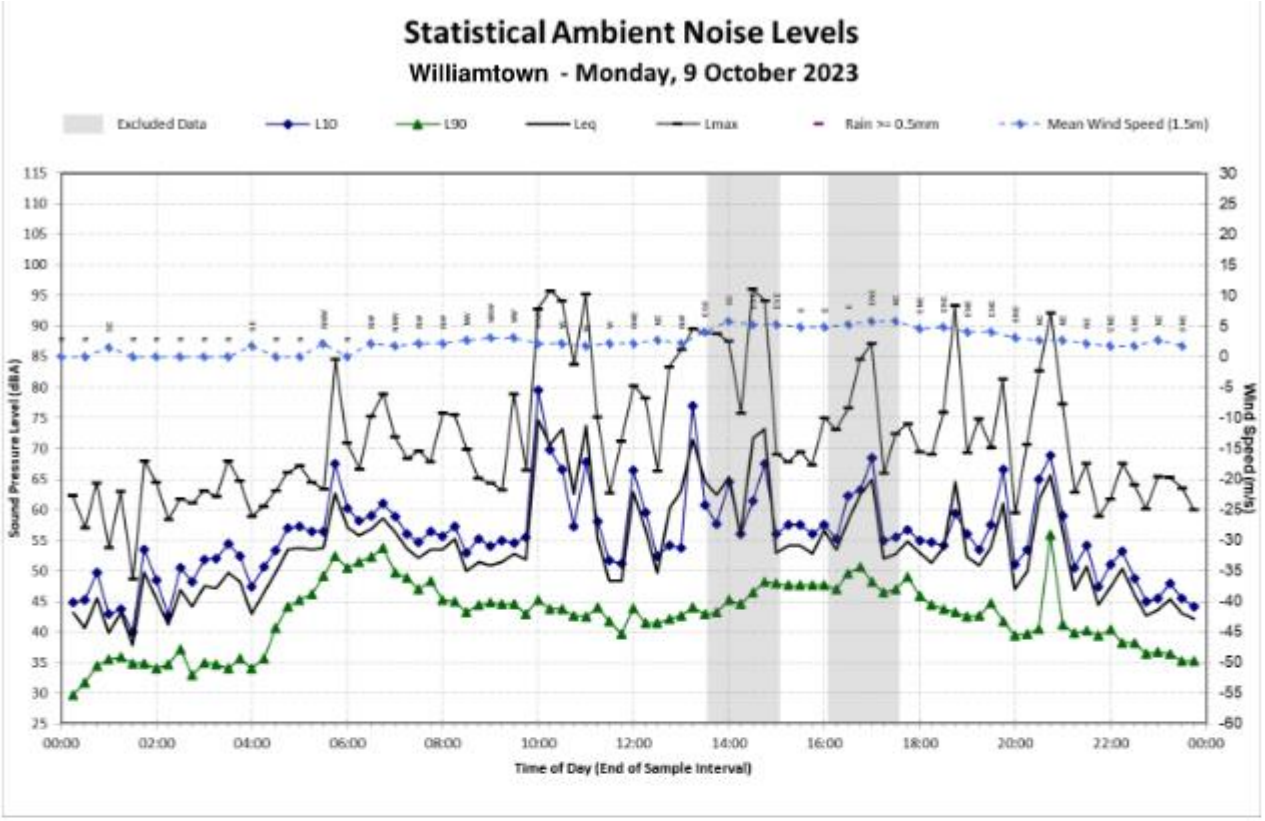
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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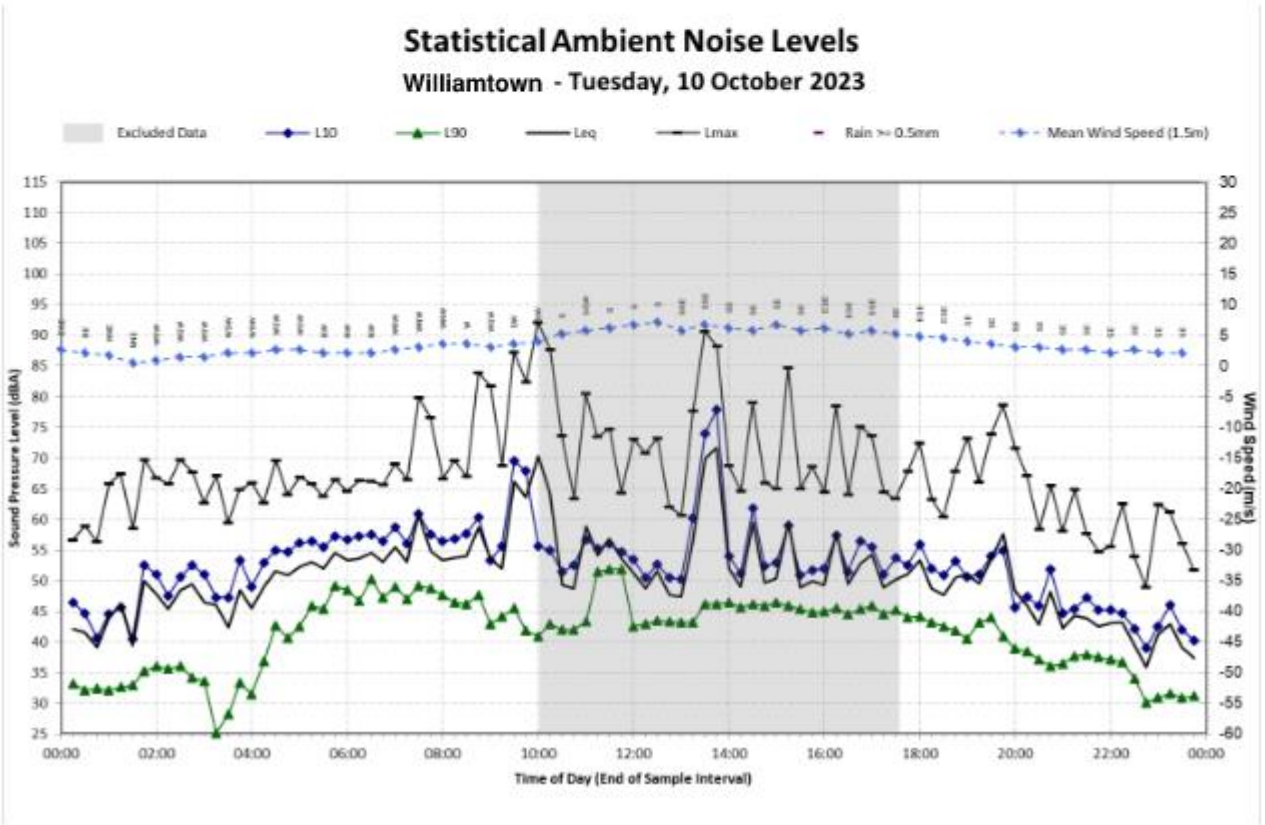
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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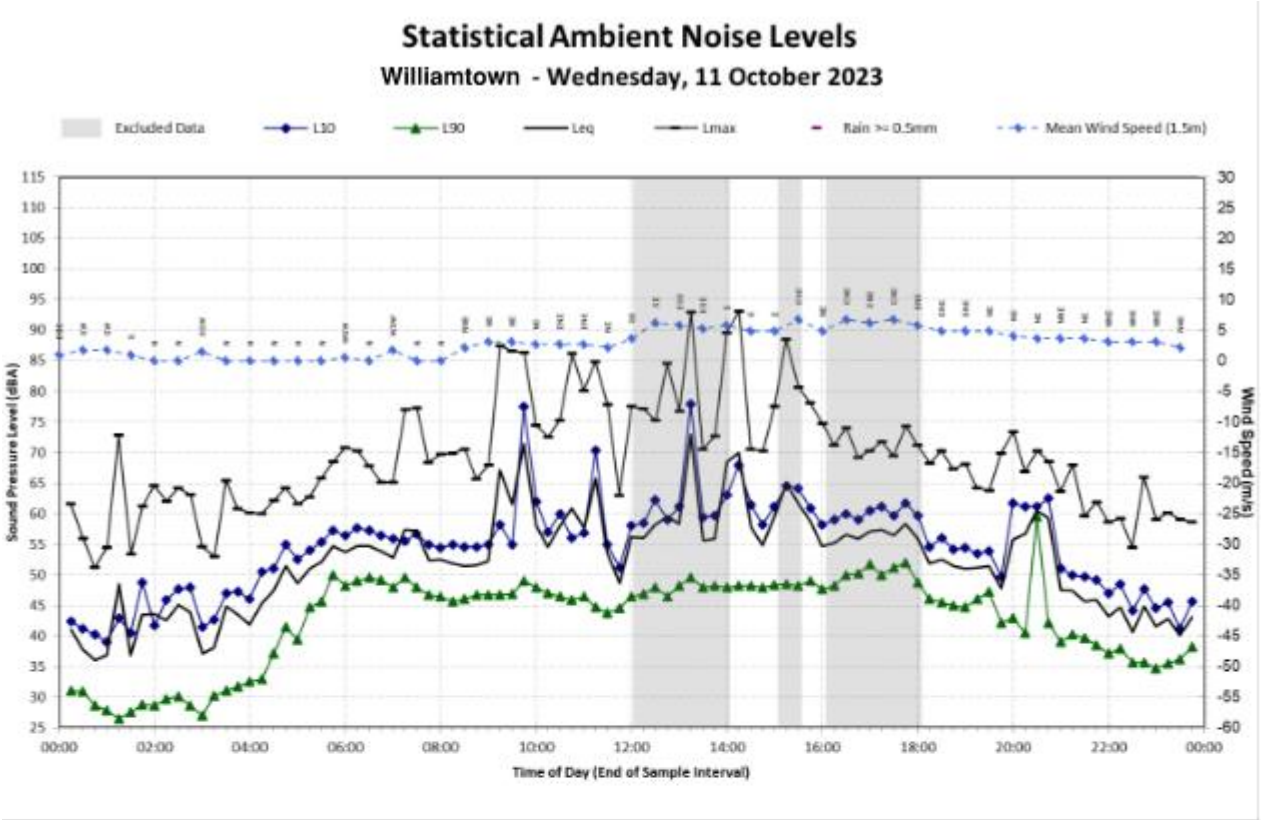
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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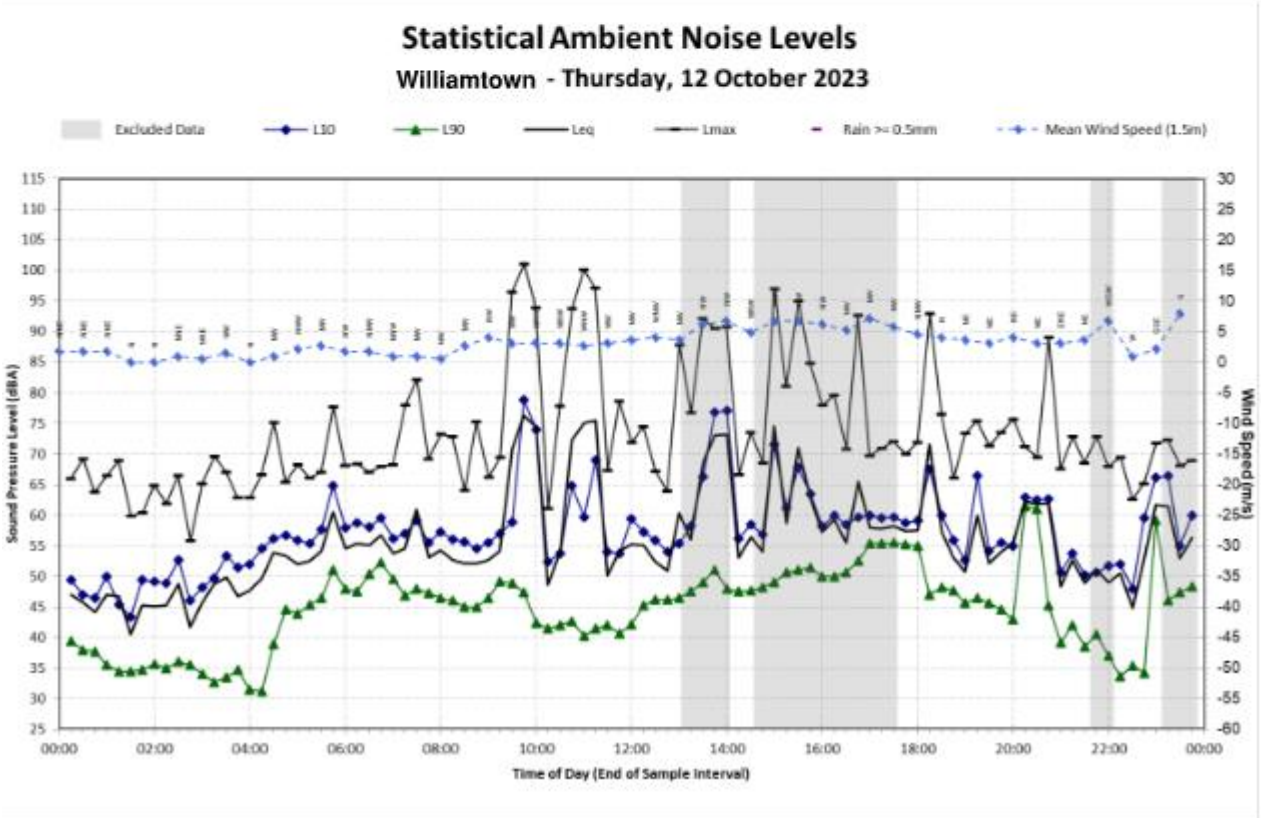
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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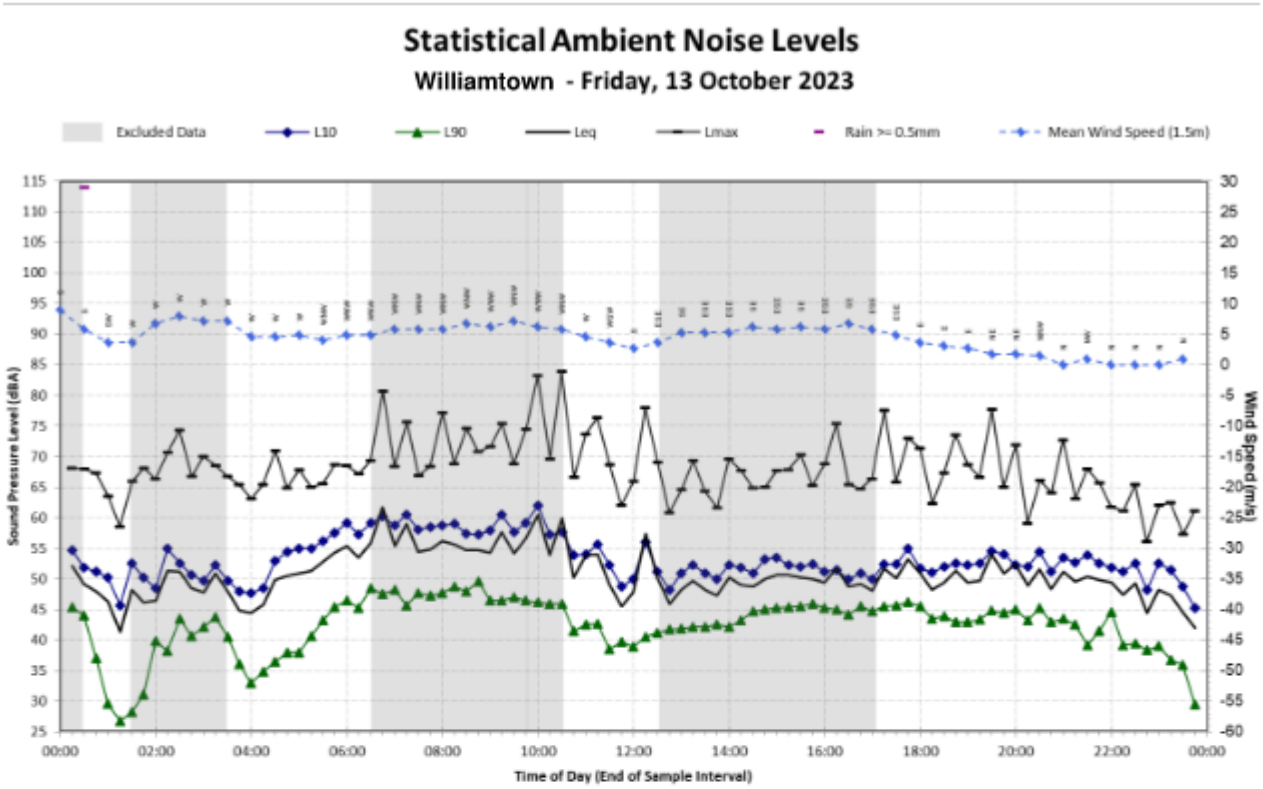
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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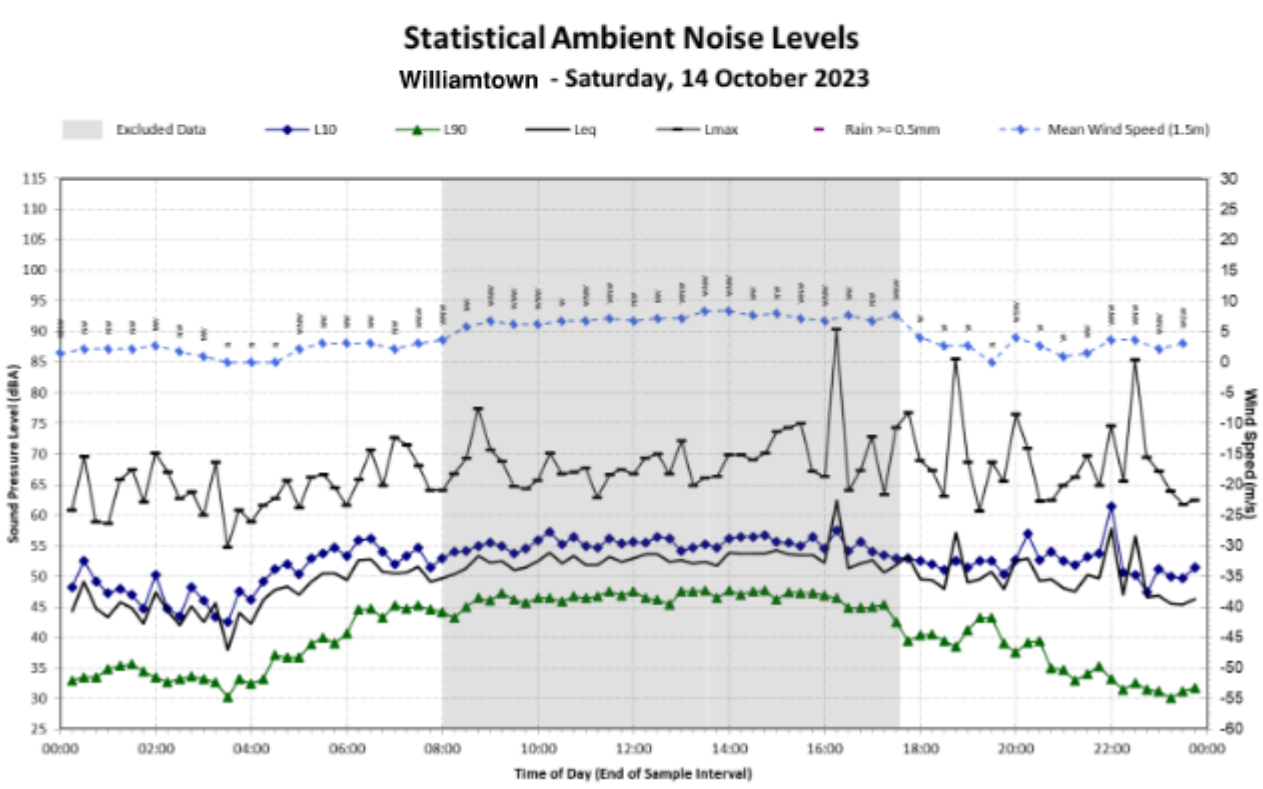
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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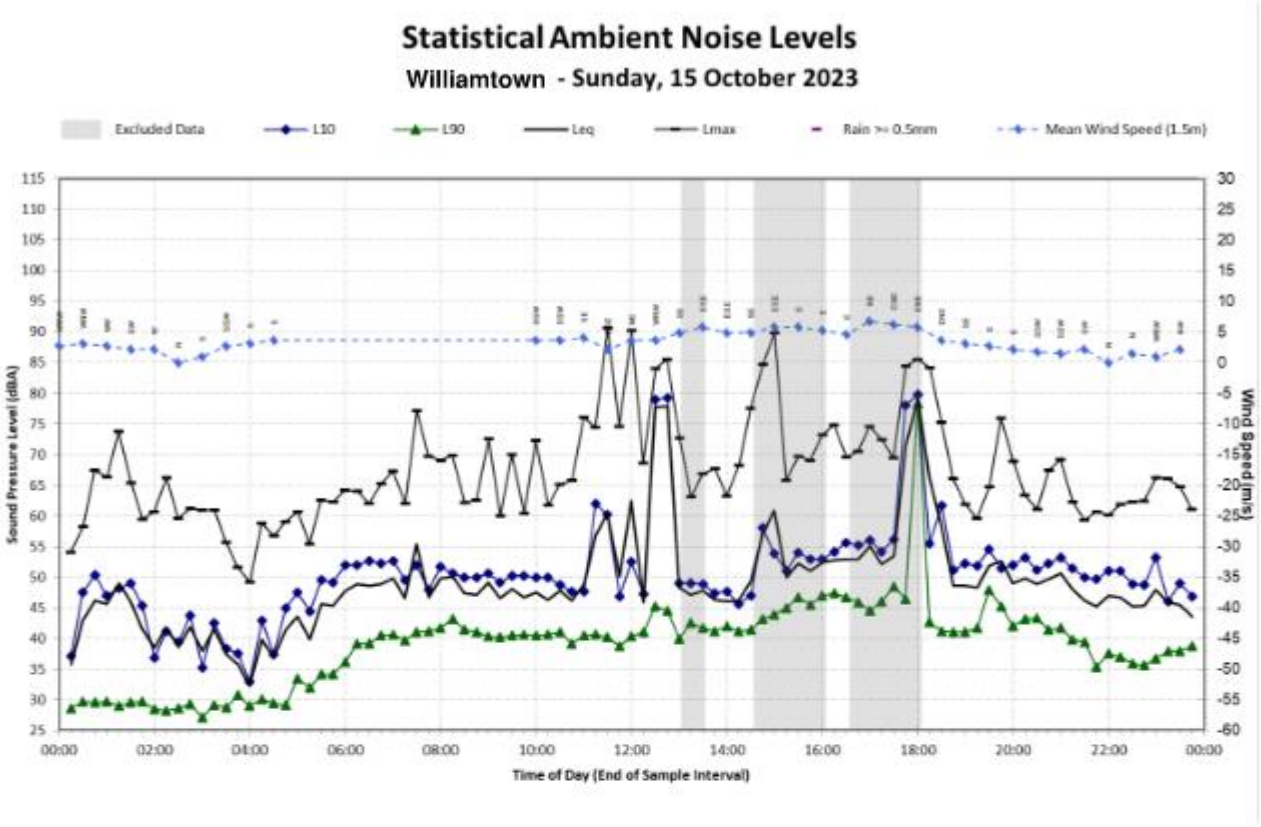
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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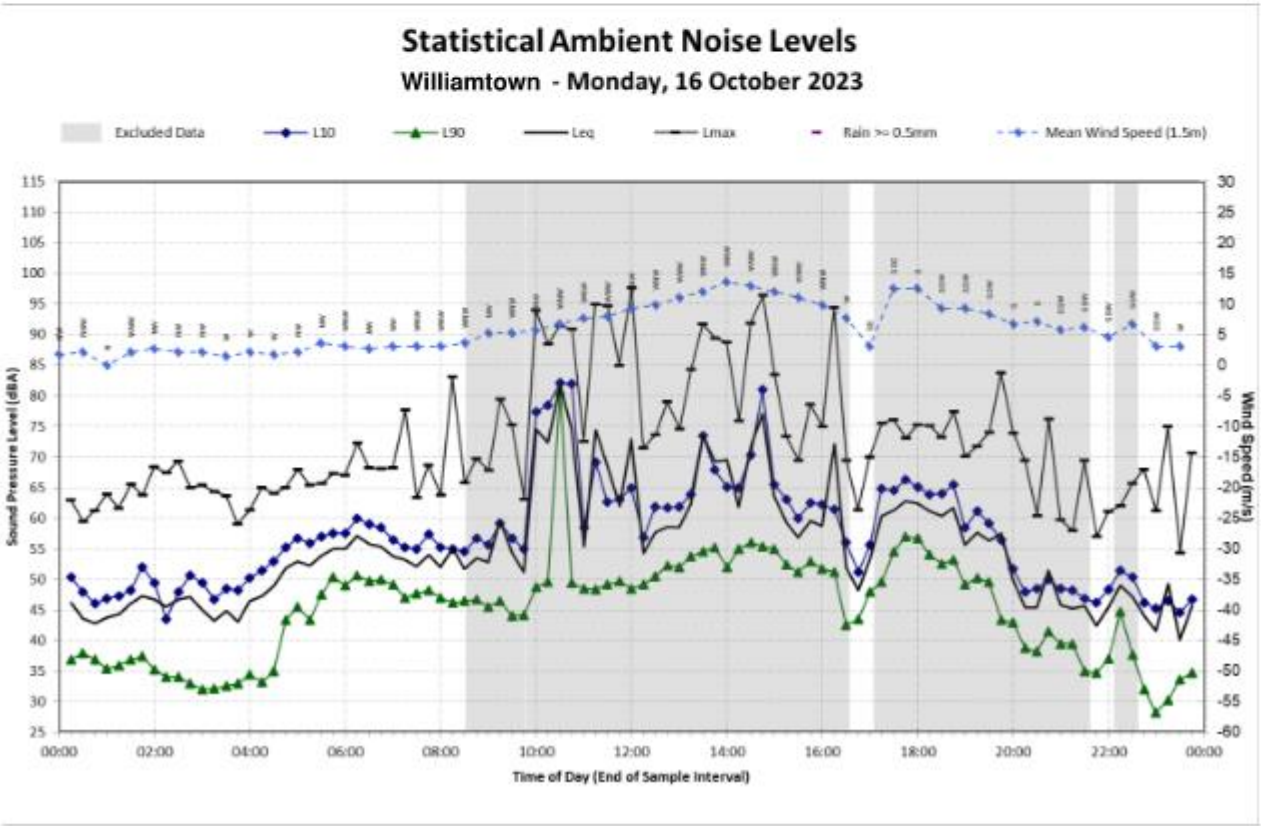
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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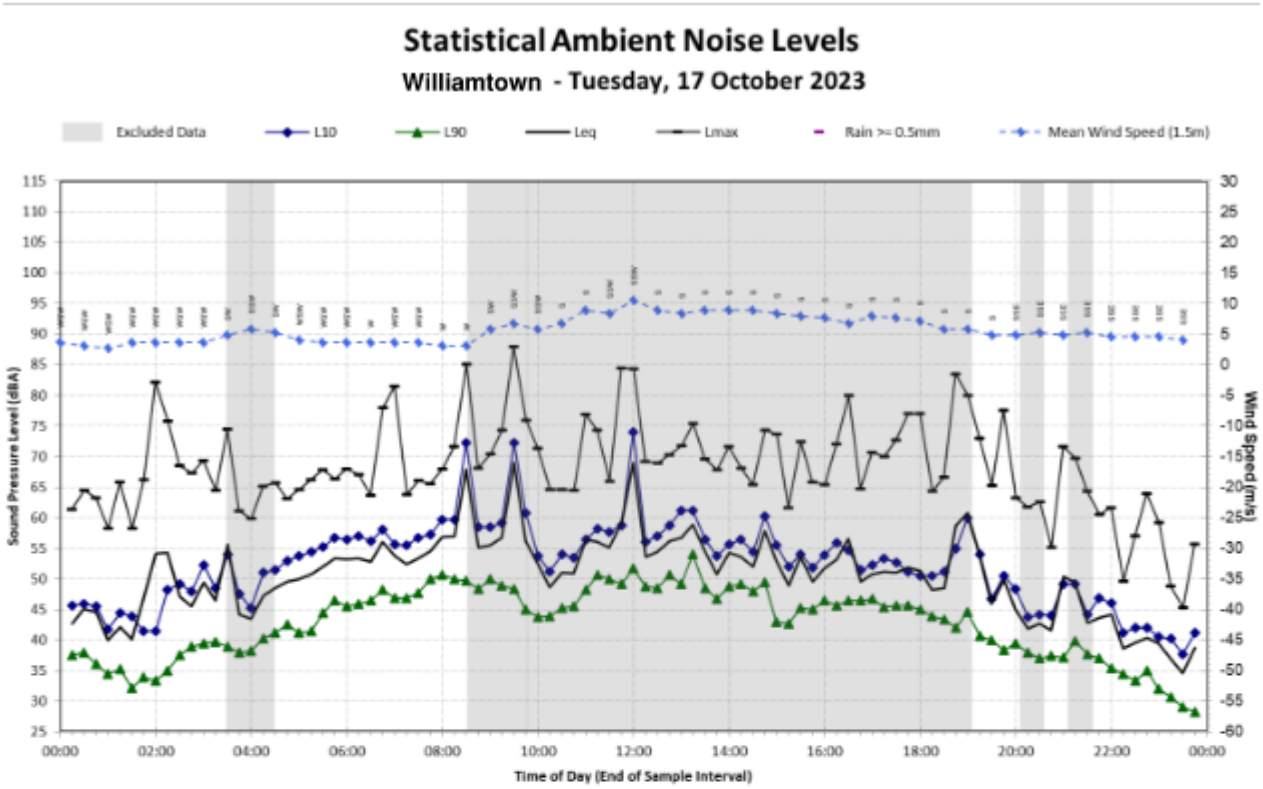
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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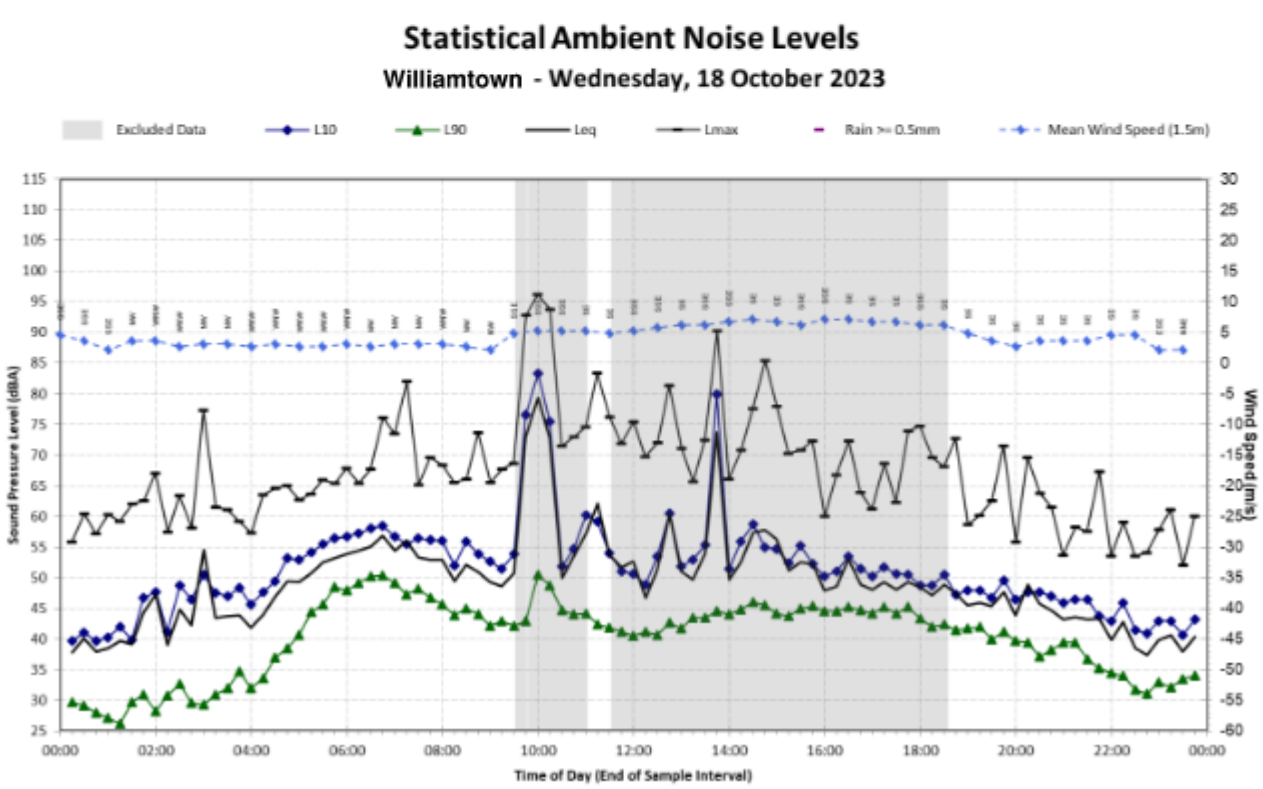
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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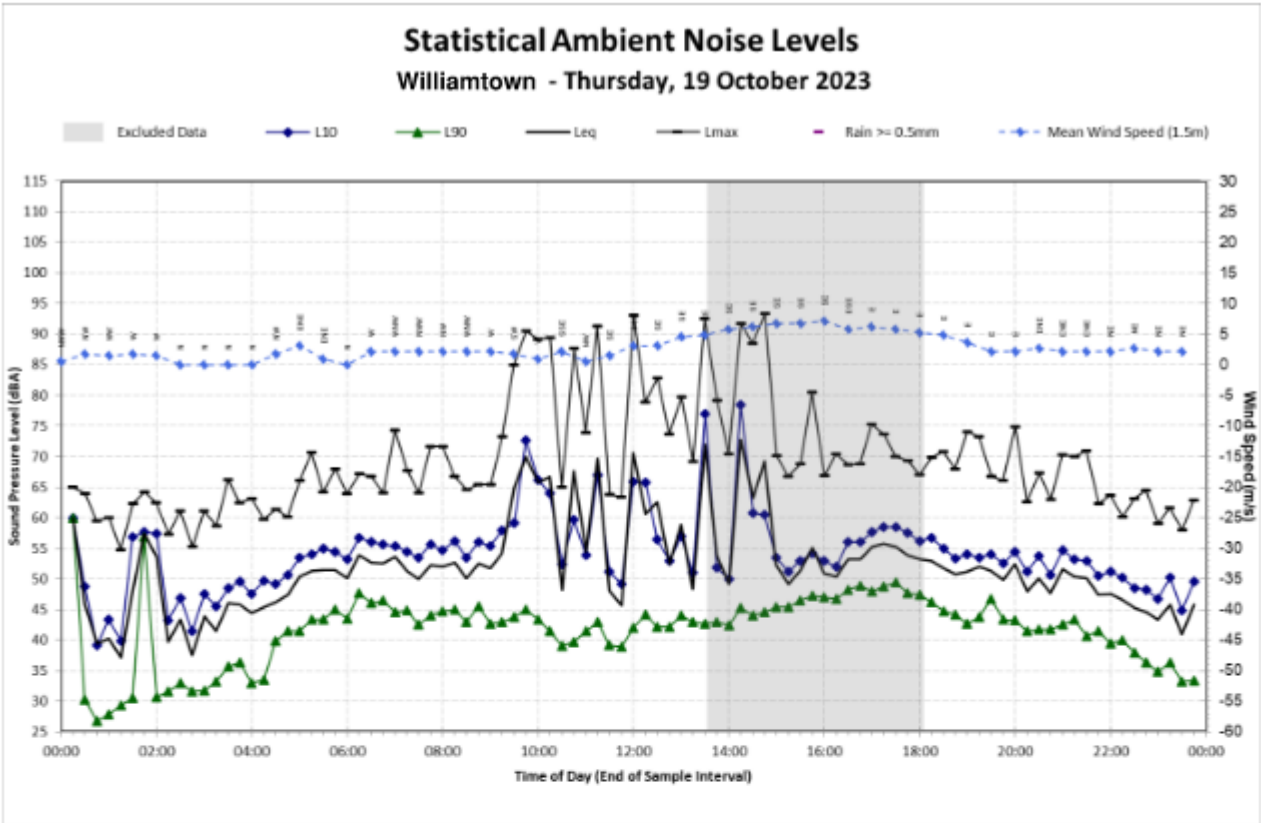
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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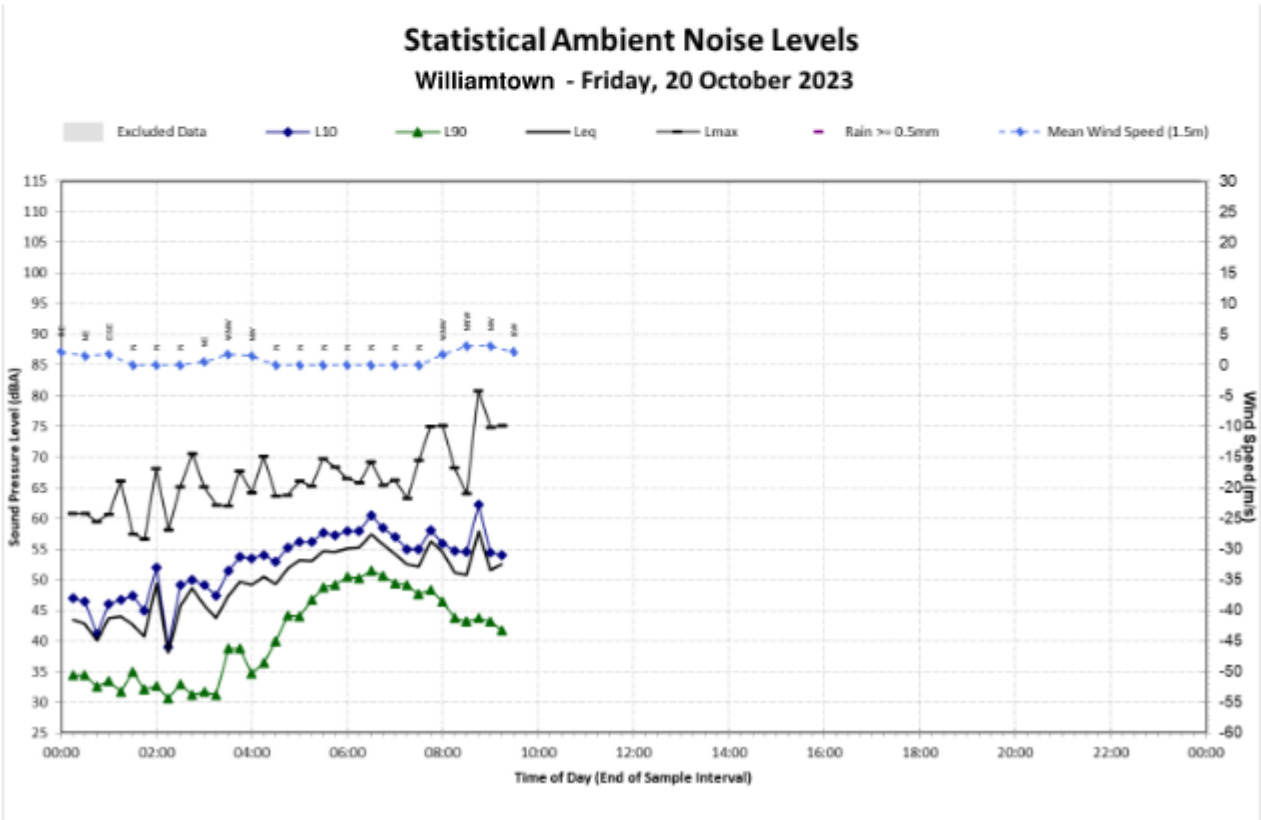
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)