TRANSPORT FOR NSW

# FAULCONBRIDGE STATION - TRANSPORT ACCESS PROGRAM

## TAP3 FAULCONBRIDGE STATION NOISE AND VIBRATION IMPACT ASSESSMENT

OCTOBER 2019


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# Faulconbridge Station - Transport Access Program
## TAP3 Faulconbridge Station Noise and Vibration Impact Assessment

Transport for NSW

WSP
Level 27, 680 George Street
Sydney NSW 2000
GPO Box 5394
Sydney NSW 2001

Tel: +61 2 9272 5100
Fax: +61 2 9272 5101
wsp.com

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# EXECUTIVE SUMMARY

WSP Australia Pty Ltd (WSP) has been engaged to undertake a noise and vibration impact assessment for the proposed accessibility upgrades at Faulconbridge Station (the Proposal).

The Proposal is intended to improve accessibility and amenities for customers and includes two new lifts, new accessible toilet, new family accessible toilet, internal building upgrades, accessible and a kiss and ride bay, and pedestrian works at Faulconbridge Station. The potential for construction noise and vibration impacts to occur was assessed in line with Transport for NSW's *Construction Noise and Vibration Strategy* (CNVS) (TfNSW, 2019) and the *Noise Policy for Industry* (NPfI) (EPA, 2017) was used to assess operational noise.

Sensitive receivers for both noise and vibration were identified in the area surrounding the Proposal and were organised into Noise Catchment Areas (NCAs) based on a similar noise environment within these areas.

A site survey was carried out to establish the existing background noise levels in the areas surrounding Faulconbridge Station using two unattended noise monitors. The results of the survey were used to set Noise Management Levels (NMLs) in accordance with the *Interim Construction Noise Guideline* (DECCW, 2009) and noise triggers for operational noise in accordance with the NPfI.

A total of seven worst-case construction activities were assessed, with works being undertaken during standard construction working hours where possible, two activities also requiring works to be undertaken during up to ssix48-hour rail possessions and potential additional works during out of hours works which are not rail possessions. The total duration of work is expected to be between 12 and 18 months.

Three-dimensional computer noise modelling predicted that the NMLs have the potential to be exceeded during construction activities for a majority of representative residential receivers for all assessed activities. Predicted noise levels increased considerably when equipment with special audible characteristics (e.g. concrete saw) were in use. The closest non-residential receivers were predicted to be noise affected during some of the assessed construction activities.

Construction traffic noise impacts were assessed with reference to the *Road Noise Policy* (RNP) (EPA, 2011) and are expected to comply with the RNP criteria due to the minor increase in traffic movements generated by construction of the Proposal when compared to current traffic volumes along Great Western Highway Avenue.

Minimum working distances for vibration intensive plant are predicted to comply with human comfort and cosmetic damage building vibration limits.

Site specific noise mitigation measures for construction works have been recommended including:

- providing temporary barriers
- using temporary screening or enclosures around works involving a concrete saw when used to assist in mitigation of noise at the identified educational receiver (Children's House Montessori)
- further consultation with the identified educational receiver to minimise impacts during sensitive periods and on sensitive facilities within the receiver.

For operational noise, the mechanical plant selections have not yet been finalised. However, it is not expected that the mechanical plant would have a significant noise impact (when appropriately designed, sited and screened from the nearest noise sensitive receivers). Any mechanical plant, equipment, or other operational noise source proposed is to be designed to meet the NPfI noise triggers identified in this report.

# ABBREVIATIONS

| | |
|---|---|
| CNVS | TfNSW *Construction Noise and Vibration Strategy* 2019 |
| dB | Decibel |
| dBA | A-Weighted Decibel |
| DEC | (NSW) Department of Environment Conservation |
| DECCW | (NSW) Department of Environment, Climate Change and Water |
| DEFRA | UK Department for Environment, Food and Rural Affairs |
| EPA | (NSW) Environment Protection Authority |
| ICNG | *Interim Construction Noise Guideline* 2009 |
| NPfI | *Noise Policy for Industry* 2017 |
| NATA | National Association of Testing Authorities |
| NML | Noise Management Level |
| PPV | Peak Particle Velocity |
| RBL | Rating Background Level as defined in the NPfI |
| RNP | *Road Noise Policy* 2011 |
| SWL | Sound Power Level |
| TAP3 | Transport Access Program Stage 3 |
| TfNSW | Transport for NSW |
| VDV | Vibration Dose Value |

# 1 INTRODUCTION

Transport for New South Wales (TfNSW) proposes to provide accessibility upgrades at Faulconbridge Station (the Proposal). WSP has been engaged to undertake a noise and vibration assessment to support the Review of Environmental Factors (REF) for the Proposal.

This noise and vibration impact assessment (NVIA) provides modelling of construction noise and vibration impacts which has been assessed in Sections 4 and 5 respectively. Additionally, guidance on mitigation measures are provided in Section 6 and Appendix C.

## 1.1 PROJECT DESCRIPTION

The Proposal involves an upgrade of Faulconbridge Station as part of the Transport Access Program which would improve accessibility and amenity for customers. The Proposal would include the following key elements:

- construction of a new lift on the platform to connect to the existing footbridge
- construction of a new lift off the Great Western Highway to connect to the existing footbridge
- upgrade of the existing pedestrian footbridge over the Great Western Highway and all stairs including new handrails, tactile ground surface indicators (TGSIs), nosings and modifying the existing balustrade
- internal station building works including:
  - reconfiguration of the existing station waiting room, door widening, and allocated spaces for wheelchairs and persons with disability
  - reconfiguration of the existing toilets to accommodate one new unisex family accessible toilet and one new unisex Ambulant toilet
- modifications to the Commuter Carpark and kiss-and-ride including:
  - upgrade of the two existing DDA parking spaces, and upgrade of the existing kiss and ride bay
  - construction of a new DSAPT compliant ramp (including demolition of existing non-complaint path) from the existing pedestrian footbridge to the Commuter Carpark
  - provision of a new rest area with seating at the western entrance of the existing footbridge
- upgrade of existing platform and access paths to include TGSIs and safety zone markings
- provision of access paths and circulation spaces to connect all customer facilities at the station (e.g. lifts, kiss and ride, DDA car space, family accessible toilet etc.)
- ancillary works including adjustments to lighting, relocation or replacement of existing customer facilities (drinking fountain, seating, telephone booth, guard indicators, Opal card readers, fencing etc.), improvement to station communications (including CCTV cameras, LED lighting, Public Address (PA) system, and hearing loops), wayfinding signage, yellow lines, bike rack etc.

Figure 1.1 outlines the location of the Proposal, which includes an outline of the Noise Catchment Areas (NCAs), noise monitoring locations, and nearest representative noise sensitive receivers.

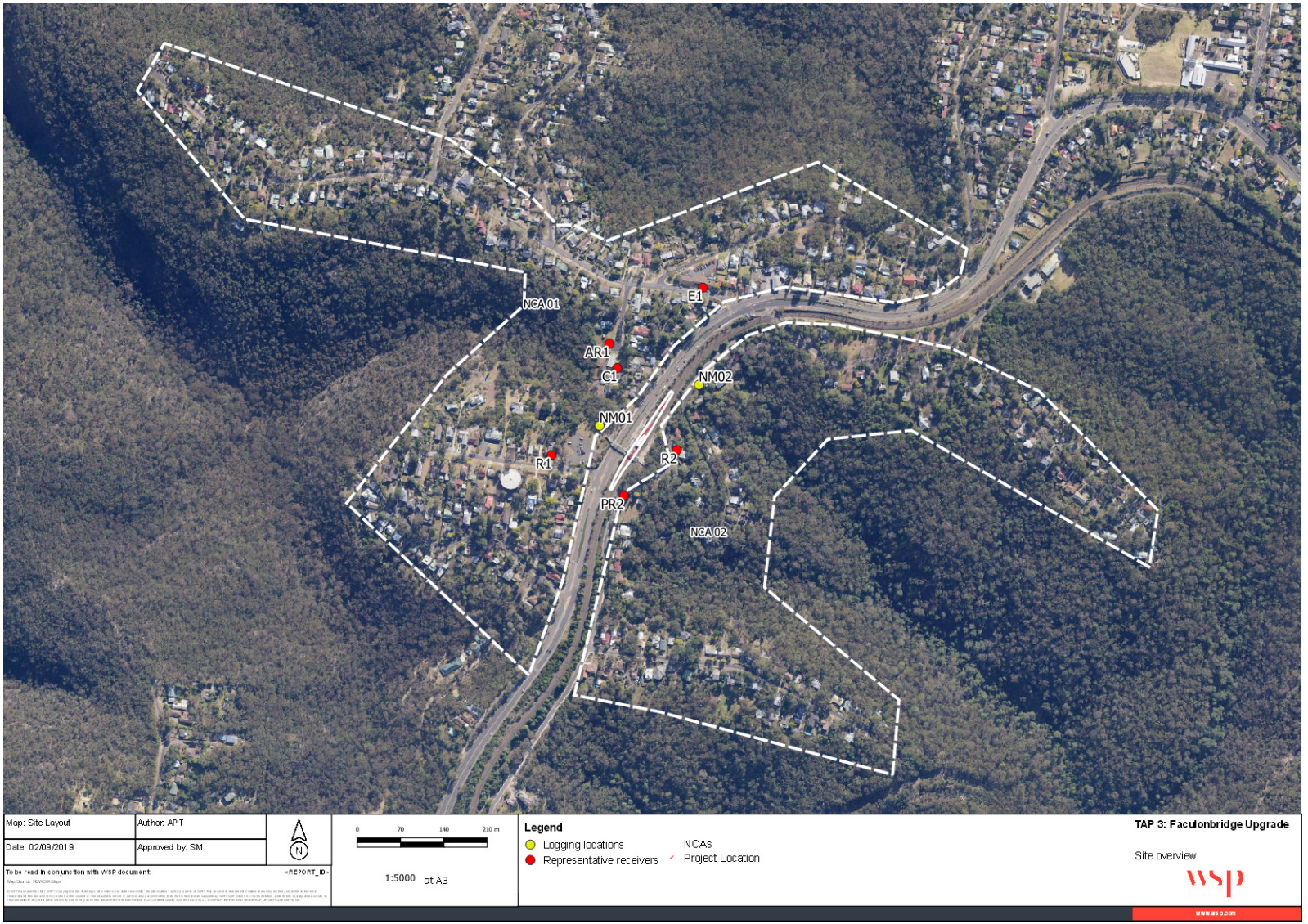



Figure 1.1 Proposal site layout showing representative receivers, noise logger locations and noise catchment areas (NCAs)

## 1.2 SENSITIVE RECEIVERS

The Proposal has the potential to impact nearby properties that are considered sensitive to noise and vibration.

Receivers potentially sensitive to both noise and vibration in the following categories as defined in *Noise Policy for Industry* (NPfI) (EPA, 2017) and *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) have been identified in the surrounding area:

- residential
- commercial
- passive recreation areas.

The receivers surrounding the Proposal have been categorised into NCAs based on a similar noise environment within these areas. Construction noise and vibration impacts have been assessed at representative receivers for each NCA. Representative receivers of each type are presented in Table 1.1.

Table 1.1 NCA and classification of representative receivers

| NCA | RECEIVER TYPE | ADDRESS | RECEIVER ID |
|---|---|---|---|
| 1 | Residential | 9 Railway Avenue, Faulconbridge | R1 |
| | Commercial | 9-9A Home St, Faulconbridge | C1 |
| | Child Care | Children's House Montessori, 1 Russell Avenue, Faulconbridge | E1 |
| | Active Recreation | Browett Park, 2/8 Home Street, Faulconbridge | AR1 |
| 2 | Residential | 24 Sir Henrys Parade, Faulconbridge | R2 |
| | Passive Recreation | Sir Henry Parkes Grave, Faulconbridge | PR1 |

## 1.3 LIST OF REFERENCED DOCUMENTS

This report has been written with reference to the following documents:

- TfNSW *Construction Noise and Vibration Strategy 2019* (CNVS)
- NSW EPA *Noise Policy for Industry 2017* (NPfI)
- NSW DECC *Interim Construction Noise Guideline 2009* (ICNG)
- NSW EPA *Road Noise Policy 2011* (RNP)
- NSW DEC *Assessed Vibration: a technical guideline 2005* (AVTG).

Furthermore, the following Standards are referenced in this report:

- Australian Standard AS 1055:1997 – *Acoustics – Description and Measurement of Environmental Noise.*
- British Standard BS 7385-2: *Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration.*
- Australian Standard AS 2436:2010 – *Guide to noise and vibration control on construction, demolition and maintenance.*
- Department for Environment Food and Rural Affairs (United Kingdom), *Update of noise database for prediction of noise on construction and open sites – Phase 3: Noise measurement data for construction plant used on quarries.*
- German Standard DIN 4150: Part 3 – 1999 *Structural Vibration in Buildings: Effects on Structures.*

It is noted that the following ISCA approved noise guidelines (ISCA v1.2) are included in the referenced documents:

- NSW DECC *Interim Construction Noise Guideline 2009* (ICNG).
- TfNSW *Construction Noise and Vibration Strategy 2019* (CNVS).

# 2 EXISTING ENVIRONMENT

The prevailing background and ambient noise levels surrounding the site were determined through a combination of unattended and operator attended noise surveys in accordance with the Australian Standard 1055:2019 – *Acoustics – Description and Measurement of Environmental Noise* (AS 1055) and the NPfI.

## 2.1 NOISE MONITORING LOCATIONS

Two noise monitoring locations were used to characterise the existing noise environment at representative residential receivers on either side of the station, presented in Table 2.1 and shown in Figure 1.1.

Monitoring locations were selected in accordance with the NPfI to provide a measurement of the noise environment at the likely most affected receiver.

Table 2.1 Noise monitoring locations

| NOISE MONITORING LOCATION | SURVEY METHOD | ADDRESS |
|---|---|---|
| NM01 | Unattended measurement and attended measurement | Next to Faulconbridge Commuter Car Park, Faulconbridge |
| NM02 | Unattended measurement and attended measurement | 20 Sir Henrys Parade, Faulconbridge |

## 2.2 INSTRUMENTATION AND QUALITY CONTROL

The monitoring equipment was fitted with windshields and were checked with a field calibrator before and after monitoring. No significant drifts in calibration (± 0.5 dB) were noted. The weather conditions at the time of monitoring were recorded at Penrith (Bureau of Meteorology station number 67113), which is located approximately 13.5 kilometres east-south-east of the Proposal site.

Monitoring data were excluded during periods of weather where wind speeds were greater than five metres per second or during significant rainfall that may have adversely affected the collected data. The excluded data is identified in the noise monitoring graphs provided in Appendix A.

All the monitoring equipment has a current certified calibration certificate (National Association of Testing Authorities, NATA) at the time of use. Details of all equipment used to conduct the noise survey are presented in Table 2.2. Copies of the calibration certificates can be provided upon request.

Table 2.2 Noise monitoring equipment

| LOCATION | SURVEY METHOD | MANUFACTURER AND MODEL NO. | SERIAL NO. |
|---|---|---|---|
| NM01 | Unattended measurement | Rion NL42 | 296507 |
| NM02 | Unattended measurement | Rion NL42 | 296510 |
| NM01 and NM02 | Attended measurement | Norsonic 140 | 1406502 |
| NM01 and NM02 | Attended measurement and unattended measurement | Rion NC 73 (calibrator) | 11248294 |

## 2.3 UNATTENDED NOISE SURVEY

Unattended noise monitoring for background noise levels in the vicinity of Faulconbridge Station was carried out by WSP between 5 August 2019 and 14 August 2019 at NM01 and NM02.

The results are summarised in Table 2.3 and detailed daily plot of data are presented for NM01 and NM02 in Appendix A.

Table 2.3 Summary of unattended noise monitoring results

| LOCATION | RATING BACKGROUND LEVEL (RBL) dBA[1, 2] | | | AMBIENT NOISE LEVEL dBA $L_{eq\ 15\ minute}$ | | |
|---|---|---|---|---|---|---|
| | Day | Evening | Night | Day | Evening | Night |
| NM01 | 44 | 41 | 35 | 55 | 52 | 52 |
| NM02 | 46 | 42 | 33 | 60 | 59 | 58 |

(1) Rating Background Level (RBL), the overall single-figure background level representing each assessment period (daytime/evening/night-time) as defined in the NPfI

(2) Time periods defined as – Day: 8 am to 6 pm Monday to Saturday, 8 am to 6 pm Sunday; Evening, 6 pm to 10 pm; Night 10 pm to 7 am Monday to Saturday, 10 pm to 8 am Sunday

## 2.4 OPERATOR ATTENDED NOISE SURVEY

WSP carried out operator attended measurements to characterise the noise environment and identify the contributors to the acoustic environment. Attended measurements were carried out at NM01 and NM02 on Monday 5 August 2019.

At both NM01 and NM02, the background levels were characterised by traffic from the Great Western Highway. Ambient noise levels were controlled by birds and traffic along the Great Western Highway. Train pass-bys were audible at both locations but were not recorded during the 15 minute attended measurements.

During the surveys, the weather was suitable for noise monitoring, noted as being dry with little to no wind.

The results of the attended noise surveys and observations are detailed in Table 2.4.

Table 2.4 Summary of attended noise measurement results

| LOCATION | TIME | dBA $L_{eq(15min)}$ | dBA $L_{90(15min)}$ | OBSERVATIONS |
|---|---|---|---|---|
| NM01 | 3:57 pm to 4:12 pm | 51 | 46 | Birds: up to 55 dBA<br>Car pass-bys: up to 60 dBA |
| NM02 | 3:10 pm to 3:25 pm | 55 | 46 | Birds: up to 60 dBA<br>Car pass-bys: up to 67 dBA |

# 3 ASSESSMENT CRITERIA

## 3.1 CONSTRUCTION NOISE

The *TfNSW Construction Noise and Vibration Strategy* (CNVS) (TfNSW, 2019) establishes assessment methods for construction noise impacts at sensitive receivers from TfNSW Proposals. The strategy includes reference to objectives in the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009).

### *3.1.1 CONSTRUCTION NOISE ASSESSMENT PERIODS*

The CNVS assessment time periods applicable to the Proposal are presented in Table 3.1.

Table 3.1 CNVS assessment periods

| NAME | RBL PERIOD | TIME PERIODS |
|---|---|---|
| Standard Hours (SH) | Day | Monday to Friday – 7 am to 6 pm<br>Saturday – 8 am to 1 pm<br>Sunday and public holidays – Nil |
| Out of Hours Works (OOHW) Period 1 | Day | Saturday – 7 am to 8 am and 1 pm to 6 pm<br>Sundays and public holidays – 8 am to 6 pm |
| | Evening | Monday to Saturday – 6 pm to 10 pm |
| Out of Hours Works (OOHW) Period 2 | Night | Monday to Sunday – 10 pm to 7 am<br>Sundays and public holidays – 6 pm to 8 am |

### *3.1.2 CONSTRUCTION NOISE MANAGEMENT LEVELS*

A quantitative assessment requires the development of noise management levels (NML) based on existing RBLs and a comparison of predicted construction noise levels with the NML.

Recommended standard hours represent the times of the day when receivers are likely to be less sensitive to noise impacts. Where work is proposed outside of standard hours, justification is required and more stringent NMLs apply. For all other receiver types, the NMLs only apply when the receiver is being used. Table 3.2 sets out the application of the management levels for noise at residences.

Table 3.2 Application of the ICNG noise management levels for residential receivers

| TIME OF DAY | NML, dBA $L_{eq,\ 15\ minute}$ | HOW TO APPLY |
|---|---|---|
| Recommended standard hours:<br>Monday to Friday 7 am to 6 pm<br>Saturday 8 am to 1 pm<br>No work on Sundays or public holidays | Noise affected<br>RBL + 10 dB | The noise affected level represents the point above which there may be some community reaction to noise.<br>Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>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. |

| TIME OF DAY | NML, dBA $L_{eq, 15\ minute}$ | HOW TO APPLY |
|---|---|---|
| | Highly noise affected<br>75 dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>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 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) 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<br>RBL + 5 dB | A strong justification would typically be required for works outside the recommended standard hours.<br>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should consult with the community. |

Representative RBLs for the area have been derived from noise monitoring described in Section 2. Table 3.3 presents the NMLs for representative residential receivers and Table 3.4 for the nearest non-residential sensitive receivers.

Table 3.3 Noise management levels at residential receivers

| NCAs | TIME | RBL dBA | NOISE MANAGEMENT LEVEL dBA $L_{eq, 15\ minute}$ | HIGHLY NOISE AFFECTED LEVEL dBA $L_{eq, 15\ minute}$ |
|---|---|---|---|---|
| NCA 1 | Standard hours | 44 | 54 | |
| | Out of hours – Day | 44 | 49 | |
| | Out of hours – Evening | 41 | 46 | |
| | Out of hours – Night | 35 | 40 | 75 |
| NCA 2 | Standard hours | 46 | 56 | |
| | Out of hours – Day | 46 | 51 | |
| | Out of hours – Evening | 42 | 47 | |
| | Out of hours – Night | 33 | 38 | |

Table 3.4 Noise management levels for non-residential sensitive receivers

| LAND USE | NOISE MANAGEMENT LEVEL (EXTERNAL) dBA $L_{eq,\ 15\ minute}$ |
|---|---|
| School Classrooms | 55[1] |
| Passive recreation | 60 |
| Active recreation | 65 |
| Commercial | 70 |

(1) A 10 dB internal to external correction has been applied, in accordance with Section 4.1.2 of the ICNG

Feasible and reasonable mitigation and management measures should be implemented where NMLs are exceeded either during or outside of recommended standard hours for construction work.

### 3.1.3 MAXIMUM NOISE LEVELS

Construction noise during the night has the potential to disturb people's sleep patterns. Guidance in the ICNG references further information in the RNP that discusses criteria for the assessment of sleep disturbance.

The RNP suggests a screening level of $L_{1,1min}$ dBA, equivalent to the RBL + 15 dB. Where this level is exceeded, further analysis should be carried out. Section 5.4 of the RNP then goes on to state that:

- maximum internal noise levels below 50 to 55 dBA would be unlikely to result in people's sleep being disturbed
- if the noise exceeds 65 to 70 dBA once or twice each night the disturbance would be unlikely to have any notable health or wellbeing effects.

The guidance within the RNP indicates that internal noise levels of 50 to 55 dBA are unlikely to cause sleep awakenings. Therefore, at levels above 55 dBA, sleep disturbance may be considered likely. Assuming that receivers may have windows partially open for ventilation, a 10 dB outside to inside correction has been adopted as indicated in the ICNG. Therefore, sleep disturbance screening criteria of RBL+15 dB and $L_{max}$ 65 dBA have been adopted for this assessment.

## 3.2 CONSTRUCTION TRAFFIC NOISE

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

The RNP criteria apply to traffic generated by construction activities. The existing roads immediately surrounding the Proposal are a mix of arterial, sub-arterial and local roads. Arterial, sub-arterial and collector roads are assessed over day (7:00 am to 10:00 pm) and night (10:00 pm to 7:00 am) periods and local roads are assessed over a one hour period (typically the peak hour) within the respective day and night periods.

Table 3.5 presents a summary of the applicable criteria for residences.

Table 3.5 Road traffic noise criteria for residential receivers on existing roads affected by additional traffic from land use developments

| ROAD TYPE | ROAD TRAFFIC NOISE CRITERIA | |
|---|---|---|
| | Day | Night |
| Arterial/Sub-arterial/Collector | 60 $L_{eq\ 15hr}$ dBA | 55 $L_{eq\ 9hr}$ dBA |
| Local Roads | 55 $L_{eq\ 1hr}$ dBA | 50 $L_{eq\ 1hr}$ dBA |

The RNP application notes state that 'for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dBA above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dBA of, or exceeds, the relevant day or night noise assessment criterion.'

Therefore, if the road traffic noise levels increase by more than 2 dBA as a result of the proposed construction traffic and the criteria in Table 3.5 are exceeded, investigation of mitigation options would be required.

## 3.3 OPERATIONAL NOISE

Operational noise emissions from the Proposal to surrounding noise sensitive areas are assessed according to the NPfI.

In assessing the impact of industrial noise sources, the NPfI requires consideration of intrusive, amenity and sleep disturbance noise impacts.

### *3.3.1 PROJECT INTRUSIVENESS NOISE LEVEL*

Table 3.6 presents the project intrusiveness level based on the measured RBL.

Table 3.6 Established Project intrusiveness noise level, residential receivers only

| MONITORING LOCATION | NCA | TIME PERIOD | RBL dBA | PROJECT INTRUSIVENESS NOISE LEVEL (RBL + 5 dB) dBA $L_{eq,\ 15\ minute}$ |
|---|---|---|---|---|
| | | Day | 44 | 49 |
| NM01 | 1 | Evening | 41 | 46 |
| | | Night | 35 | 40 |
| | | Day | 46 | 51 |
| NM02 | 2 | Evening | 42 | 47 |
| | | Night | 33 | 38 |

### 3.3.2 PROJECT AMENITY NOISE LEVELS

To limit continuing increases in noise levels, the amenity noise level within an area from industrial noise sources should not normally exceed the amenity noise levels prescribed in the NPfI.

The recommended amenity noise levels represent the objective for **total** industrial noise at a receiver location, whereas the **Proposal amenity noise level** represents the objective for noise from a **single** industrial development at a receiver location as follows:

**Proposal amenity noise level = recommended amenity noise level (Table 2.2 of NPfI) minus 5 dB(A)**

The amenity criteria have been established at the identified receivers based on the results of the attended and unattended noise survey. The established amenity criteria applicable to the Proposal are presented in Table 3.7.

Residential receivers with a similar noise environment to that observed across the Proposal site have been classified as a suburban noise environment in accordance with the NPfI as the background noise environment is defined by traffic and bird noise, with traffic from nearby local roads and the Great Western Highway as part of the noise environment.

Table 3.7 Established Proposal amenity noise level

| TYPE OF RECEIVER[1] | RECOMMENDED AMENITY NOISE LEVEL (ANL) dBA $L_{eq, period}$ | PROPOSAL AMENITY NOISE LEVEL (ANL -5dB) dBA $L_{eq, period}$ | PROPOSAL ADJUSTED ANL[2] dBA $L_{eq\ period}$ | | |
|---|---|---|---|---|---|
| | | | Day | Evening | Night |
| Suburban Residential (NM01) | Day: 55<br>Evening: 45<br>Night: 40 | Day: 50<br>Evening: 40<br>Night: 35 | 50 | 40 | 37[4] |
| Suburban Residential (NM02) | Day: 55<br>Evening: 45<br>Night: 40 | Day: 50<br>Evening: 40<br>Night: 35 | 50 | 44[4] | 43[4] |
| Passive recreation | 50 | 45 | 45 | 45 | 45 |
| Active Recreation | 55 | 50 | 50 | 50 | 50 |
| Educational | 45[3] | 40 | 40 | 40 | 40 |
| Commercial | 65 | 60 | 60 | 60 | 60 |

(1) Amenity levels only apply during times of use for all receivers except residential

(1) Time periods defined as – Day: 7 am to 6 pm Monday to Saturday, 8 am to 6 pm Sunday; Evening, 6 pm to 10 pm; Night 10 pm to 7 am Monday to Saturday, 10 pm to 8 am Sunday

(2) A 10 dB internal to external correction has been applied, in accordance with Section 2.6 of the NPfI

(3) In accordance with Section 2.4.1 of the NPfI, where existing traffic noise levels are more than 10 dB higher than the recommended amenity noise level, the amenity noise level may instead be set to 15 dB below existing traffic noise levels

### 3.3.3 PROPOSAL NOISE TRIGGER LEVELS

In assessing the noise impact of the Proposal on surrounding residential receivers, both the intrusiveness and amenity criterion must be considered. The most stringent trigger level forms the Proposal noise trigger levels (PNTL) for the development under assessment.

In order to standardise the time periods for the intrusiveness and amenity noise levels, the following conversion between $L_{eq,\ period}$ and $L_{eq,\ 15\ minute}$ has been applied (as per Section 2.2 of the NPfI):

$$\textbf{dBA } L_{eq,\ 15\ minute} = \textbf{dBA } L_{eq,\ period} + 3\ \textbf{dB}$$

As required in Section 2.2 of the NPfI, all Proposal noise trigger levels and limits are expressed as $L_{eq,\ 15\ minute}$, unless otherwise expressed. A summary of the PNTL applicable to this Proposal is presented in Table 3.8.

Table 3.8 Summary of NSW Noise Policy for Industry Proposal Noise Trigger Levels (PNTL)

| RECEIVER TYPE | NCA | TIME PERIOD[1] | NOISE LEVEL dBA $L_{eq,\ 15\ minute}$ | | |
|---|---|---|---|---|---|
| | | | Intrusiveness | Amenity | PNTL |
| Residential | | Day | 49 | 50 | 49 |
| (Suburban) | NCA 1 | Evening | 46 | 40 | 40 |
| (NM01) | | Night | 40 | 37 | 37 |
| Residential | | Day | 51 | 50 | 50 |
| (Suburban) | NCA 2 | Evening | 47 | 44 | 44 |
| (NM02) | | Night | 38 | 43 | 38 |
| Passive recreation | All | When in use | – | 48 | 48 |
| Active recreation | All | When in use | – | 53 | 53 |
| Educational | All | When in use | – | 43 | 43 |
| Commercial | All | When in use | – | 63 | 63 |

(1) Non-residential receivers trigger levels apply when the premises are in use. Time periods defined as – Day: 7 am to 6 pm Monday to Saturday, 8 am to 6 pm Sunday; Evening, 6 pm to 10 pm; Night 10 pm to 7 am Monday to Saturday, 10 pm to 8 am Sunday

### 3.3.4 SLEEP DISTURBANCE

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

As outlined in the NPfI, where the development night time noise levels at a residential location exceed the following, 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."*

Table 3.9 summarises the operational noise sleep disturbance screening criteria for this Proposal.

Table 3.9 Sleep disturbance Proposal screening criteria

| NCA | PROVIDED SCREENING CRITERIA | RBL BASED SCREENING CRITERIA[1] | PROPOSAL SCREENING CRITERIA |
|---|---|---|---|
| NCA 1 | 40 $L_{Aeq,\ 15\ minute}$ dBA | *(35 + 5)*[2]<br>40 | **40 $L_{eq,\ 15\ minute}$ dBA** |
| | 52 $L_{AFmax}$ dBA | *(35 + 15)*[3]<br>50 | **52 $L_{Fmax}$ dBA** |
| NCA 42 | 40 $L_{Aeq,\ 15\ minute}$ dBA | *(33 + 5)*[2]<br>*38* | **40 $L_{eq,\ 15\ minute}$ dBA** |
| | 52 $L_{AFmax}$ dBA | *(33+ 15)*[3]<br>*48* | **52 $L_{Fmax}$ dBA** |

(1) Based on the night time noise monitoring results (Table 2.3 of this document)

(2) RBL + 5 as outlined in the NPfI

(3) RBL + 15 as outlined in the NPfI

## 3.4 VIBRATION

Construction vibration can lead to:

- cosmetic and structural building damage
- loss of amenity due to perceptible vibration, termed human comfort.

Importantly, cosmetic damage is regarded as minor in nature; it is readily repairable and does not affect a building's structural integrity. Damage of this nature is typically described as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks, and separation of partitions or intermediate walls from load bearing walls. If there is no significant risk of cosmetic damage, then structural damage is not considered a significant risk and is not further assessed.

### 3.4.1 COSMETIC BUILDING DAMAGE

The CNVS presents minimum working distances based on the British Standard BS 7385-2: *Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration*. The CNVS details a general vibration screening criteria for intermittent vibration sources in Appendix A.3.4 based on BS 7385-2 as follows:

- reinforced or framed structures: 25.0 mm/s
- unreinforced or light framed structures 7.5 mm/s.

At locations where the predicted and/or measured vibration levels are greater than shown above (peak component particle velocity), a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be required to determine the applicable safe vibration level.

Heritage buildings and structures would be assessed as per the screening criteria in Appendix C.3.4 as they should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound.

### 3.4.2 HUMAN COMFORT

The CNVS requires the assessment of vibration on human comfort in accordance with *Assessing Vibration – A technical guideline* (DEC, 2006).

The Proposal may generate intermittent vibration during construction. The applicable criteria are shown in Table 3.10 as vibration dose value (m/s$^{1.75}$), with the proposed construction vibration limits shown in bold.

Table 3.10 Vibration limits for human exposure from intermittent vibration

| LOCATION | ASSESSMENT PERIOD | VIBRATION DOSE VALUE (m/s$^{1.75}$) | |
|---|---|---|---|
| | | Preferred values | Maximum values |
| Residences | Daytime | 0.2 | **0.4** |
| | Night | 0.13 | **0.26** |
| Offices, schools, educational institutions, and places of worship | Anytime | 0.4 | **0.8** |

(1) Daytime is 7 am to 10 pm and night-time is 10 pm to 7 am.

# 4 CONSTRUCTION NOISE ASSESSMENT

## 4.1 NOISE MODELLING METHODOLOGY

A noise model was prepared using the SoundPLAN 8 Industrial Module implementing the ISO 9613-2 calculation method.

A three-dimensional representation of the physical environment within the Proposal site was simulated. Modelling inputs for each scenario included ground contours, locations of sensitive receivers, noise-generating equipment as well as any other inputs which have an effect on the noise environment, such as the buildings surrounding the Proposal. The model considered noise sources, receivers and the effect of distance, ground topography, atmospheric attenuation and obstacles such as barriers and buildings.

The following assumptions were used in the modelling:

- all noise sources in each scenario operating simultaneously
- all noise sources modelled at two metres from ground level (or stair/footbridge level where appropriate)
- topography for the area has been provided by SIX Maps NSW
- NCA noise impacts assessed at the most affected representative receiver
- receiver heights 1.5 metres above ground level, or at the most affected storey.

The noise modelling is considered to be conservative as it assumes all equipment operating simultaneously at their closest point within the work area to the receivers. Actual measured noise levels would be expected to be lower on most occasions.

## 4.2 ASSESSMENT SCENARIOS

The following scenarios outlined in Table 4.1 have been modelled as part of the quantitative assessment. Out-of-hours work is expected to take place during the identified six 48-hour rail possessions.

The below timings are intended to be indicative only, out of hours works may occur during activities other than those where it is currently nominated. Where this is to occur, mitigation measures outlined in Section 6 should be utilised to minimise impacts on residences.

Table 4.1 Modelling scenarios

| ACTIVITY ID | STAGE | ACTIVITIES | TIMING | DURATION (TOTAL) |
|---|---|---|---|---|
| 1 | Site establishment and enabling work | — establish site compounds (i.e. erecting fencing, tree protection zones, site offices, amenities and plant/material storage areas)<br>— establish temporary facilities as required (e.g. temporary access stairs, temporary toilets, temporary construction lights etc.)<br>— erect site hoarding / fencing as required<br>— service location and relocation | Standard hours | 40 days |

| ACTIVITY ID | STAGE | ACTIVITIES | TIMING | DURATION (TOTAL) |
|---|---|---|---|---|
| 2 | Lift work | — excavation and rock breaking for lift pits/foundations<br>— demolition of remnant bridge footing under platform (in new lift location)<br>— waterproof (as required), install reinforcement, formwork and concrete to form the lift pit<br>— erect glass and steel shaft structure<br>— lift installation and commissioning<br>— architectural fit-out around lift shaft including new awning over the lift. | Standard hours, night-works and 48-hour rail shutdown during scheduled Sydney Trains track maintenance weekends | 90 days |
| 3 | Stair upgrade | — demolish existing non-complaint rails (where required)<br>— modify stairs including installation of new nosings, hand railing and TGSIs. | Standard hours | 30 days |
| 4 | Ramp upgrade | — earthworks for new ramp grading<br>— ramp formwork and structure<br>— ramp fitout of new handrailing, seating and tactiles | Standard hours | 60 days |
| 5 | Commuter Carpark upgrades | — reconfiguration of the existing roadway (kerb, line marking, etc.) to accommodate the upgraded accessible parking and Kiss and Ride Bays<br>— installation of new kerb ramps<br>— widening of footpath landing connection to ramps | Standard hours or 48-hour rail shutdown during scheduled Sydney Trains track maintenance weekends | 60 days |
| 6 | Station building works | — provision of new family accessible toilet and ambulant toilets in place of existing toilet facilities<br>— door widening to waiting room to allow wheelchair access, provision of allocated space in waiting room<br>— upgrade the general station infrastructure including DDA signage, CCTV etc. where applicable | Standard hours | 60 days |
| 7 | Platform modification work | — regrade platform surface as required for accessible path<br>— relocate platform furniture along accessible paths<br>— install new yellow line and tactiles along platforms<br>— install new canopy extension<br>— relocate seating<br>— install new drinking fountain and adjust telephone booth height<br>— install new Opal card reader | Standard hours or 48-hour rail shutdown during scheduled Sydney Trains track maintenance weekends | 60 days |

## 4.3 NOISE SOURCE LEVELS

The nominated equipment for the construction work scenarios and the sound power level (SWL) of each item are detailed in Table 4.2. SWLs have been sourced from AS 2436:2010 – *Guide to noise and vibration control on construction, demolition and maintenance sites,* the *Department for Environment, Food and Rural Affairs (United Kingdom), Update of noise database for prediction of noise on construction and open sites – Phase 3: Noise measurement data for construction plant used on quarries* (DEFRA noise database), and the CNVS.

The equipment presented in Table 4.2 is indicative only. It is recommended that monitoring is conducted during construction and mitigation measures applied as detailed in Section 6 to ensure any changes to equipment do not adversely impact receivers.

Table 4.2 Sound power levels

| ITEM | SWL dBA | ACTIVITY ID |
|---|---|---|
| Chainsaw – petrol | 114 | 1, 4 |
| Core drill (electric 250 mm) | 113 | 6, 7 |
| Crane – Franna | 98 | 1, 2, 3, 7 |
| Crane – Mobile | 113 | 1, 2, 3, 7 |
| EWP | 97 | 3, 4 |
| Excavator – Tracked (10t) | 100 | 2, 4 |
| Excavator – Tracked (20t) | 105 | 2, 4 |
| Excavator – Tracked (6t) | 95 | 1 |
| Forklift | 106 | 1 |
| Grinder | 105 | 3, 6 |
| Hand tools – electric | 102 | 1, 2, 3, 4, 5, 6, 7 |
| Hi-Rail EWP | 97 | 2 |
| Hi-rail truck | 103 | 2, 3, 7 |
| Jackhammer | 113 | 1, 3, 4, 5, 6 |
| Lighting tower | 80 | 2, 7 |
| Loader – skidsteer | 107 | 1, 4 |
| Piling rig (assumed bored) | 112 | 2, 4 |
| Pump – concrete | 109 | 4, 5, 6, 7 |
| Roller – Vibratory | 109 | 7 |
| Saw – concrete | 118 | 2, 5 |
| Truck – Concrete | 109 | 4, 5, 6, 7 |
| Truck – medium | 103 | 4 |
| Truck – road truck and dog | 108 | 1, 2, 3, 4, 5, 6, 7 |
| Truck Vacuum (NDD) | 109 | 2 |
| Water cart | 107 | 5 |
| Wrench – impact | 111 | 2 |

(1) A +5 dB penalty has been applied for special audible characteristics as per the CNVS (presented sound power level is inclusive of the penalty)

(2) Due to the particularly high noise levels of the concrete saw, it has been modelled separately for all activities

## 4.4 PREDICTED NOISE LEVELS

The predicted noise levels for each scenario are presented in Table 4.3 outlining the noise level within each NCA for each representative receiver type. Predicted noise levels at buildings within each NCA is presented in Appendix B.

The maximum noise level assessment is presented in Table 4.4. The predicted noise levels have been assessed at the closest affected representative receiver within each NCA. Values included in brackets indicate the maximum noise level assessment for each scenario excluding the plant with special noise characteristics.

The calculations are conservative as they include all equipment operating simultaneously at their closest point to the receiver in a worst case 15-minute period. Actual noise levels from the construction site would be expected to be lower on most occasions.

Where a predicted noise level exceeds a less stringent management level, it follows that the more stringent management levels are also exceeded.

Table 4.3 Predicted construction noise levels

| NCA | RECEIVER ID | RECEIVER TYPE | NML | | | | ACTIVITY PREDICTED NOISE LEVEL dBA $L_{eq, 15\ minute}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Standard hours | Out-of-hours day | Out-of-hours evening | Out-of-hours night | Activity 1 | Activity 2 | Activity 3 | Activity 4 | Activity 5 | Activity 6 | Activity 7 |
| 1 | R1 | Residential | 54 | 49 | 46 | 40 | 74 *(81)* | 65 (71) | 66 | 72 *(78)* | 70 *(78)* | 62 | 66 |
| | C1 | Commercial | 70 | 70 | 70 | 70 | 64 (71) | 61 (67) | 55 | 60 (66) | 57 (65) | 62 | 67 |
| | E1 | Educational | 55 | | | | 55 (62) | 51 (57) | 51 | 57 (63) | 54 (62) | 49 | 51 |
| | AR1 | Active Recreation | 65 | | | | 64 (71) | 60 (66) | 52 | 64 (70) | 61 (69) | 54 | 64 |
| 2 | R2 | Residential | 56 | 51 | 47 | 38 | 74 *(81)* | 67 (73) | 69 | 63 (69) | 61 (69) | 69 | 72 |
| | PR2 | Passive Recreation | 60 | | | | 73 *(80)* | 69 (75) | 69 | 68 (74) | 66 (74) | 66 | *84* |

(1) Values in brackets indicate predicted noise levels including plant items with special audible characteristics (concrete saw, chain saw)

The formatting within the construction noise assessment table indicates the following:

- The orange shaded cells show exceedances of the standard-hours day period.
- The yellow shaded cells show exceedances of the out-of-hours day period.
- The green shaded cells show exceedances of the out-of-hours evening period.
- The blue shaded cells show exceedances of the out-of-hours night period.
- The cells with red text show exceedances of highly noise affected noise management levels.

Table 4.4 Predicted sleep disturbance assessment

| NCA | RECEIVER ID | NML | | ACTIVITY PREDICTED MAXIMUM NOISE LEVEL $L_{max}$ dBA | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | RBL + 15 screening criteria | Maximum noise level event | Activity 1[1] | Activity 2 | Activity 3[1] | Activity 4[1] | Activity 5 | Activity 6[1] | Activity 7 |
| 1 | R1 | 51 | 65 | 82 (89) | 73 (79) | 74 | 80 (86) | 78 (86) | 70 | 74 |
| 2 | R2 | 51 | 65 | 82 (89) | 75 (81) | 77 | 71 (77) | 69 (77) | 77 | 80 |

Note: Values in brackets indicate predicted noise levels including plant items with special audible characteristics (concrete saw, chain saw)

(1) Out of hours works are not expected for these activities, predicted noise levels are provided for reference in the event that out of hours works occur during these activities.

The formatting within the maximum noise level table indicates the following.

- The grey shaded cells show exceedances of the RBL + 15 criteria.
- The blue shaded cells show exceedances of the $L_{max}$ criteria.

## 4.5 ASSESSMENT OF PREDICTED NOISE LEVELS

During construction activities, the predictions indicate that construction noise levels could adversely impact the closest receivers without implementation of feasible and reasonable mitigation measures as provided in Section 6. This is expected to occur during the worst case 15 minute periods when works are carried out during standard hours or rail possessions. These impacts include exceedance of noise management levels, highly noise affected receivers, and in some cases, sleep disturbance. However, works are expected to take place intermittently over a 12 to 18 month period, so these exceedances would not be expected to occur continuously over the duration of the Proposal. Out of hours works would take place during rail possessions (occurring over a 48 hour period on a weekend) with only six rail possessions expected to occur over the duration of the Proposal (i.e. between 12 and 18 months). Other works may also be required to occur outside of standard hours which are not part of rail possessions.

As noted above, the predictions are based on a worst case 15-minute period. As these predictions are conservative, and it is anticipated that the proposed works would be short term in nature, actual noise levels from the construction site are expected to be lower than those indicated.

As plant with special audible characteristics, such as concrete saws and chainsaws, represent the worst-case noise impacts (and are not expected to be in use for the majority of the duration of construction activities), a separate assessment has been undertaken excluding these plant items. This additional assessment is intended to provide a more representative assessment of potential noise impacts from a majority of the construction works.

Predicted noise levels including plant with special audible characteristics (concrete saw, chainsaw) indicated the following:

- Exceedances of standard hours and out-of-hours NMLs within all NCAs at representative residential receivers during all activities. Residential receiver R1 is predicted to be highly noise affected during Activities 1, 4 and 5 (Site establishment, ramp upgrade, and commuter carpark upgrades). Residential receiver R2 is predicted to be highly noise affected during Activities 1, 3, 6 and 7 (Site establishment, stair upgrade, station building works, and platform modification works).
- When plant with special audible characteristics (concrete saw, chainsaw) were not used, a significant decrease in noise levels and impacts was predicted as follows:
  - a decrease in noise level of around 7 dB was predicted for all activities
  - the worst affected residential receivers in both NCAs were still predicted to have exceedances of the standard hours NMLs for all activities. However, the level of exceedance was typically lower. The receiver at R2 was still predicted to be highly noise affected, however only during activity 7 (platform modification works).

Maximum noise level exceedances are predicted to occur during all out-of-hours work activities at both NCAs. Receiver R2 is expected to experience the greatest maximum noise level exceedances, predicted to be up to 17 dB above the sleep disturbance criteria. For construction plant with special audible characteristics, the predicted maximum noise levels are expected to be up to 7 dB higher.

Some non-residential receivers are predicted to exceed their NML. Receiver E1 is expected to exceed standard hours NMLs during activity 4. Receiver PR2 is expected to exceed NMLs during all activities. However, NMLs for C1 and AR1 are not excepted to be exceeded.

When construction plant with special audible characteristics were included all non-residential receivers were predicted to exceed NMLs. E1 and PR2 are expected to exceed NMLs during all activities with PR2 exceeding highly noise affected levels during Activities 1, 3, 6 and 7. Receiver C1 is predicted to exceed NMLs during activities 1 and 7 and AR1 during Activities 1, 2, 4, 5, and 7. NMLs only apply when these premises are in use and therefore the premises would only be impacted when it is occupied.

As a result of the predicted exceedances of the NMLs and sleep disturbance goals, mitigation and management measures have been recommended in Section 6.

## 4.6 CONSTRUCTION TRAFFIC NOISE

The potential for noise impacts to occur due to light and heavy vehicle movements on public roads generated by the construction work has been assessed.

A screening calculation in line with the Calculation of Road Traffic Noise (CoRTN, Welsh Office 1988) was undertaken to predict noise impacts due to vehicle movements on public roads. Construction traffic is expected to travel along Great Western Highway then either Sir Henrys Parade or Railway Avenue to reach the project construction compounds. For the standard hours works, a scenario of 10 heavy vehicle and 20 light vehicle movements generated by the construction work occurring within a one hour period was assessed. These vehicles are assumed to be travelling at 50 kilometres per hour. The screening calculation indicated that noise levels from the construction traffic along both Sir Henrys Parade and Railway Avenue will meet the RNP criteria.

For the six 48 hour rail possessions it is anticipated that up to 12 deliveries (heavy vehicles) and up to 50 light vehicles would be generated. Provided that these are staged such that no more than 10 heavy vehicles and 20 light vehicles occur in the same hour for daytime, and 2 heavy vehicles and 5 light vehicles in the same hour during night time it is anticipated that the construction traffic will meet the RNP criteria.

A summary of the maximum number of allowable vehicle movements per hour for each time period to enable compliance with the RNP criteria is presented in Table 4.5.

Table 4.5 Maximum hourly traffic movements

| VEHICLE TYPE | TIME PERIOD | MAXIMUM VEHICLES PER HOUR TO ACHIEVE COMPLIANCE |
|---|---|---|
| Heavy vehicles | Daytime 7 am – 10 pm | 10 |
| Light vehicles | | 20 |
| Heavy vehicles | Night time 10 pm – 7 am | 2 |
| Light vehicles | | 5 |

# 5 CONSTRUCTION VIBRATION ASSESSMENT

Certain construction activities would require the use of vibration intensive equipment that may affect the nearest sensitive receivers. The vibration intensive plant nominated as part of the work is jack hammering, vibratory rolling, piling and the use of a hydraulic hammer (Activities 3, 4, 5 and 7 – stair upgrade, interchange upgrades, station building works, platform modification works).

Table 5.1 presents the indicative minimum working distances for the nominated construction plant to minimise the risk of structural damage and human comfort for sensitive receivers, based on the data provided in the CNVS.

The minimum working distances outline conservative distances at which the operation of vibration intensive plant is expected to meet the limits set out in Section 3.3. The distances are indicative only and results may vary depending on the activity, equipment, local ground, and receiver conditions.

Table 5.1 Recommended minimum working distances for vibration intensive plant

| PLANT ITEM | RATING / DESCRIPTION | MINIMUM WORKING DISTANCE (m) | |
|---|---|---|---|
| | | Cosmetic damage | Human response |
| Vibratory roller | < 50 kN (typically 1-2 tonnes) | 5 | 15 to 20 |
| | < 100 kN (typically 2-4 tonnes) | 6 | 20 |
| | < 200 kN (typically 4-6 tonnes) | 12 | 40 |
| | < 300 kN (typically 7-13 tonnes) | 15 | 100 |
| | < 300 kN (typically 13-18 tonnes) | 20 | 100 |
| | > 300 kN (typically > 18 tonnes) | 25 | 100 |
| Hydraulic hammer | 300 kg (5-12 tonne excavator) | 2 | 7 |
| | 900 kg (12-18 tonne excavator) | 7 | 23 |
| | 1600 kg (18-34 tonne excavator) | 22 | 73 |
| Pile boring | ≤ 800 mm | 2 (nominal) | - |
| Jackhammer | Hand held | 1 (nominal) | Avoid contact with structure |

If minimum working distances are complied with, no adverse impacts are expected for cosmetic damage or human response on nearby sensitive receivers. If works occur within these minimum working distances, mitigation measures outlined in Section 6 should be considered.

# 6 CONSTRUCTION NOISE AND VIBRATION MITIGATION AND MANAGEMENT

## 6.1 STANDARD CONSTRUCTION NOISE AND VIBRATION MITIGATION

The CNVS outlines standard measures for mitigating and managing construction noise and vibration to be implemented across all TfNSW construction proposals where reasonable and feasible. These standard measures are outlined in Appendix C.

Prior to commencement of works, a Construction Noise and Vibration Management Plan (CNVMP) shall be prepared and implemented in accordance with the requirements of the ICNG and CNVS. The CNVMP shall take into consideration measures for reducing the source noise levels of construction equipment by construction planning and equipment selection where practicable.

The CNVMP shall outline measures to reduce the noise impact from construction activities. Reasonable and feasible noise mitigation measures which should be considered, include:

- avoiding any unnecessary noise when carrying out manual operations and when operating plant
- ensuring spoil is placed and not dropped into awaiting trucks
- avoiding/limiting simultaneous operation of noisy plant and equipment within discernible range of a sensitive receiver where practicable
- switching off any equipment not in use for extended periods e.g. heavy vehicles engines would be switched off whilst being unloaded
- avoiding deliveries at night/evenings wherever practicable
- no idling of delivery trucks
- keeping truck drivers informed of designated vehicle routes, parking locations and acceptable delivery hours for the site
- minimising talking loudly; no swearing or unnecessary shouting, or loud stereos/radios onsite; no dropping of materials from height where practicable, no throwing of metal items and slamming of doors.
- maximising the offset distance between noisy plant and adjacent sensitive receivers and determining safe working distances
- using the most suitable equipment necessary for the construction works at any one time
- directing noise-emitting plant away from sensitive receivers
- regularly inspecting and maintaining plant to avoid increased noise levels from rattling hatches, loose fittings etc
- using non-tonal reversing/movement alarms such as broadband (non-tonal) alarms or ambient noise-sensing alarms for all plant used regularly onsite (greater than one day), and for any out of hours works – also set up the site where possible to minimise reversing (e.g. forward in, forward out movements)
- use of quieter and less vibration emitting construction methods where feasible and reasonable.

The most applicable standard management measures are outlined as follows:

- Construction hours and scheduling:
  - Works would generally be carried out during standard construction hours (i.e. 7:00 am to 6:00 pm Monday to Friday; 8:00 am to 1:00 pm Saturdays). Any works outside these hours may be undertaken if approved by TfNSW and the community is notified prior to these works commencing. An Out of Hours Work application form would need to be prepared by the Contractor and submitted to the TfNSW Environment and Planning Manager for approval prior to any works outside normal hours.
    - Six 48-hour rail possession periods have been identified as part of the proposal, out of hours works will be undertaken during these rail possessions. However, as these works will only take place over up to two consecutive nights sleep disturbance impacts at residences are expected to be minimal.
- Respite periods:
  - Where the $L_{Aeq\ (15minute)}$ construction noise levels are predicted to exceed 75 dBA and/or 30 dB above the Rating Background Level at nearby affected sensitive receivers, respite periods would be observed, where practicable, and in accordance with the CNVS. This would include restricting the hours that very noisy activities can occur.
- Vibration monitoring:
  - To avoid structural impacts as a result of vibration or direct contact with structures, the proposed works would be undertaken in accordance with the safe work distances and attended vibration monitoring or vibration trials would be undertaken where these distances are required to be challenged.
  - Vibration resulting from construction and received at any structure outside of the Proposal would be managed in accordance with:
    - for structural damage vibration – British Standard *BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings* and for structurally unsound heritage items German Standard *DIN 4150: Part 3 – 1999 Structural Vibration in Buildings: Effects on Structures*
    - for human exposure to vibration the acceptable vibration – values set out in the *Environmental Noise Management Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation, 2006) which includes British Standard BS 6472:1992 *Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz).*
  - Property conditions surveys would be completed prior to any vibration intensive work being carried out at or within the minimum distances set out in the CNVS. Where a heritage item is determined to be structurally unsound and a reassessment of the minimum working distances would be required. Minimum working distances should be confirmed prior to carrying out any vibration intensive work on site.

Table 6.1 provides indicative benefits of typical engineering control mitigation measures for construction activities, based on guidance in AS 2436 and experience on similar construction Proposals.

Table 6.1 Indicative noise reduction from construction controls

| ENGINEERING CONTROLS | POSSIBLE NOISE BENEFIT, dBA |
|---|---|
| Portable temporary screens | 5–10 |
| Screen or enclosure for stationary equipment | 10–15 |
| Maximising the offset distance between noisy plant items and sensitive receivers | 3–6 |
| Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers | 2–5 |
| Orienting equipment away from sensitive receivers | 3–5 |
| Carrying out loading and unloading away from sensitive receivers | 3–5 |
| Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks | 5–10 |
| Selecting site access points and roads as far as possible away from sensitive receivers | 3–6 |

## 6.2 SITE SPECIFIC CONSTRUCTION NOISE MITIGATION

The following site specific construction noise mitigation measures should be considered:

- During site establishment (Activity 1), temporary barriers could be erected to ensure that work would be conducted behind temporary hoardings/screens wherever practicable. The installation of construction hoarding would take into consideration the location of sensitive receivers to ensure that 'line of sight' is broken, where feasible. This has the potential to reduce noise levels between 5 and 10 dB.
- During lift, station building works (Activities 2 and 5), use of the concrete saw is the main contributor to construction noise. The concrete saw is a particularly loud construction plant item which produces a noise the CNS identifies as having 'special audible characteristics' and incurs a +5 dB penalty.

  Without the concrete saw, the total activity noise level is reduced by 6-8 dB. It is recommended that the use of these plant items is limited where possible, and works are undertaken during standard hours and avoid sensitive time periods. Where work is required outside of standard hours, the use of this equipment is to avoid sensitive periods such as after midnight and before 7:00 am.
- Due to the exceedances during activity 4 of construction at the educational receiver E1 (Children's House Montessori) where possible, it is recommended that a temporary screen or enclosure is placed around the works in conjunction with temporary barriers (actual noise levels/exceedances could be confirmed through on-site noise monitoring prior to providing screens or enclosures). This receiver is more likely to be more sensitive during certain times of the day. Therefore, further consultation should be undertaken to determine feasible construction periods and inform construction staging with respect to minimising the impacts on receiver E1. As much as reasonably possible, noise intensive construction works near affected education buildings are to be minimised. It is also recommended that where reasonable and feasible the use of the concrete saw is limited to standard hours or when the premises are not in use (e.g. between 7 am and 9 am, and 5 pm and 6 pm or during school holiday periods), to minimise the impact on this receiver.

## 6.3 ADDITIONAL CONSTRUCTION NOISE MITIGATION

Where all reasonable and feasible standard mitigation measures have been applied and exceedances are still predicted to occur, the CNVS provides guidance on additional mitigation measures to be implemented for each receiver depending on how far the predicted noise level is above the RBL and NML. Additional mitigation measures and their associated acronyms are outlined in Appendix C. Table 6.2 outlines when to implement the additional noise management measures.

Table 6.2 Implementation of additional management measures

| CONSTRUCTION HOURS | RECEIVER PERCEPTION | dBA ABOVE RBL | dBA ABOVE NML | ADDITIONAL MANAGEMENT MEASURES[1] |
|---|---|---|---|---|
| **Standard Hours** | Noticeable | 5 to 10 | 0 | – |
| Monday-Friday (7 am–6 pm) | Clearly audible | > 10 to 20 | < 10 | – |
| Saturday (8 am–1 pm) | Moderately intrusive | > 20 to 30 | > 10 to 20 | PN, V |
| | Highly intrusive | > 30 | > 30 | PN, V |
| | 75 dBA or greater | N/A | N/A | PN, V, SN |
| **OOHW Period 1** | Noticeable | 5 to 10 | < 5 | – |
| Monday-Friday (6 pm–10 pm) | Clearly audible | > 10 to 20 | 5 to 15 | PN |
| Saturday (7 am–8 am, 1 pm–10 pm) | Moderately intrusive | > 20 to 30 | > 15 to 25 | PN, V, SN, RO |
| Sunday/PH (8 am–6 pm) | Highly intrusive | > 30 | > 25 | PN, V, SN, RP[2], DR[2] |
| **OOHW Period 2** | Noticeable | 0 to 10 | < 5 | PN |
| Monday-Saturday (10 pm–7 am | Clearly audible | > 10 to 20 | 5 to 15 | PN, V |
| Sunday/PH (6 pm–8 am) | Moderately intrusive | > 20 to 30 | > 15 to 25 | PN, V, SN, RP, DR |
| | Highly intrusive | > 30 | > 25 | PN, V, SN, AA, RP, DR |

(1) Acronyms are defined in Appendix C

(2) Respite periods and duration reduction are not applicable when works are carried out during OOHW Period 1 Day only.

## 6.4 ADDITIONAL CONSTRUCTION VIBRATION MITIGATION

Where vibration intensive activities occur within the minimum working distances, all reasonable and feasible standard mitigation measures have been applied, and exceedances of vibration management levels are expected, the CNVS provides guidance on additional mitigation measures to be implemented for each receiver. Additional mitigation measures and the associated acronyms are outlined in Appendix C. Table 6.3 outlines how to implement the additional noise management measures.

Table 6.3 Implementation of additional vibration management measures

| CONSTRUCTION HOURS | RECEIVER PERCEPTION | ABOVE VIBRATION LIMIT | ADDITIONAL MANAGEMENT MEASURES[3] |
|---|---|---|---|
| Standard hours | Human disturbance | > HVML[1] | PN, V, RO |
| | Building damage | > DVML[2] | V, AC |
| OOHW Period 1 | Human disturbance | > HVML[1] | PN, V, SN, RO, RP, DR |
| | Building damage | > DVML[2] | V, AC |
| OOHW Period 2 | Human disturbance | > HVML[1] | PN, V, SN, RO, AA, RP, DR |
| | Building damage | > DVML[2] | V, AC |

(1) Human vibration management level – see maximum vibration dose values for human comfort outlined in Section 3.3

(2) Damage vibration management level – see screening criteria for cosmetic damage outlined in Section 3.3

(3) Acronyms are defined in Appendix C.

# 7 OPERATIONAL NOISE ASSESSMENT AND MITIGATION

The operation of Faulconbridge Station would remain unchanged as a result of the Proposal. There would be no expected changes to the operation of the rail and, as such, this has not been assessed.

New plant and equipment associated with the upgrade to Faulconbridge Station would include a new lift and provision of a family accessible toilet.

Operational noise from the Proposal would need to be designed to meet the NPfI noise goals presented in Section 3.3. Mechanical plant details are yet to be finalised. It is expected that mechanical noise emissions would not have a significant impact on the surrounding environment, and that the use of standard controls such as quiet plant selection, noise barriers and screening, and duct lining and/or attenuators, would allow mechanical plant noise to be reduced to acceptable levels.

Operational noise emissions shall be assessed, and if required appropriate noise mitigation measures incorporated, during the detailed design phase in order to ensure compliance with operational noise criteria as per the NPfI.

# 8 CONCLUSION

WSP has undertaken a noise and vibration assessment for the proposed Faulconbridge Station upgrade.

Seven construction scenarios have been assessed for the two noise catchment areas surrounding the site. The key findings of this assessment include:

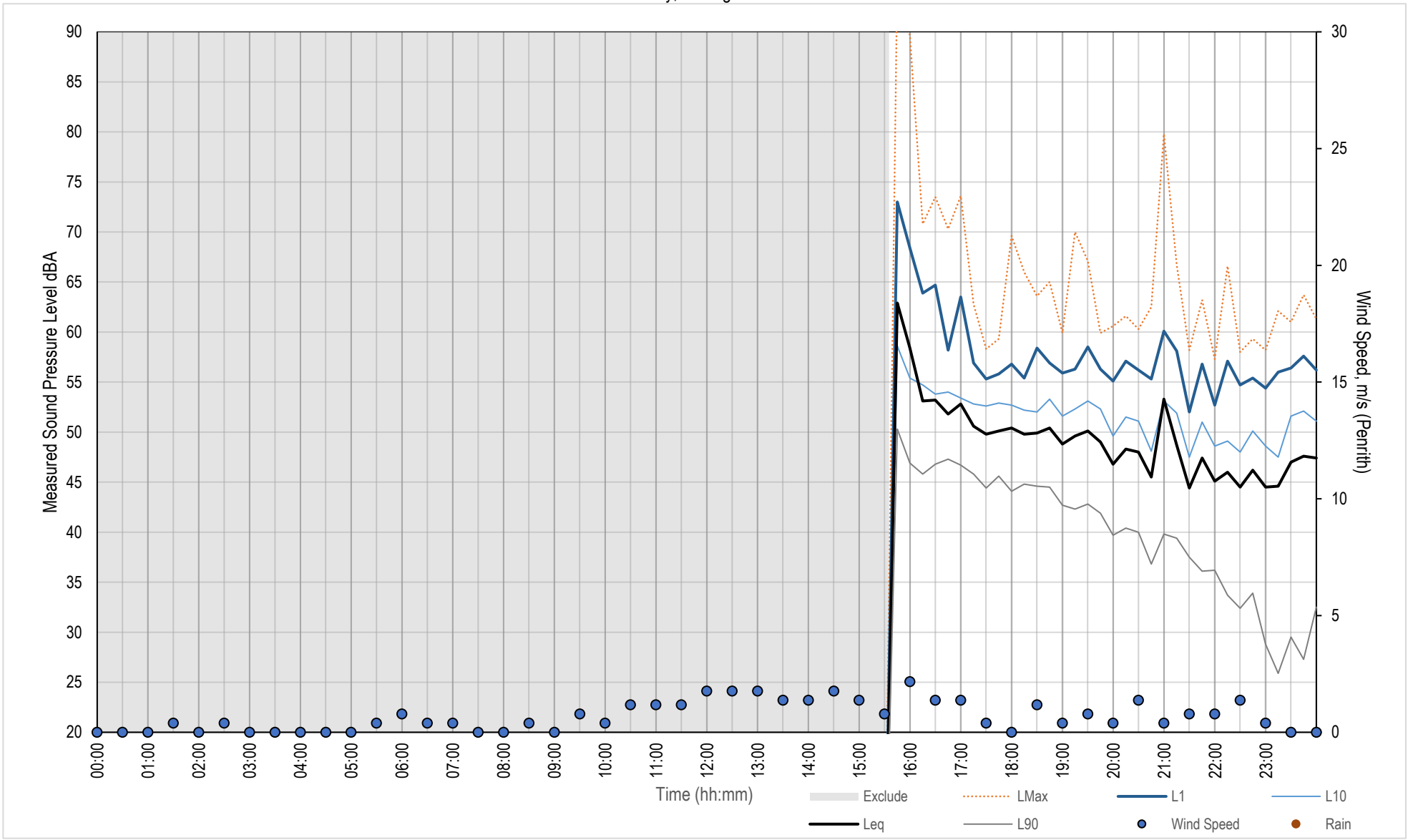
- NMLs were derived for residential and non-residential sensitive land uses using the ICNG in accordance with the CNVS based on background noise monitoring.
- NML exceedances are predicted at a majority of residential receivers for all activities. Predicted noise levels decrease considerably when equipment with special audible characteristics (concrete saw) are not in use. However, receivers in both NCAs are still expected to exceed NMLs but to a significantly lesser degree.
    - where possible, works should be undertaken during standard hours to minimise noise impacts at nearby residences.
- Minimum working distances for vibration intensive equipment to nearby receivers has been identified based on the CNVS. If minimum working distances are maintained, then adverse impacts in terms of human comfort or cosmetic damage are not expected.
- Site specific noise mitigation measures have been recommended including:
    - providing temporary barriers
    - using temporary screening or enclosures around works involving a concrete saw when used to assist in mitigation of noise at the identified educational receiver
    - further consultation with the identified educational receiver to minimise impacts during sensitive periods and on sensitive facilities within the receiver.
- The standard CNVS construction noise and vibration management measures and additional mitigation measures are recommended for the receivers within NCAs with predicted exceedances of the NMLs or within minimum working distances for vibration.
- Construction traffic noise has been assessed in accordance with the RNP, and the noise increase due to increase traffic is expected to be within the RNP criteria.
- Mechanical (air conditioning) plant has not yet been finalised. Mechanical plant is not expected to significantly impact the existing environment, and standard noise controls are expected to reduce noise emissions to acceptable levels as outlined in the NPfI. Operational noise emissions should be designed to meet the NPfI noise triggers derived in this report.

# APPENDIX A

## NOISE MONITORING GRAPHS

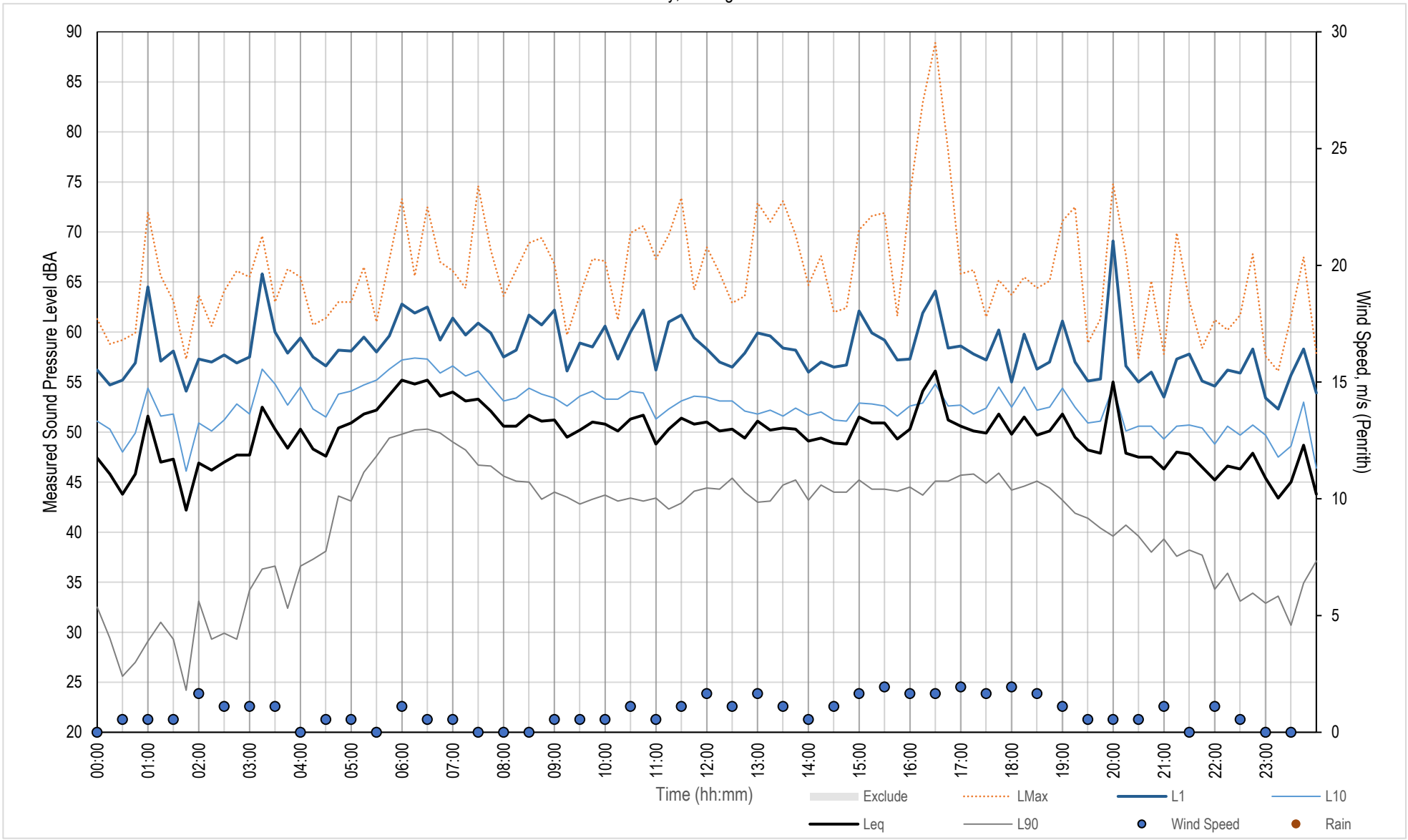
**Measured Noise Levels - NM01**

Monday, 05 August 2019



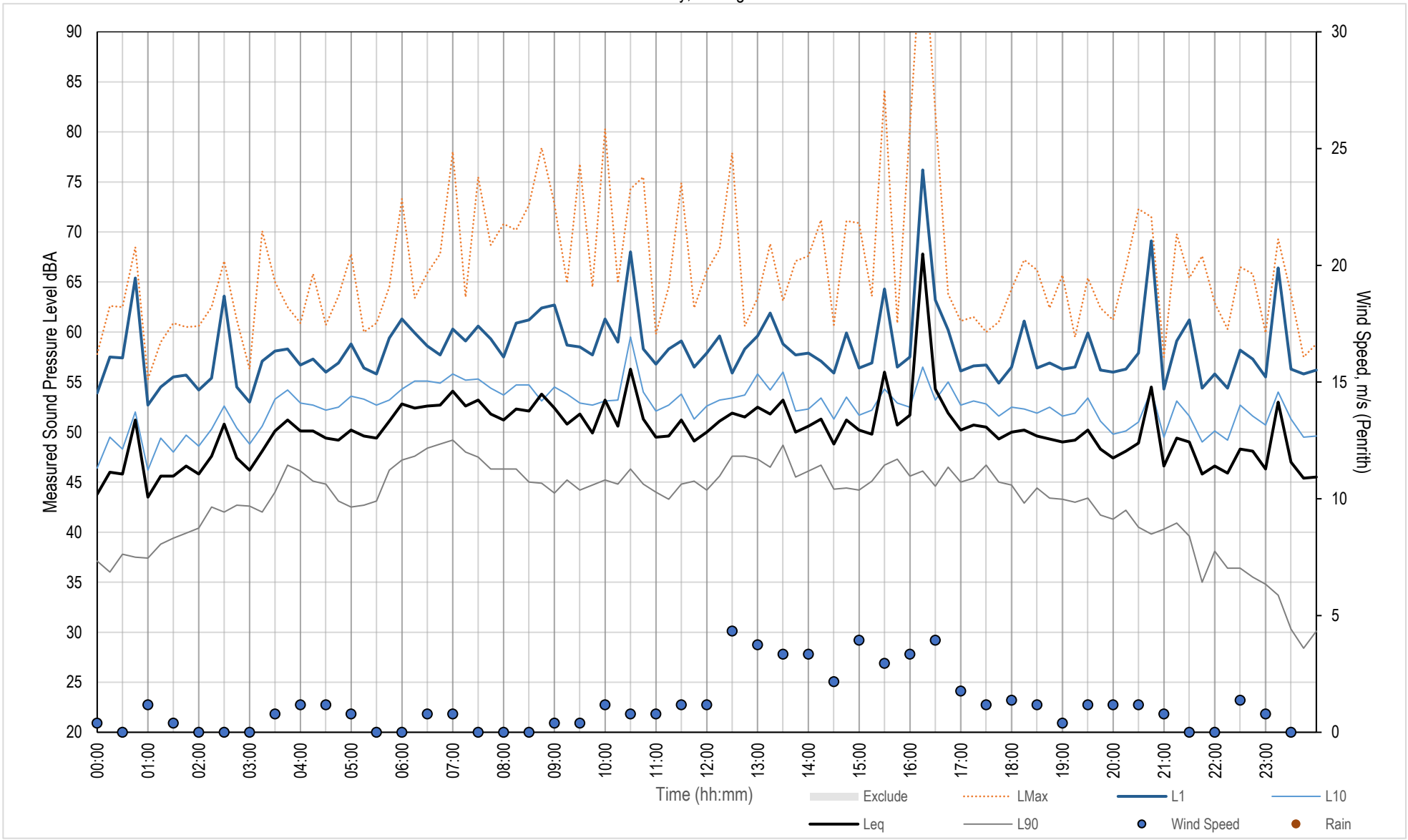
**Measured Noise Levels - NM01**

Tuesday, 06 August 2019



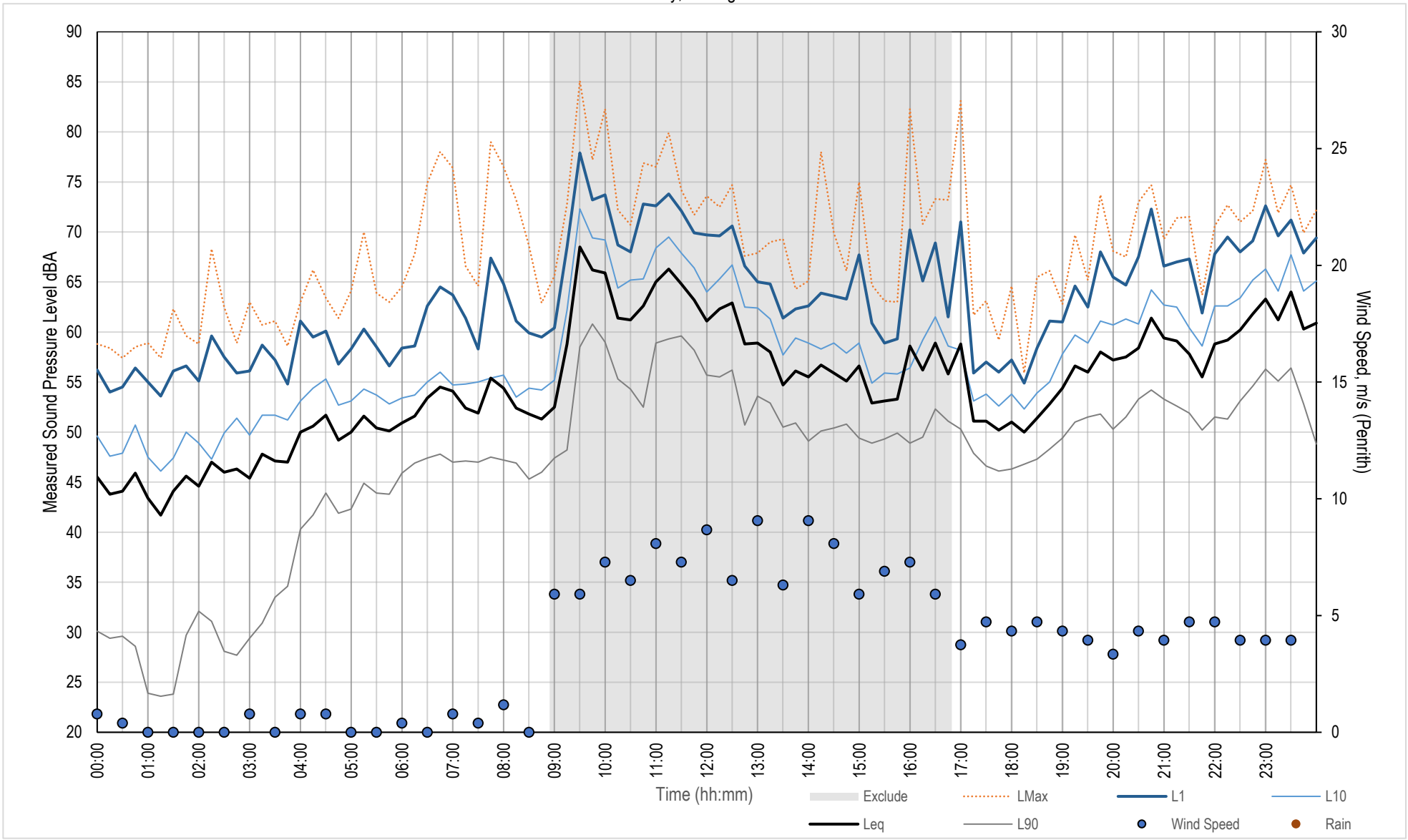
**Measured Noise Levels - NM01**

Wednesday, 07 August 2019



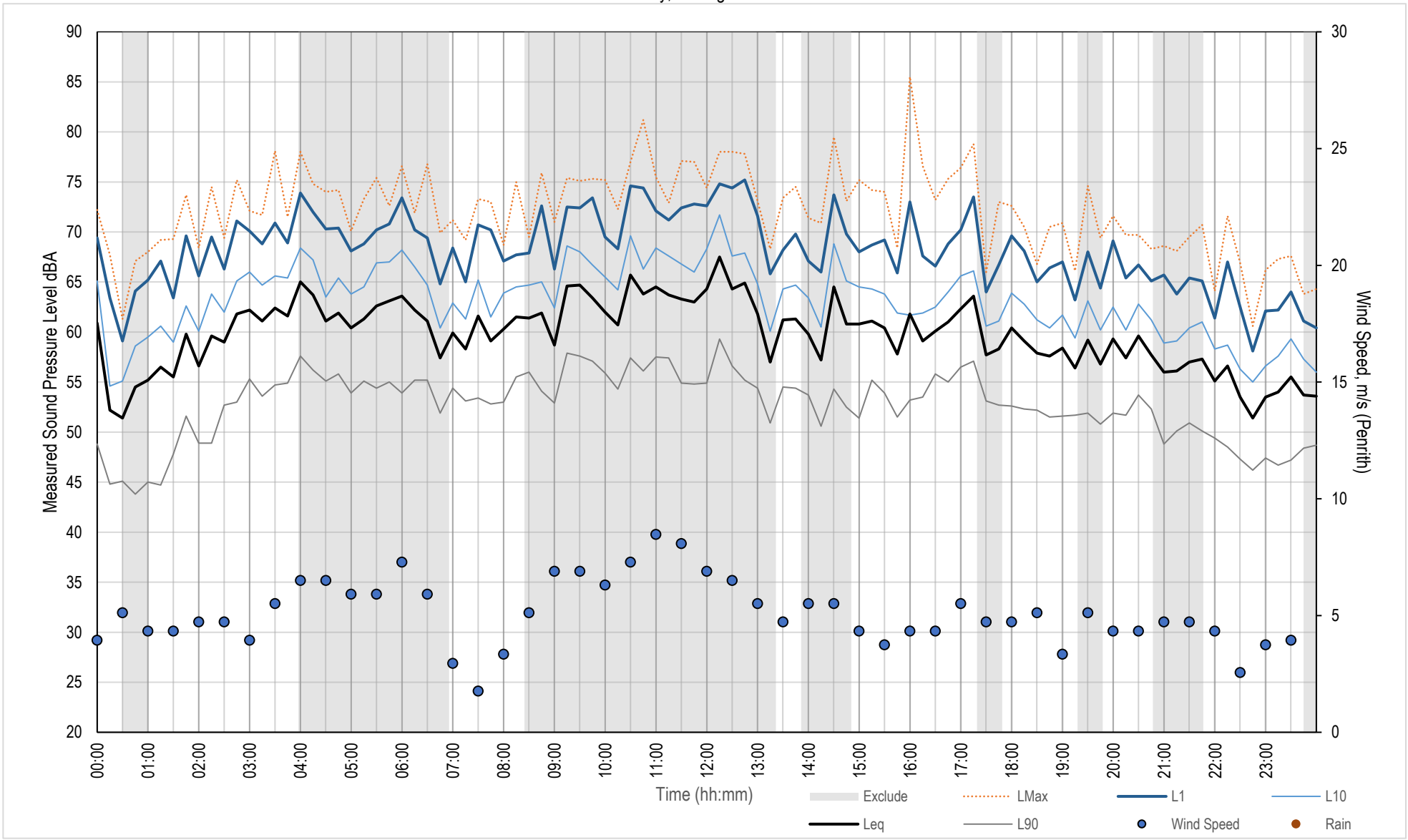
**Measured Noise Levels - NM01**

Thursday, 08 August 2019



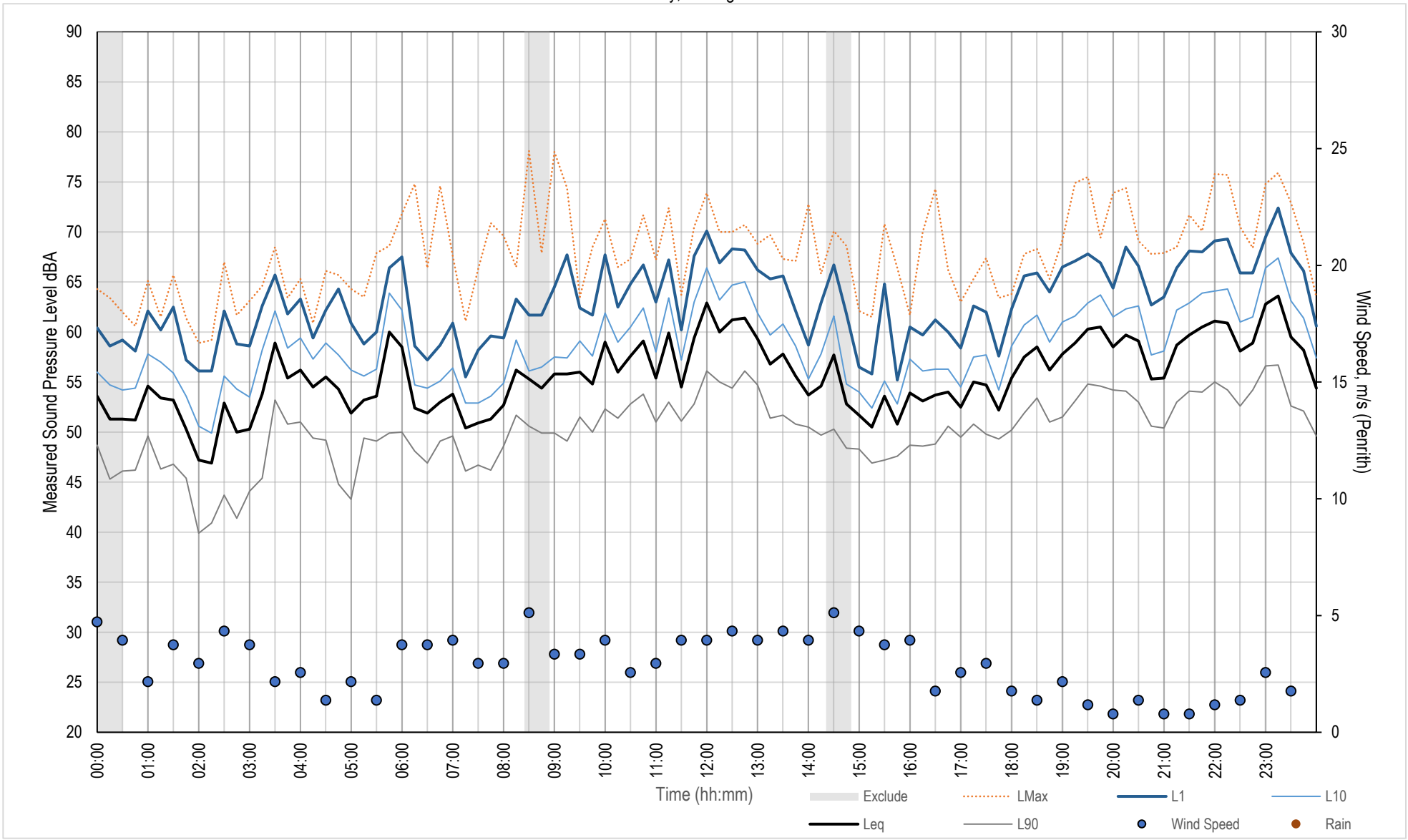
**Measured Noise Levels - NM01**

Friday, 09 August 2019



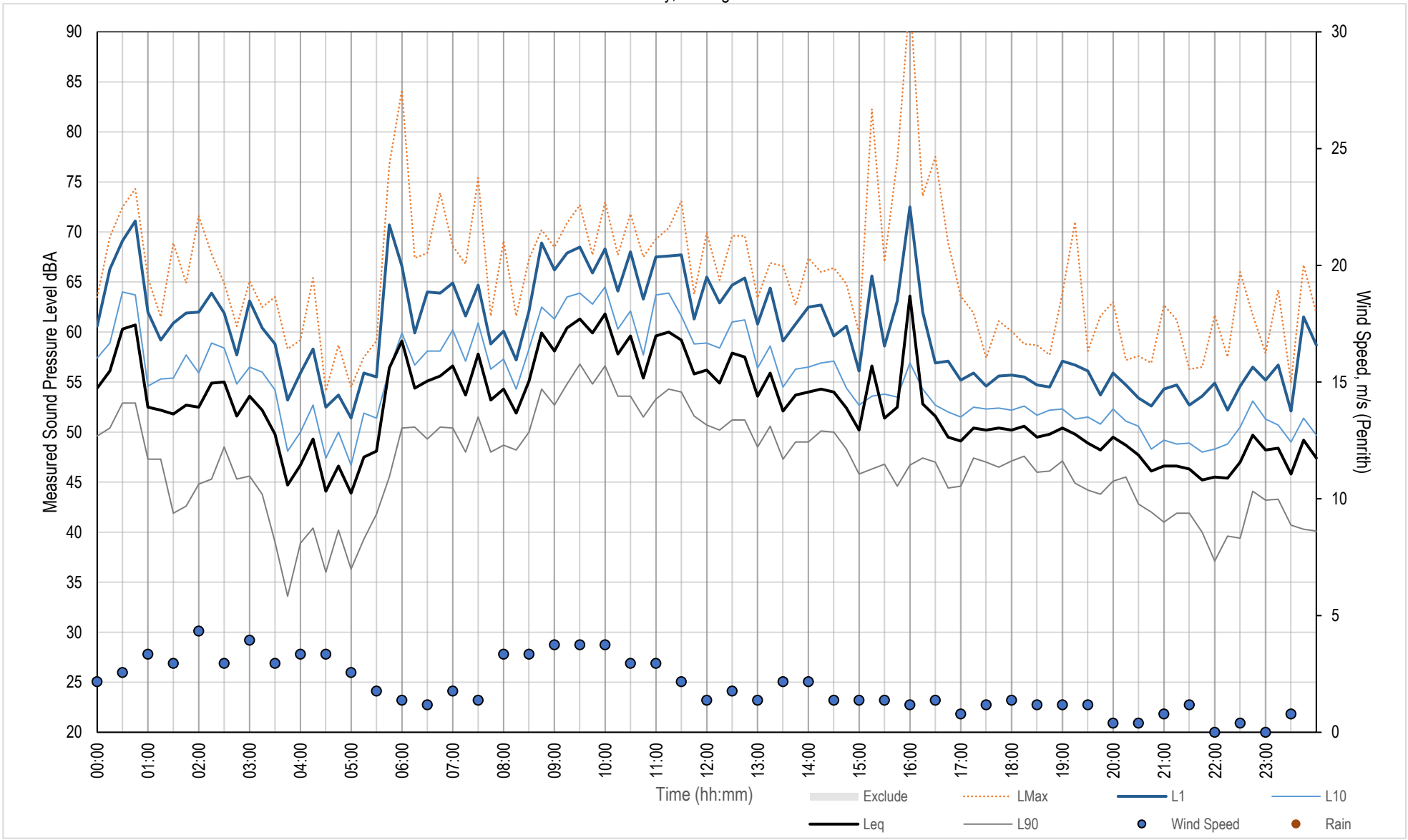
**Measured Noise Levels - NM01**

Saturday, 10 August 2019



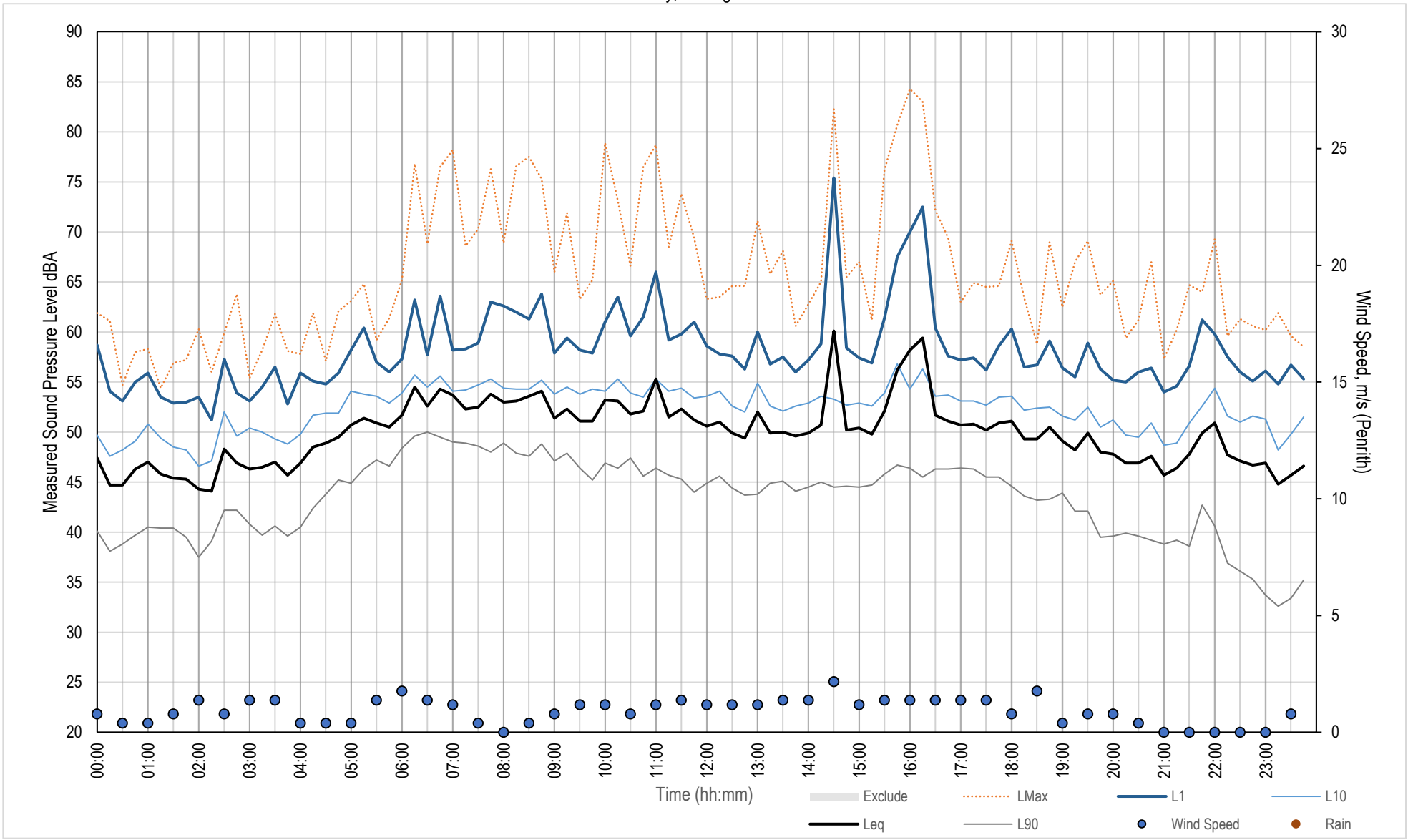
**Measured Noise Levels - NM01**

Sunday, 11 August 2019



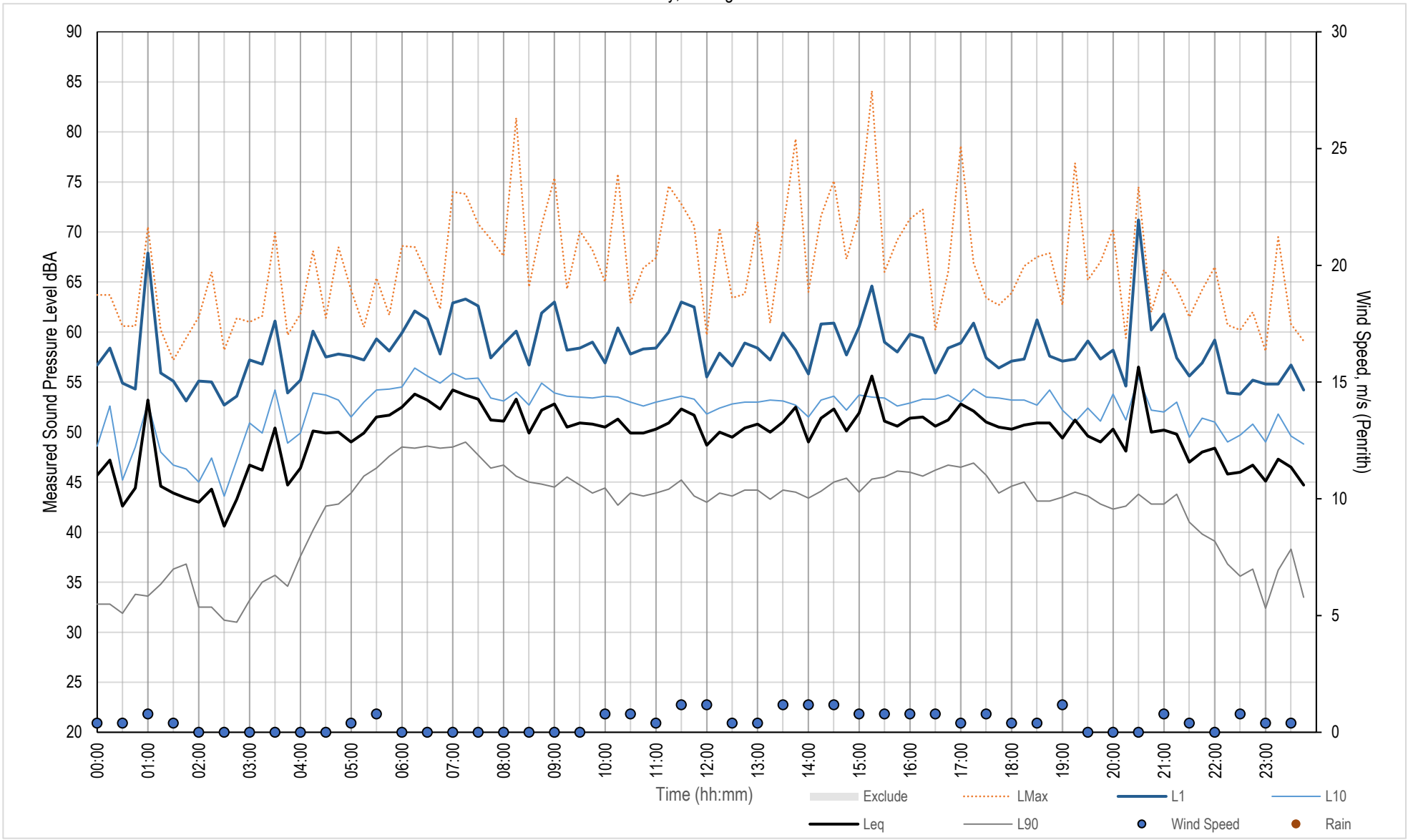
**Measured Noise Levels - NM01**

Monday, 12 August 2019



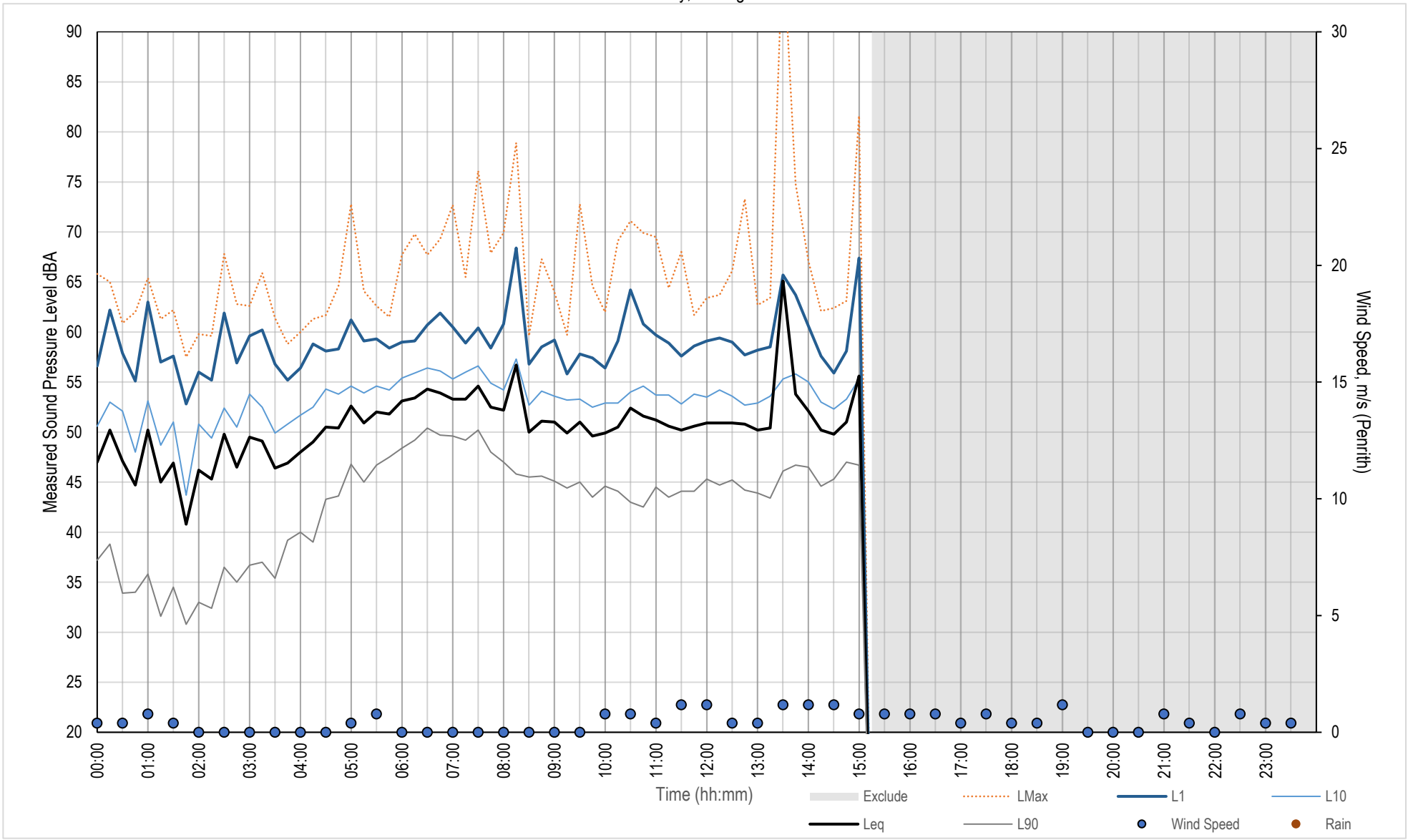
**Measured Noise Levels - NM01**

Tuesday, 13 August 2019



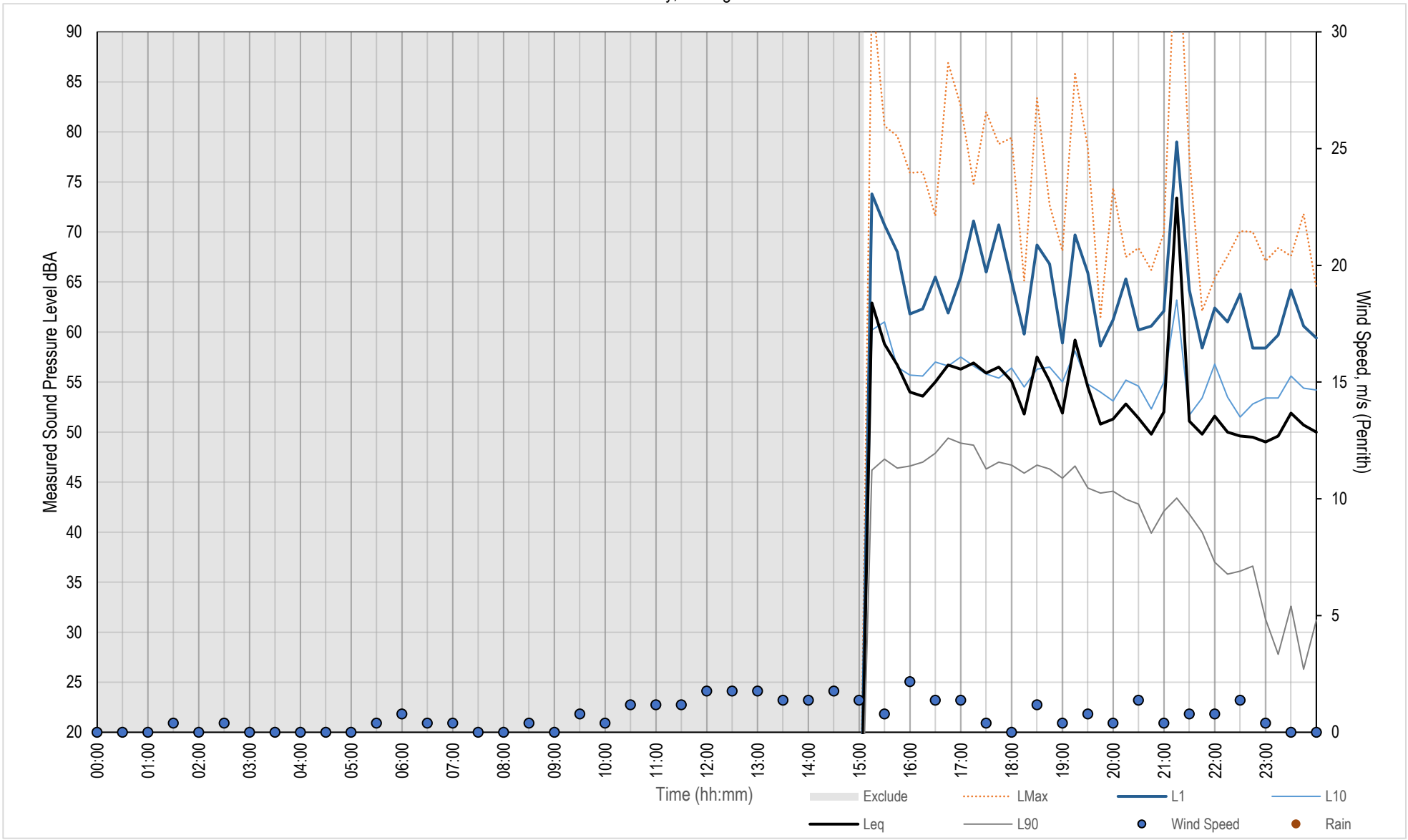
**Measured Noise Levels - NM01**

Wednesday, 14 August 2019



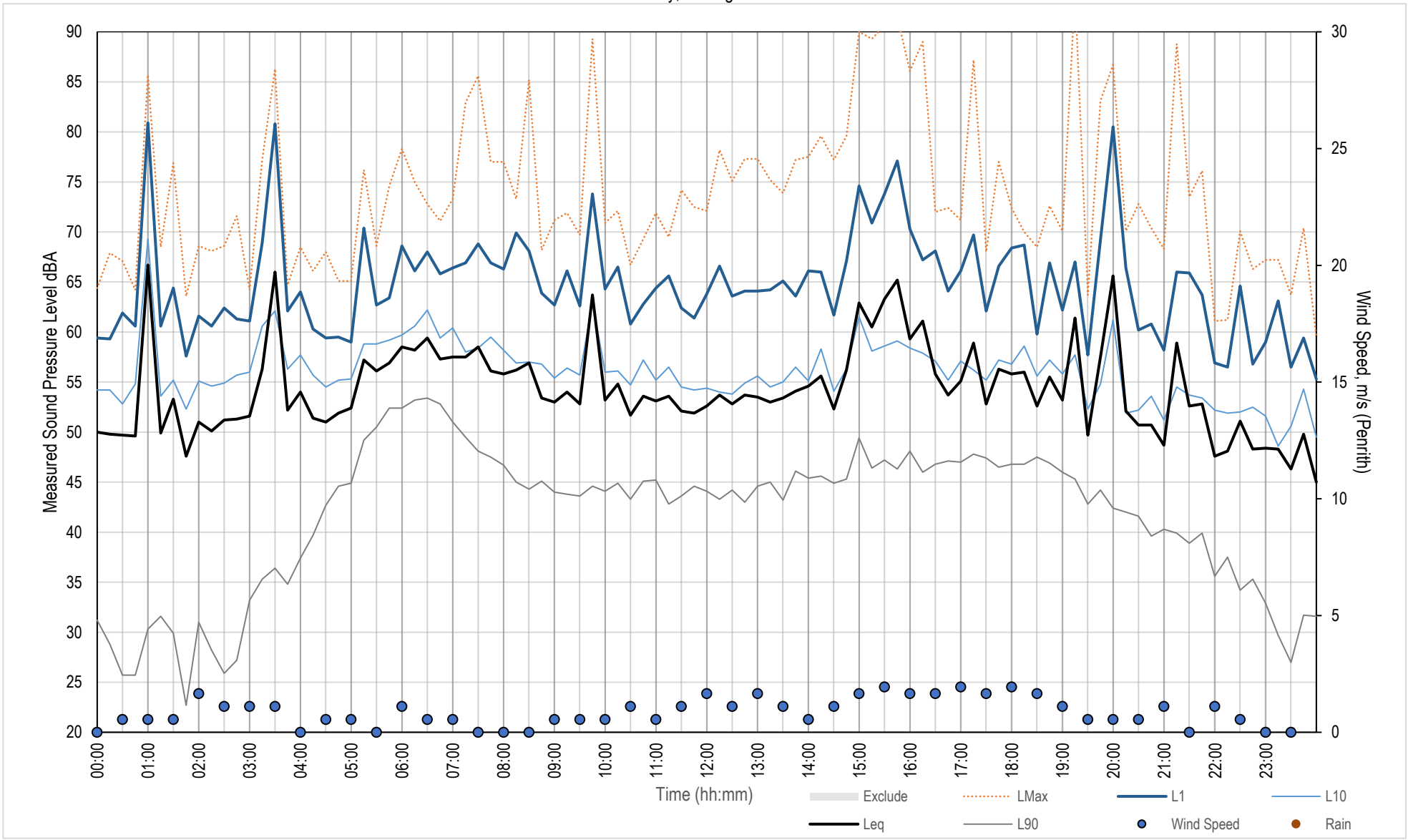
**Measured Noise Levels - NM02**

Monday, 05 August 2019



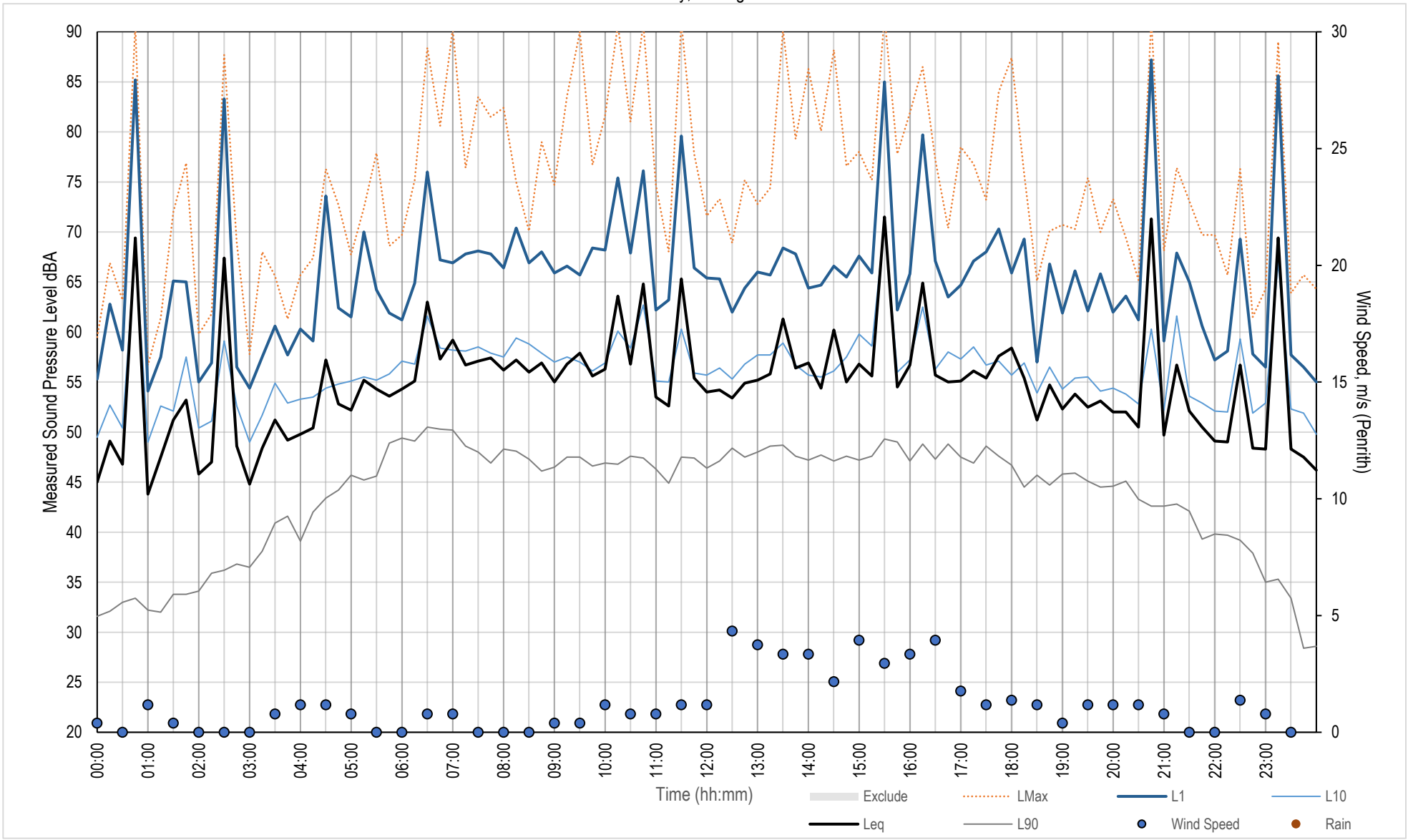
**Measured Noise Levels - NM02**

Tuesday, 06 August 2019



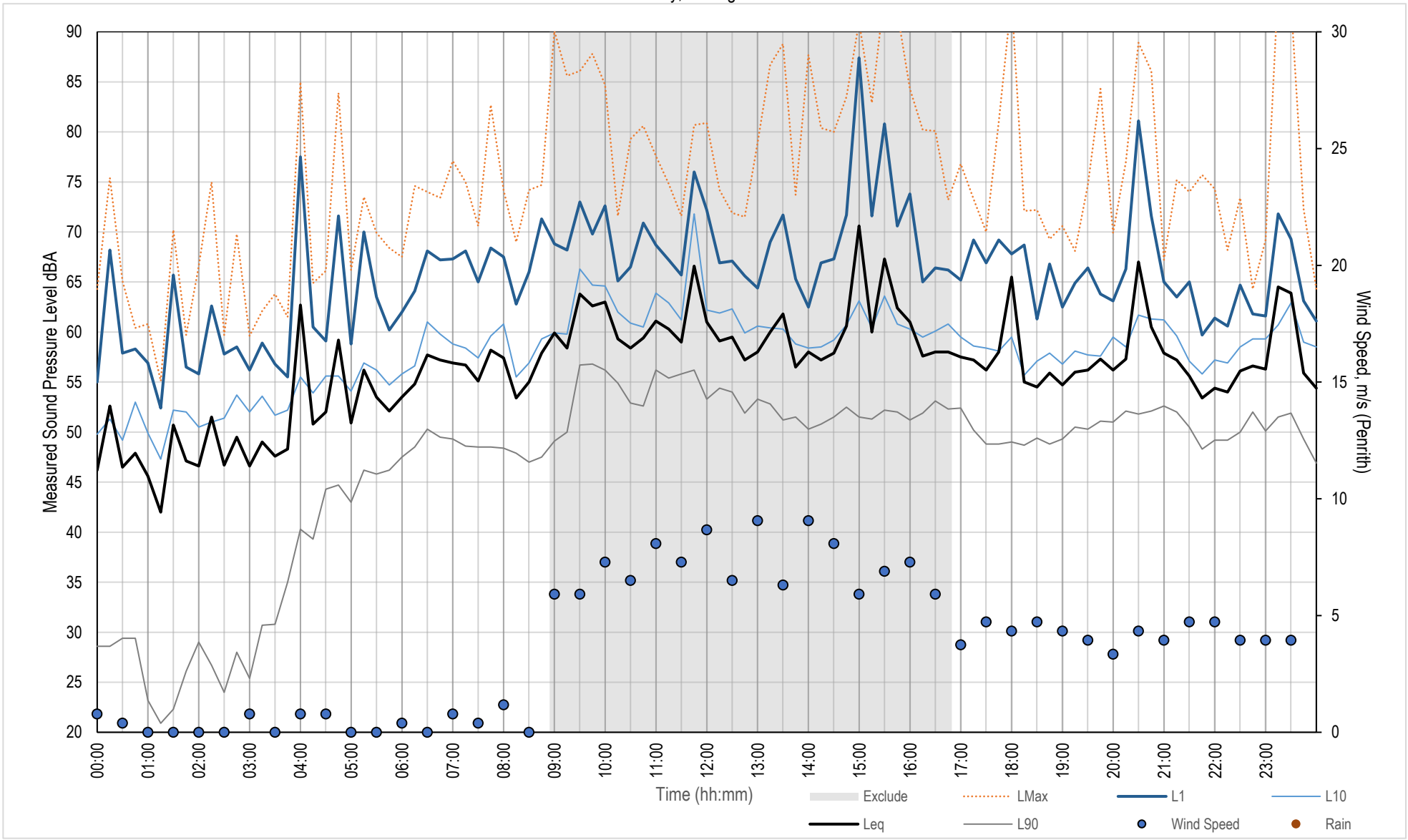
**Measured Noise Levels - NM02**

Wednesday, 07 August 2019



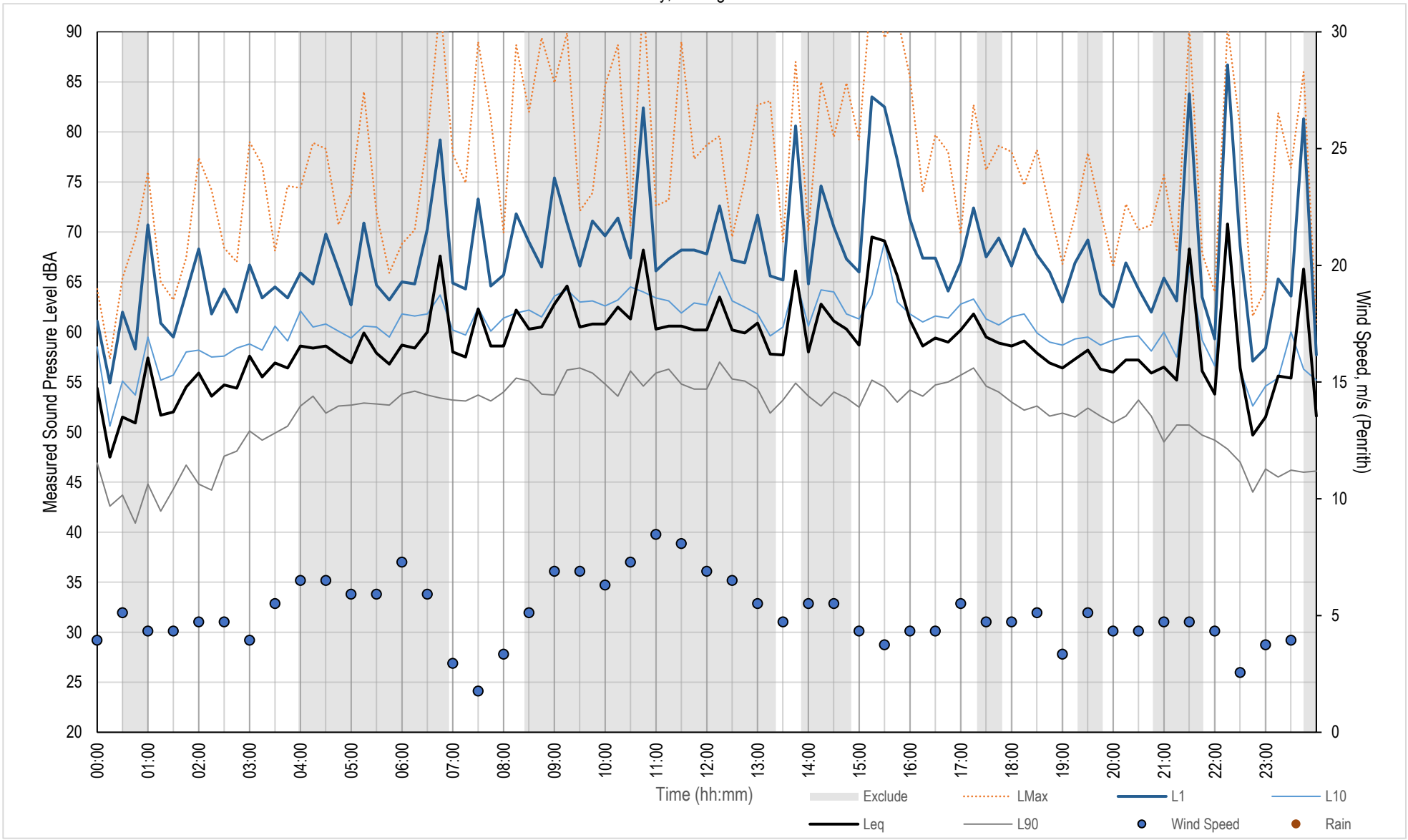
**Measured Noise Levels - NM02**

Thursday, 08 August 2019



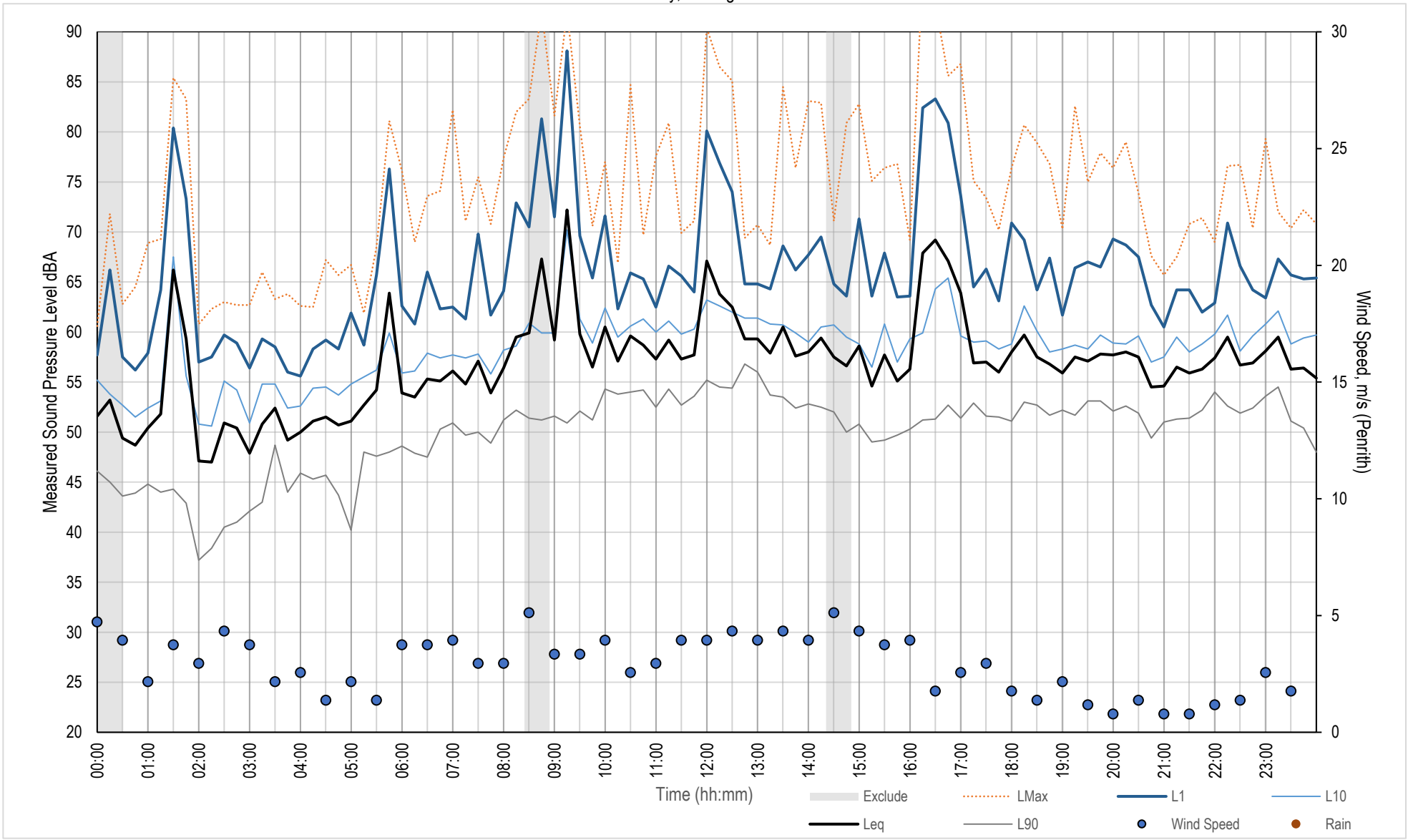
**Measured Noise Levels - NM02**

Friday, 09 August 2019



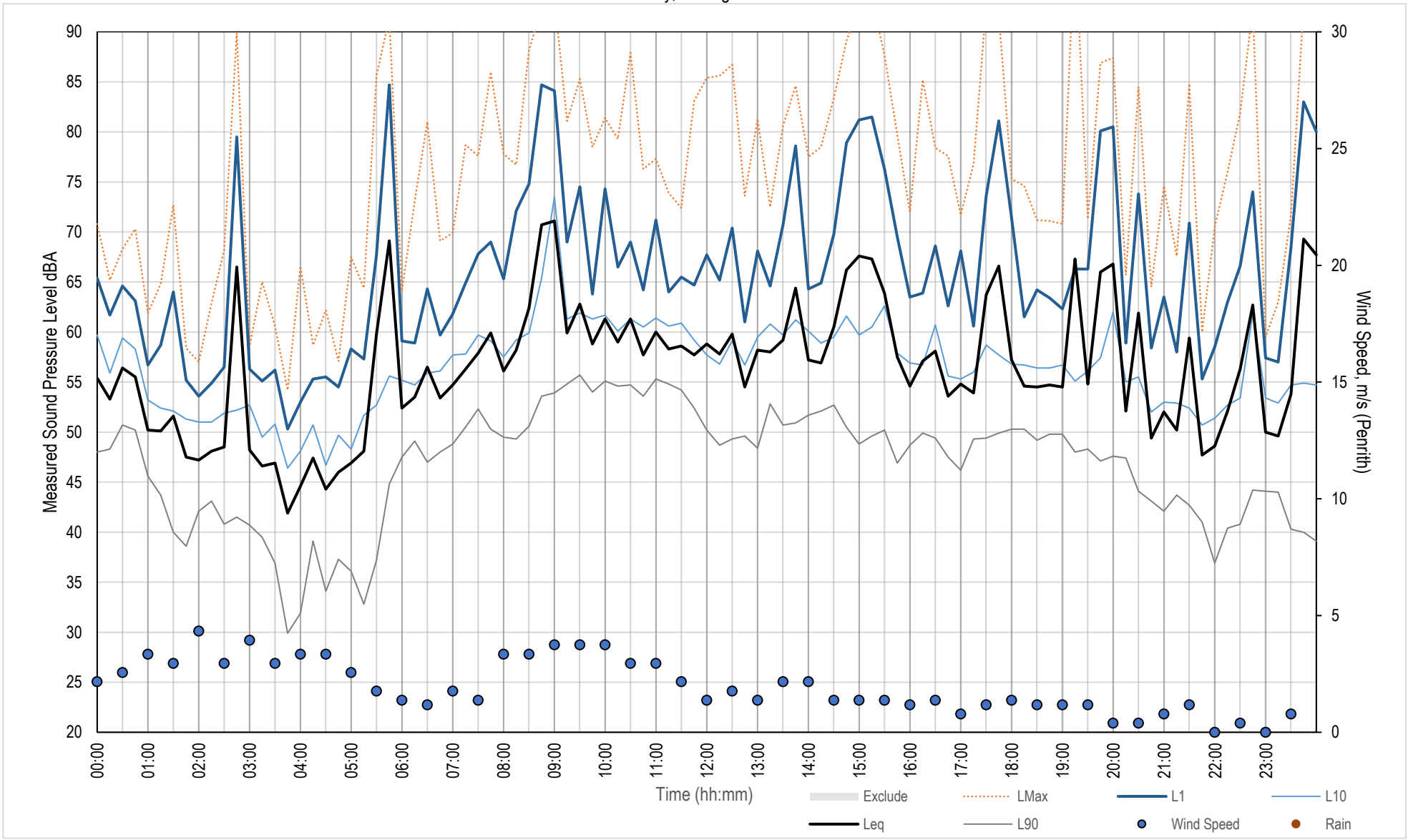
**Measured Noise Levels - NM02**

Saturday, 10 August 2019



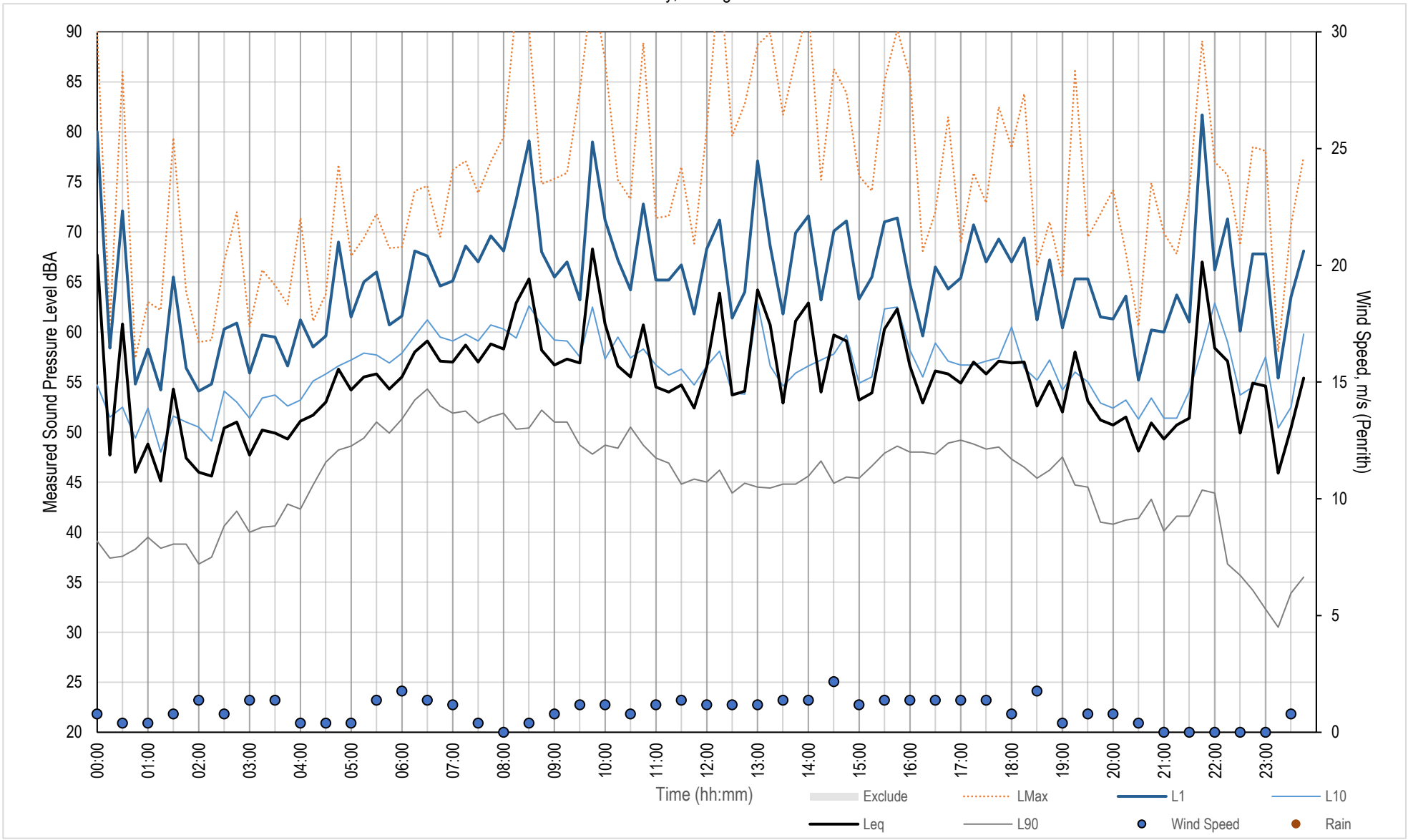
**Measured Noise Levels - NM02**

Sunday, 11 August 2019



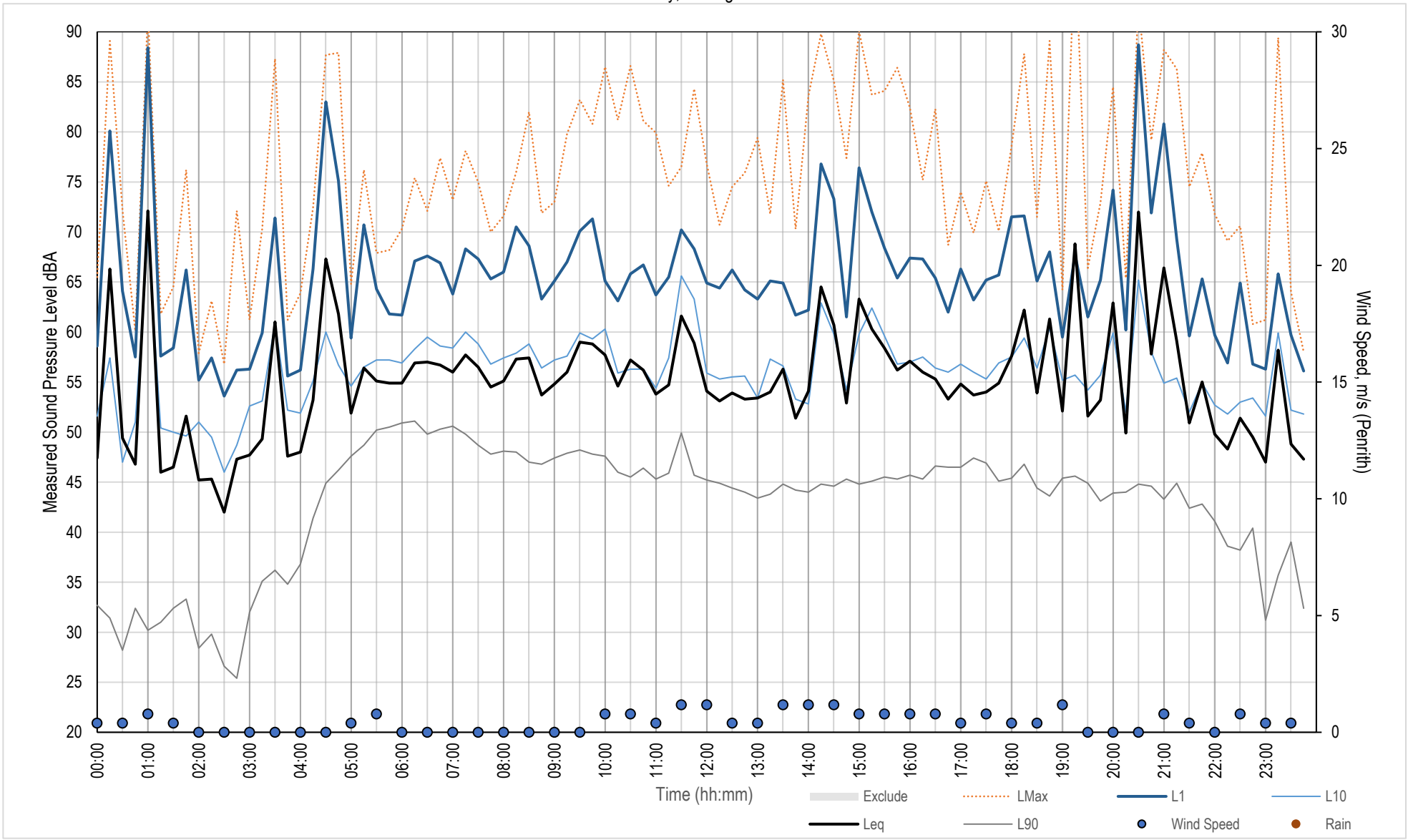
**Measured Noise Levels - NM02**

Monday, 12 August 2019



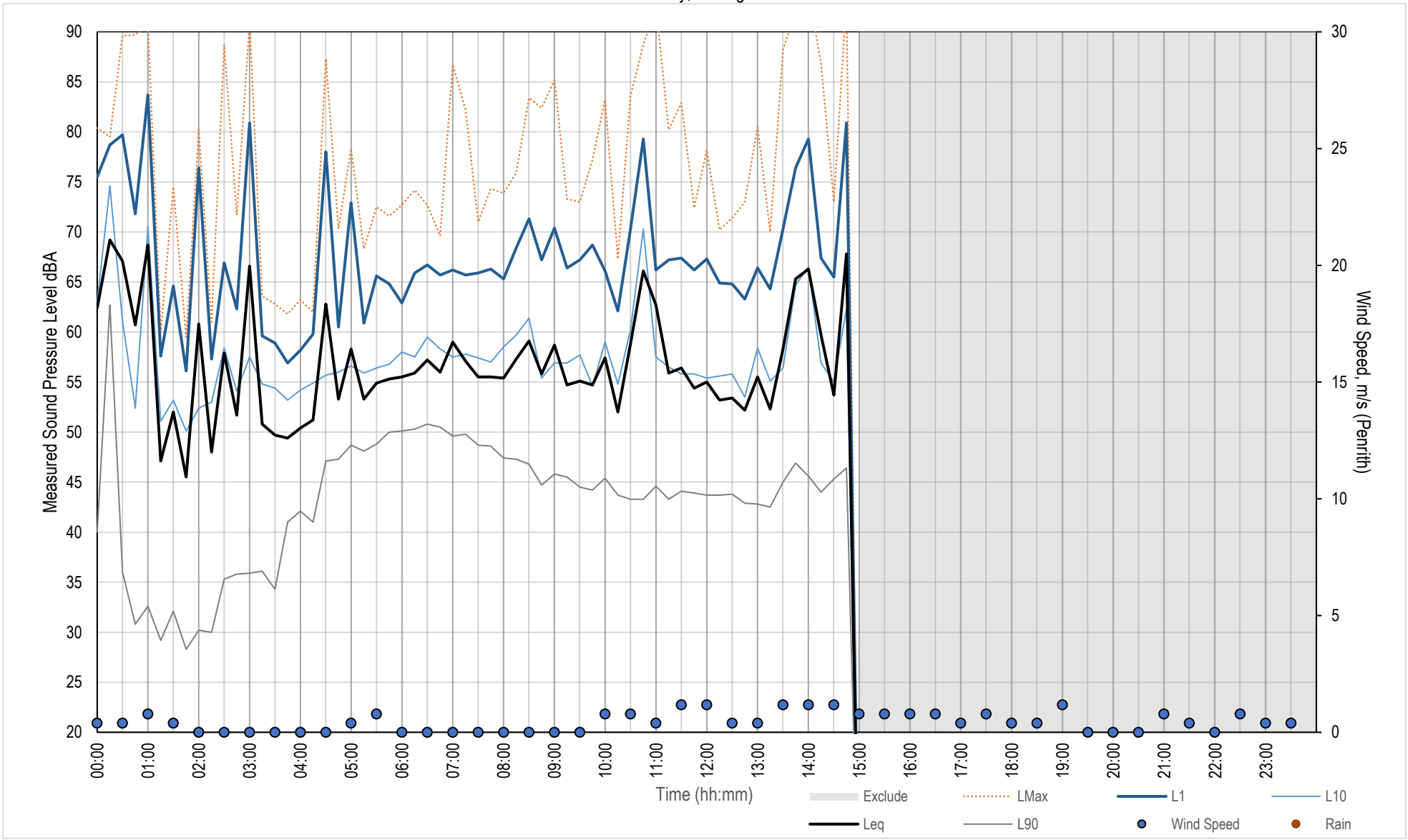
**Measured Noise Levels - NM02**

Tuesday, 13 August 2019



**Measured Noise Levels - NM02**

Wednesday, 14 August 2019



# APPENDIX B

## PREDICTED NOISE MAPS


| | |
|---|---|
| Map: Faulconbridge_Activity1 | Author: APT |
| Date: 10/09/2019 | Approved by: SM |

To be read in conjunction with WSP document: <REPORT_ID>

0 70 140 210 m

1:5000 at A3

**Legend**

- Project Location

**Noise level, dBA Leq period**

| | | |
|---|---|---|
| < 35 | 45 - 50 | 65 - 70 |
| 35 - 40 | 50 - 55 | 70 - 75 |
| 40 - 45 | 55 - 60 | 75 - 80 |
| | 60 - 65 | > 80 |

**TAP3: Faulconbridge Upgrade**

Activity 1 - Site establishment and enabling work

wsp

www.wsp.com


| | | |
|---|---|---|
| Map: Faulconbridge_Activity2 | Author: APT | N |
| Date: 10/09/2019 | Approved by: SM | |
| To be read in conjunction with WSP document: | | <REPORT_ID> |

0 70 140 210 m

1:5000 at A3

**Legend**

- Project Location

**Noise level, dBA Leq period**

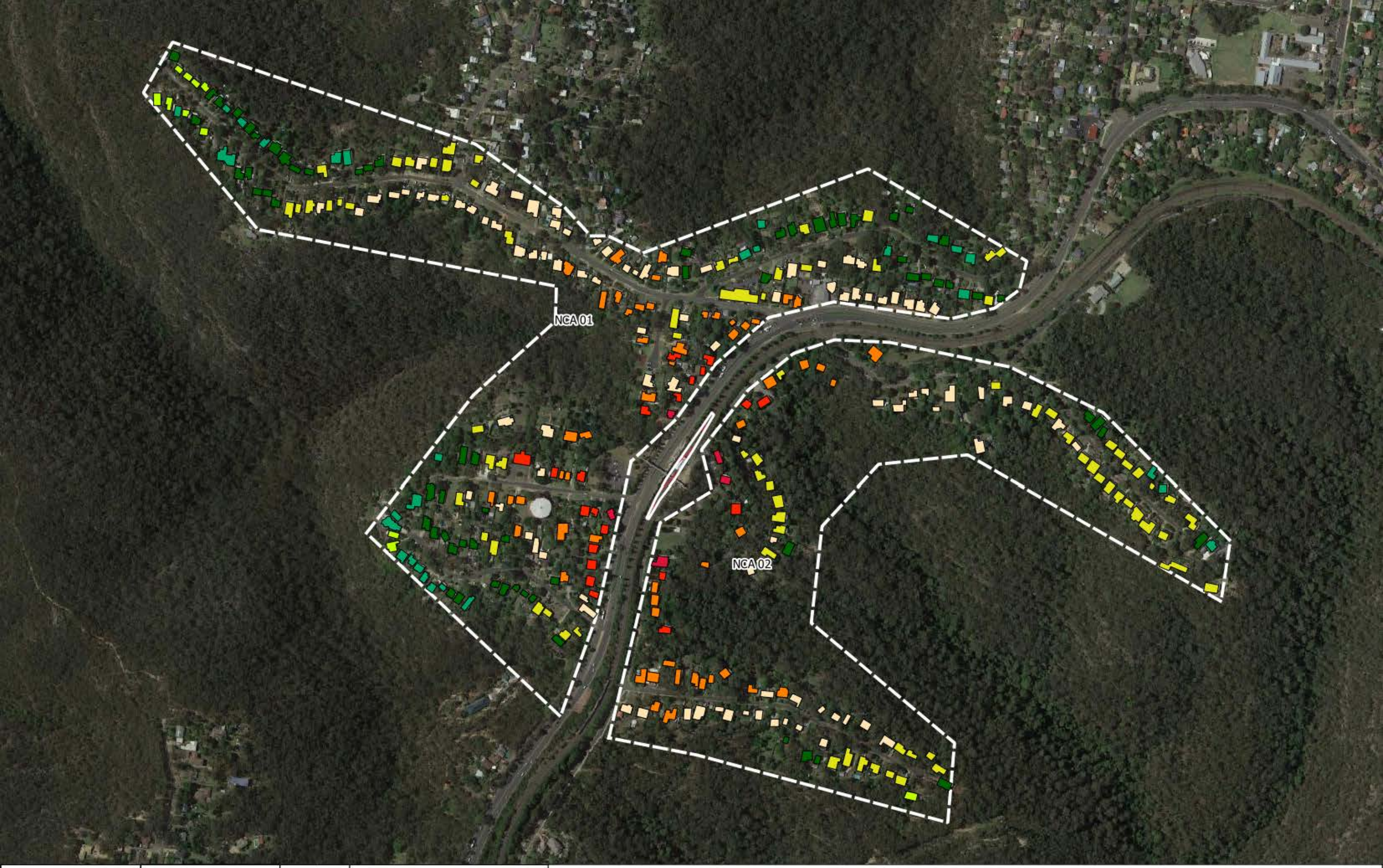
| | | |
|---|---|---|
| < 35 | 45 - 50 | 65 - 70 |
| 35 - 40 | 50 - 55 | 70 - 75 |
| 40 - 45 | 55 - 60 | 75 - 80 |
| | 60 - 65 | > 80 |

**TAP3: Faulconbridge Upgrade**

Activity 2 - Lift Work

wsp

www.wsp.com




| | | |
|---|---|---|
| Map: Faulconbridge_Activity3 | Author: APT | N |
| Date: 10/09/2019 | Approved by: SM | |

To be read in conjunction with WSP document: <REPORT_ID>

0 70 140 210 m

1:5000 at A3

**Legend**

- Project Location

**Noise level, dBA Leq period**

- < 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- > 80

**TAP3: Faulconbridge Upgrade**

Activity 3 - Stair Upgrade

wsp

www.wsp.com


| | | |
|---|---|---|
| Map: Faulconbridge_Activity4 | Author: APT | N |
| Date: 10/09/2019 | Approved by: SM | |
| To be read in conjunction with WSP document: | | <REPORT_ID> |

0 70 140 210 m

1:5000 at A3

**Legend**

- Project Location

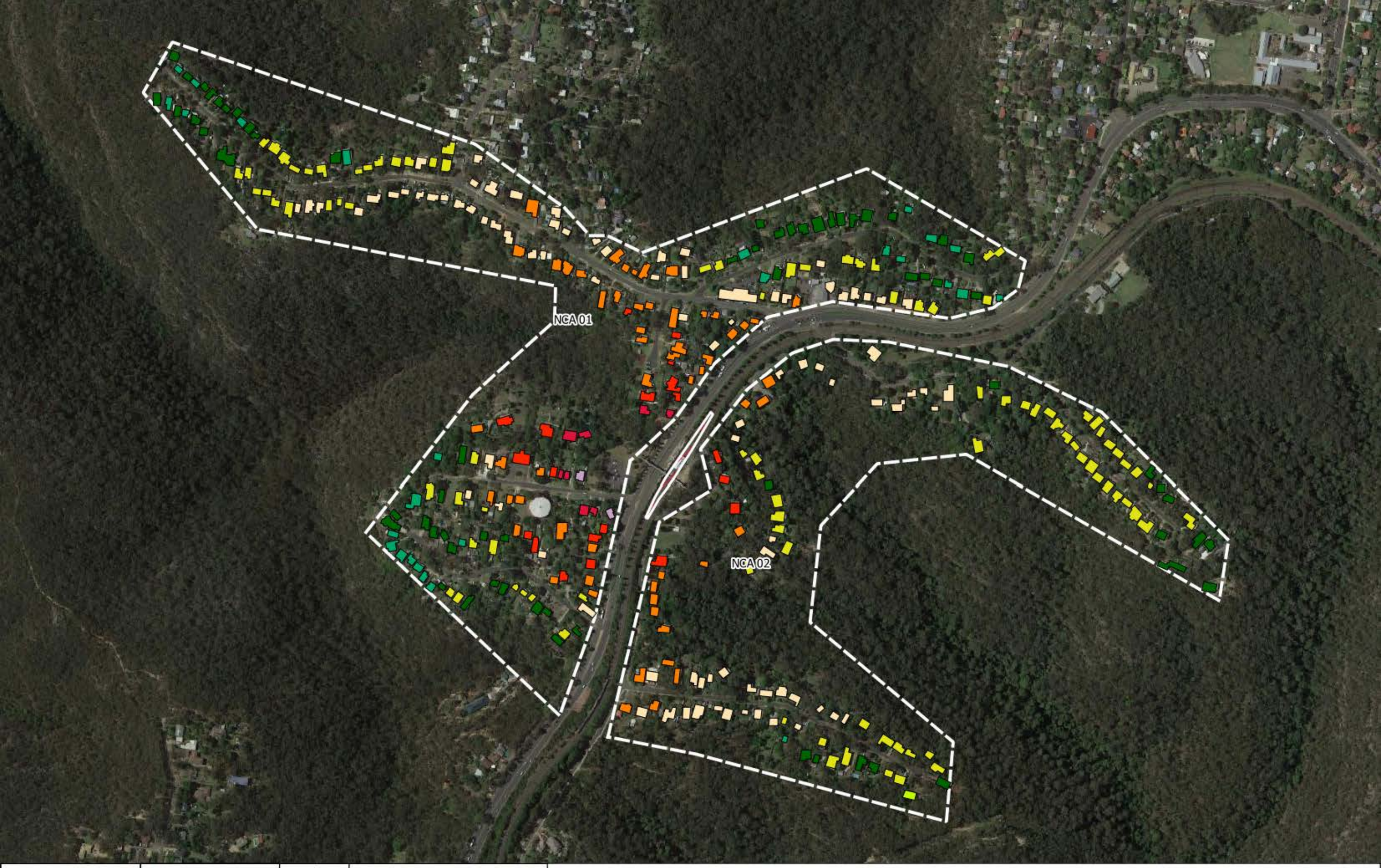
**Noise level, dBA Leq period**

| | | |
|---|---|---|
| < 35 | 45 - 50 | 65 - 70 |
| 35 - 40 | 50 - 55 | 70 - 75 |
| 40 - 45 | 55 - 60 | 75 - 80 |
| | 60 - 65 | > 80 |

**TAP3: Faulconbridge Upgrade**

Activity 4 - Ramp Upgrade

wsp




| | | |
|---|---|---|
| Map: Faulconbridge_Activity5 | Author: APT | N |
| Date: 10/09/2019 | Approved by: SM | |
| To be read in conjunction with WSP document: | | <REPORT_ID> |

0 70 140 210 m

1:5000 at A3

**Legend**

- Project Location

**Noise level, dBA Leq period**

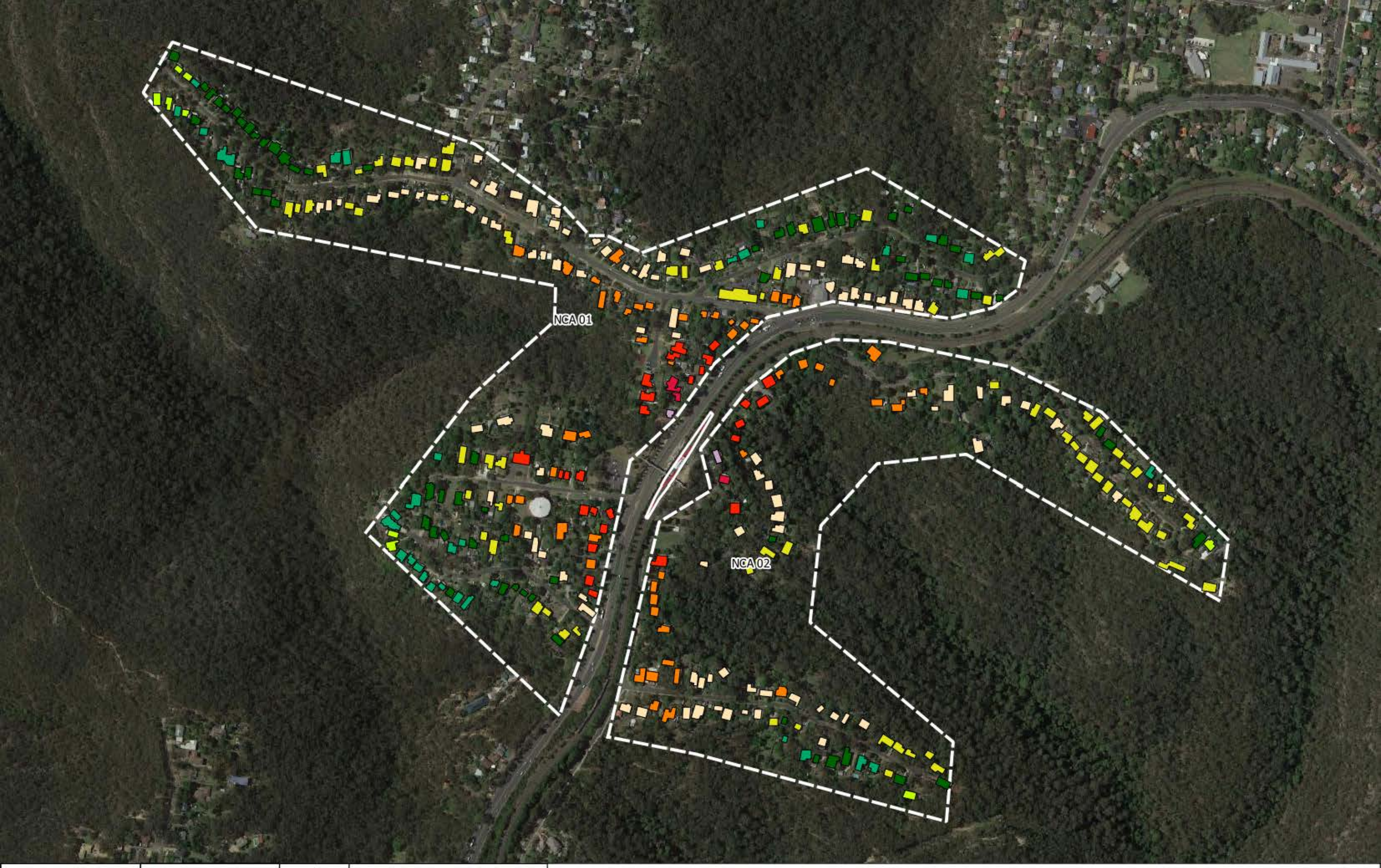
| | | |
|---|---|---|
| < 35 | 45 - 50 | 65 - 70 |
| 35 - 40 | 50 - 55 | 70 - 75 |
| 40 - 45 | 55 - 60 | 75 - 80 |
| | 60 - 65 | > 80 |

**TAP3: Faulconbridge Upgrade**

Activity 5 - Commuter Carpark Upgrade

wsp

www.wsp.com




| | | |
|---|---|---|
| Map: Faulconbridge_Activity6 | Author: APT | N |
| Date: 10/09/2019 | Approved by: SM | |
| To be read in conjunction with WSP document: | | <REPORT_ID> |

0 70 140 210 m

1:5000 at A3

**Legend**

- Project Location

**Noise level, dBA Leq period**

| | | |
|---|---|---|
| < 35 | 45 - 50 | 65 - 70 |
| 35 - 40 | 50 - 55 | 70 - 75 |
| 40 - 45 | 55 - 60 | 75 - 80 |
| | 60 - 65 | > 80 |

**TAP3: Faulconbridge Upgrade**

Activity 6 - Station Building Works

wsp

www.wsp.com


| | | | |
|---|---|---|---|
| Map: Faulconbridge_Activity7 | Author: APT | N | 0 70 140 210 m |
| Date: 10/09/2019 | Approved by: SM | | 1:5000 at A3 |
| To be read in conjunction with WSP document: <REPORT_ID> | | | |

**Legend**

- Project Location

**Noise level, dBA Leq period**

| | | |
|---|---|---|
| < 35 | 45 - 50 | 65 - 70 |
| 35 - 40 | 50 - 55 | 70 - 75 |
| 40 - 45 | 55 - 60 | 75 - 80 |
| | 60 - 65 | > 80 |

**TAP3: Faulconbridge Upgrade**

Activity 7 - Platform Modification Work

wsp

www.wsp.com

# APPENDIX C

## STANDARD AND ADDITIONAL NOISE AND VIBRATION MITIGATION MEASURES

# C1 STANDARD MITIGATION MEASURES

Table C.1 Standard management measures to reduce construction noise and vibration

| ACTION REQUIRED | APPLIES TO | DETAILS |
|---|---|---|
| **Implementation of any Proposal specific mitigation measures required** | Airborne noise<br>Ground-borne noise & vibration | In addition to the measures set out in this table, any project specific mitigation measures identified in the EIA documentation (e.g. REF, submissions or representations report) or approval or licence conditions must be implemented. |
| **Implement stakeholder consultation measures (refer to Sections 8.2.1 and 8.3 for further details of community consultation measures)** | Airborne noise<br>Ground-borne noise & vibration | Periodic notification (monthly letterbox drop and website notification) detailing all upcoming construction activities delivered to sensitive receivers at least 7 days prior to commencement of relevant works.<br>In addition to Periodic Notification, the following strategies may be adopted on a case-by-case basis:<br>• Project Specific Website<br>• Project Infoline<br>• Construction Response Line<br>• Email Distribution List<br>• Web-based Surveys<br>• Social Media<br>• Community and Stakeholder Meetings and<br>• Community Based Forums (if required by approval conditions). |
| **Register of noise and vibration sensitive receivers** | Airborne noise<br>Ground-borne noise & vibration | A register of most affected noise and vibration sensitive receivers (NVSRs) would be kept on site. The register would include the following details for each NVSR:<br>• Address of receiver<br>• Category of receiver (e.g. Residential, Commercial etc.)<br>• Contact name and phone number.<br>The register may be included as part of the Project's Community Liaison Plan or similar document and maintained in accordance with the requirements of this plan. |
| **Construction hours and scheduling** | Airborne noise<br>Ground-borne noise & vibration | Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating noise with special audible characteristics and/or vibration levels should be scheduled during less sensitive time periods. |
| **Construction respite period** | Ground-borne noise & vibration<br>Airborne noise | Noise with special audible characteristics and vibration generating activities (including jack and rock hammering, sheet and pile driving, rock breaking and vibratory rolling) may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block. 'Continuous' includes any period during which there is less than a 1 hour respite between ceasing and recommencing any of the work.<br>No more than two consecutive nights of noise with special audible characteristics and/or vibration generating work may be undertaken in the same NCA over any 7-day period, unless otherwise approved by the relevant authority. |
| **Site inductions** | Airborne noise<br>Ground-borne noise & vibration | All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include:<br>• All relevant project specific and standard noise and vibration mitigation measures<br>• Relevant licence and approval conditions<br>• Permissible hours of work<br>• Any limitations on noise generating activities with special audible characteristics |

| ACTION REQUIRED | APPLIES TO | DETAILS |
|---|---|---|
| **Site inductions** *continued* | | • Location of nearest sensitive receivers<br>• Construction employee parking areas<br>• Designated loading/unloading areas and procedures<br>• Site opening/closing times (including deliveries)<br>• Environmental incident procedures. |
| **Behavioural practices** | Airborne noise | No swearing or unnecessary shouting or loud stereos/radios on site.<br>No dropping of materials from height, throwing of metal items and slamming of doors.<br>No excessive revving of plant and vehicle engines.<br>Controlled release of compressed air. |
| **Monitoring** | Airborne noise<br>Ground-borne noise & vibration | A noise monitoring program should be carried out for the duration of works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions. |
| **Attended vibration measurements** | Ground-borne vibration | Attended vibration measurements shall be undertaken at all buildings within 25 m of vibration generating activities when these activities commence to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage. |
| **Update Construction Environmental Management Plans** | Airborne noise<br>Ground-borne noise & vibration | The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies. |
| **Building condition surveys** | Vibration Blasting | Undertake building dilapidation surveys on all buildings located within the buffer zone prior to major project construction activities with the potential to cause property damage. |

Table C.2 Standard source measures to reduce construction noise and vibration

| ACTION REQUIRED | APPLIES TO | DETAILS |
|---|---|---|
| **Plan worksites and activities to minimise noise and vibration** | Airborne noise<br>Ground-borne vibration | Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. |
| **Equipment selection** | Airborne noise<br>Ground-borne noise & vibration | Use quieter and less vibration emitting construction methods where feasible and reasonable, see APPENDIX C.<br>For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits. |
| **Maximum noise levels** | Airborne-noise | The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the allowable noise levels in APPENDIX C. |
| **Rental plant and equipment** | Airborne-noise | The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the allowable noise levels in APPENDIX C. |
| **Use and siting of plant** | Airborne-noise | Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided.<br>The offset distance between noisy plant and adjacent sensitive receivers is to be maximised.<br>Plant used intermittently to be throttled down or shut down.<br>Noise-emitting plant to be directed away from sensitive receivers. |
| **Non-tonal reversing alarms** | Airborne noise | Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out-of-hours work, including delivery vehicles. |
| **Minimise disturbance arising from delivery of goods to construction sites** | Airborne noise | Loading and unloading of materials/deliveries is to occur *as far as possible* from sensitive receivers. |
| **Minimise disturbance arising from delivery of goods to construction sites *continued*** | | Select site access points and roads as far as possible away from sensitive receivers.<br>Dedicated loading/unloading areas to be shielded if close to sensitive receivers.<br>Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. |
| **Construction Related Traffic** | Airborne noise | Schedule and route vehicle movements away from sensitive receivers and during less sensitive times.<br>Limit the speed of vehicles and avoid the use of engine compression brakes.<br>Maximise on-site storage capacity to reduce the need for truck movements during sensitive times. |
| **Silencers on Mobile Plant** | Airborne noise | Where possible reduce noise from mobile plant through additional fittings including:<br>Residential grade mufflers<br>Damped hammers such as “City” Model Rammer Hammers<br>Air Parking brake engagement is silenced. |
| **Prefabrication of materials off-site** | Airborne noise | Where practicable, pre-fabricate and/or prepare materials off-site to reduce noise with special audible characteristics occurring on site. Materials can then be delivered to site for installation. |
| **Engine compression brakes** | Airborne noise | Limit the use of engine compression brakes at night and in residential areas.<br>Ensure vehicles are fitted with a maintained original equipment manufacturer exhaust silencer or a silencer that complies with the National Transport Commission’s ‘In-service test procedure’ and standard. |

Table C.3 Standard path measures to reduce construction noise and vibration

| ACTION REQUIRED | APPLIES TO | DETAILS |
|---|---|---|
| **Shield stationary noise sources such as pumps, compressors, fans etc** | Airborne noise | Stationary noise sources should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained.<br>Appendix F of AS 2436: 1981 lists materials suitable for shielding. |
| **Shield sensitive receivers from noisy activities** | Airborne noise | Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant. |

# C2 ADDITIONAL MITIGATION MEASURES

Table C.4 Additional mitigation measures

| MEASURE | DESCRIPTION | ABBREVIATION |
|---|---|---|
| **Periodic Notification** | For each I&S project, a notification entitled 'Project Update' or 'Construction Update' is produced and distributed to stakeholders via letterbox drop and distributed to the project postal and/or email mailing lists. The same information will be published on the TfNSW website (www.transport.nsw.gov.au). Periodic notifications provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage, inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on stakeholders. The approval conditions for projects specify requirements for notification to sensitive receivers where works may impact on them.<br>Content and length is determined on a project-by-project basis and must be approved by TfNSW prior to distribution.<br>Most projects distribute notifications on a monthly basis. Each notification is graphically designed within a branded template.<br><br>In certain circumstances media advertising may also be used to supplement Periodic Notifications, where considered effective.<br>Periodic Notification may be advised by the I&S Community Engagement Team in cases where AMMM are not triggered as shown in Tables 9 to 11, for example where community impacts extend beyond noise and vibration (traffic, light spill, parking etc). In these circumstances the I&S Community Engagement Team will determine the community engagement strategy on a case-by-case basis. | PN |
| **Verification Monitoring** | Verification monitoring of noise and/or vibration during construction may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver has been identified). Monitoring can be in the form of either unattended logging (i.e. for vibration provided there is an immediate feedback mechanism such as SMS capabilities) or operator attended surveys (i.e. for specific periods of construction noise).<br>The purpose of monitoring is to confirm that:<br>• construction noise and vibration from the project are consistent with the predictions in the noise assessment<br>• mitigation and management of construction noise and vibration is appropriate for receivers affected by the works<br>Where noise monitoring finds that the actual noise levels exceed those predicted in the noise assessment then immediate refinement of mitigation measures may be required and the CNVIS amended. Refer to Section 8.4 for more details. | V |
| **Specific Notification** | Specific notifications are in the form of a personalised letter or phone call to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. Alternatively (or in addition to), communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities and provide an individual briefing.<br>• Letters may be letterbox dropped or hand distributed<br>• Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and their specific needs<br>• Individual briefings are used to inform stakeholders about the impacts of noisy activities and mitigation measures that will be implemented. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project<br><br>Specific notifications are used to support periodic notifications, or to advertise unscheduled works and must be approved by TfNSW prior to implementation/distribution. | SN |
| **Respite Offer** | The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact. The offer could comprise pre- purchased movie tickets, bowling activities, meal vouchers or similar offer. This measure is determined on a case-by-case basis, and may not be applicable to all I&S projects. | RO |

| MEASURE | DESCRIPTION | ABBREVIATION |
|---|---|---|
| **Alternative Accommodation** | Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts. Alternative accommodation will be determined on a case-by-case basis and should provide a like-for-like replacement for permanent residents, including provisions for pets, where reasonable and feasible. | AA |
| **Alternative construction methodology** | Where the vibration assessment identifies that the proposed construction method has a high risk of causing structural damage to buildings near the works, the proponent will need to consider alternative construction options that achieve compliance with<br>the VMLs for building damage. For example, replace large rock breaker with smaller rock breakers or rock saws. | AC |
| **Respite Period** | OOHW during evening and night periods will be restricted so that receivers are impacted for no more than 3 consecutive evenings and no more than 2 consecutive nights in the same NCA in any one week. A minimum respite period of 4 evenings/5 nights shall be implemented between periods of consecutive evening and/or night works. Strong justification must be provided where it is not reasonable and feasible to implement these period restrictions (e.g. to minimise impacts to rail operations), and approval must be given by TfNSW through the OOHW Approval Protocol (Section 6). Note; this management measure does not apply to OOHW Period 1 – Days (See Table 1). | RP |
| **Duration Reduction** | Where Respite Periods (see management measure above) are considered to be counterproductive to reducing noise and vibration impacts to the community it may be beneficial to increase the number of consecutive evenings and/or nights through Duration Reduction to minimise the duration of the activity. This measure is determined on a project-by-project basis, and may not be applicable to all I&S projects. Impacted receivers must be consulted and evidence of community support for the Duration Reduction must be provided as justification for the Duration Reduction. A community engagement strategy must be agreed with and implemented in consultation with I&S Community Engagement Representatives. | DR |