Appendix D

Noise Assessment

Balranald Mineral Sands Project

Noise Assessment

Prepared for Iluka Resources Limited
May 2015

ILUKA

EMM
EMGA Mitchell McLennan

Balranald Mineral Sands Project

Noise Assessment

Iluka Trim Reference No: 1305945

Prepared for Iluka Resources Ltd | 1 May 2015

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Balranald Mineral Sands Project

Final

Report J12011RP1|Prepared for Iluka Resources Ltd|1 May 2015

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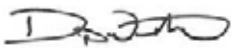
Signature		Signature	
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Executive Summary

Iluka Resources Pty Limited (Iluka) proposes to develop a mineral sands mine in south-western New South Wales (NSW), known as the Balranald Mineral Sands Project (the Balranald Project). The Balranald Project includes construction, mining and rehabilitation of two linear mineral sand deposits, known as West Balranald and Nepean, located approximately 12 kilometres (km) and 66 km north-west of the town of Balranald, respectively.

EMGA Mitchell McLennan Pty Limited (EMM) has been commissioned to undertake a noise assessment for the state significant development application for the Balranald Project. The noise assessment has been completed in accordance with the Secretary Environmental Assessment Requirements and with reference to the following guidelines and policies:

- the *NSW Industrial Noise Policy* (EPA 2000) (INP);
- the *Road Noise Policy* (EPA 2011) (RNP);
- the *Interim Construction Noise Guideline* (EPA 2009) (ICNG); and
- the *Integrated Mining Policy, Voluntary Land Acquisition and Mitigation Policy* (NSW Government 2014) (VLAMP).

The noise assessment shows that during adverse weather conditions for all assessment periods and all stages of the mine life, one assessment locations (R5) is predicted to experience noise levels above the INP project specific noise level (PSNL) of 35 dB(A). This location is predicted to experience noise levels greater than 40 dB(A). Assessment locations where noise levels are predicted to be more than 5 dB above PSNL are entitled to voluntary acquisition upon request in accordance with the VLAMP (NSW Government 2014). Iluka therefore intends to enter into an amenity agreement or acquire this property (R5).

The privately owned land assessment has identified two land parcels that fall into the VLAMP voluntary acquisition criteria over the life of the Balranald Project. The project area physically spans over the majority of these two land parcels and this land would be subject to acquisition and/or compensation agreements irrespective of the noise impact assessment.

The low frequency assessment identified that all assessment locations satisfy the 60 dB(C) 'Broner' criterion, while the INP low frequency noise criteria is achieved at all residential locations. Analysis of sound power levels in Appendix C shows that the difference between dB(A) and dB(C) noise levels for all plant and equipment (ie at source) is less than 15 dB. Low frequency noise impacts from the Balranald Project are considered unlikely, however, Iluka will monitor and manage operating noise levels, which will include provisions for low frequency noise identification.

Potential sleep disturbance impacts from operational maximum noise level events have been assessed and are expected to satisfy the relevant criteria for all assessment locations.

The 24 hour construction noise assessment identifies that most assessment locations satisfy the ICNG noise management levels (NMLs), with the exception being R13 where noise levels are predicted to be marginally above the out of hours NML and sleep disturbance criteria. This is generated by West Balranald to Nepean haul road construction. It is expected that with appropriate management and mitigation that noise levels can be managed to below the ICNG NMLs over a 24 hour construction period. Construction noise and vibration management and mitigation will be developed in a CEMP for the project as described in Section 7.3.

Predicted operational and construction road traffic noise levels satisfy the EPA's Road Noise Policy (RNP) noise criteria and guidelines at all assessment locations for all assessed roads.

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1 Introduction

1.1 Overview

Iluka Resources Pty Limited (Iluka) proposes to develop a mineral sands mine in south-western New South Wales (NSW), known as the Balranald Mineral Sands Project (the Balranald Project). The Balranald Project includes construction, mining and rehabilitation of two linear mineral sand deposits, known as West Balranald and Nepean, located approximately 12 kilometres (km) and 66 km north-west of the town of Balranald, respectively.

Iluka is seeking development consent under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Balranald Project, broadly comprising:

- open cut mining of the West Balranald and Nepean deposits, referred to as the West Balranald and Nepean mines, including progressive rehabilitation;
- processing of extracted ore in the project area to produce heavy mineral concentrate (HMC) and ilmenite;
- road transport of HMC and ilmenite from the project area to Victoria;
- backfilling of the mine voids with overburden and tailings, including transport of by-products from the processing of HMC in Victoria back to the project area for backfilling in the mine voids;
- return of hypersaline groundwater extracted prior to mining to its original aquifer by a network of injection borefields;
- an accommodation facility for the construction and operational workforce;
- gravel extraction from local sources for construction requirements; and
- a water supply pipeline from the Murrumbidgee River to provide fresh water during operation.

Separate approvals, are being sought for:

- the construction of a transmission line to supply power to the Balranald Project; and
- project components located within Victoria.

1.2 Approval process

The planning approval process for the Balranald Project is complex as it requires a number of approvals in NSW and Victoria, as well as approval from the Commonwealth. In NSW, the Balranald Project requires development consent under Part 4, Division 4.1 of the EP&A Act. Part 4 of the EP&A Act relates to development assessment. Division 4.1 specifically relates to the assessment of development deemed to be significant to the state, known as State significant development (SSD). The Balranald Project is a mineral sands mining development which meets the requirements for SSD.

An application for SSD must be accompanied by an environmental impact statement (EIS), prepared in accordance with the NSW *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

An approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is required for the Balranald Project (with the exception of the transmission line which will be subject to a separate EPBC Act referral process). A separate EIS will be prepared to support an application in accordance with the requirements of Part 8 of the EPBC Act.

1.3 Secretary's environmental assessment requirements

This EIS has been prepared to address specific requirements provided in the Secretary's environmental assessment requirements (SEARs) for the SSD application, issued on 2 December 2014.

This noise impact assessment has been prepared to address specific requirements for noise in the SEARs.

Table 1.1 Relevant SEARs for this assessment

Requirement	Section addressed
Including a quantitative assessment of potential:	
Construction noise impacts	Section 6.5
Operational noise impacts	Section 6.1, 6.2, 6.3, 6.4
Transport noise impacts	Section 6.6
Reasonable and feasible mitigation measures, including evidence that there are no such measures available other than those proposed	Chapter 7
Monitoring and management measures, in particular real-time, attended noise monitoring and predictive meteorological forecasting	Chapter 7

1.4 Purpose of this report

EMGA Mitchell McLennan Pty Limited (EMM) has been commissioned to undertake a noise assessment for the SSD application for the Balranald Project. The noise assessment has been completed in accordance with the SEARs and with reference to the following standards, guidelines and policies:

- the *NSW Industrial Noise Policy* (EPA 2000) (INP);
- the *Road Noise Policy* (EPA 2011) (RNP);
- the *Interim Construction Noise Guideline* (EPA 2009) (ICNG); and
- the *Integrated Mining Policy, Voluntary Land Acquisition and Mitigation Policy* (NSW Government 2014) (VLAMP).

1.5 Common noise levels

It is useful to have an appreciation of decibels (dB), the unit of noise measurement when reading this assessment. Table 1.2 gives some practical indication of what an average person perceives about changes in noise levels.

Table 1.2 Perceived change in noise

Change in sound level (dB)	Perceived change in noise
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times as loud (or quarter) as loud

2 Project description

2.1 Project schedule

The Balranald Project will have a life of approximately 15 years, including construction, mining, backfilling of all overburden material, rehabilitation and decommissioning.

Construction of the Balranald Project will commence at the West Balranald mine, and is expected to take about 2.5 years. Operations will commence at the West Balranald mine in Year 1 of the operational phase, which will overlap with approximately the last six months of the construction. The operational phase would include mining and associated ore extraction, processing and transport activities, and would be approximately nine years in duration. This would include completion of backfilling overburden into the pits at both the West Balranald and Nepean mines. Construction of infrastructure at the Nepean mine will commence in approximately Year 5 of the operational phase, with mining of ore starting in Year 6, and being complete by approximately Year 8.

Rehabilitation and decommissioning is expected to take a further two to five years following Year 9 of the operational phase.

2.2 Project area

All development for the Balranald Project that is the subject of the SSD application is within the project area as shown in Figure 2.1. The project area is approximately 9,964 ha, and includes the following key project elements, described in subsequent sections:

- West Balranald and Nepean mines;
- West Balranald access road;
- Nepean access road;
- injection borefields;
- gravel extraction;
- water supply pipeline (from the Murrumbidgee River); and
- accommodation facility.

Within the project area, the land directly disturbed for the Balranald Project is referred to as the disturbance area. For some project elements in the project area, a larger area has been surveyed than would actually be disturbed. This enables some flexibility to account for changes that may occur during detailed design and operation. The project area and disturbance area for each project element are in Table 2.1.

Table 2.1 Balranald Project area and disturbance area

Project element	Project area (ha)	Disturbance area (ha)
West Balranald mine	3,059	3,059
Nepean mine	805	805
West Balranald access road	128	52 [1]
Nepean access road	173	156 [2]
Injection borefields	5,721	1,214 [3]
Gravel extraction	42	42
Water supply pipeline	29	11 [4]
Accommodation facility	7	7
Total	**9,964**	**5,346**

Notes: 1. 60 m wide corridor within project area.
2. 40-50 m wide corridor within project area.
3. 100 m wide corridors within project area.
4. 15 m wide corridor within project area.

2.2.1 West Balranald and Nepean mines

The West Balranald and Nepean mines include:

- open cut mining areas (ie pit/mine void) that would be developed using conventional dry mining methods to extract the ore;
- soil and overburden stockpiles;
- ore stockpiles and mining unit plant (MUP) locations;
- a processing area (at the West Balranald mine), including a mineral processing plant, tailings storage facility (TSF), maintenance areas and workshops, product stockpiles, truck load-out area, administration offices and amenities;
- groundwater management infrastructure, including dewatering, injection and monitoring bores and associated pumps and pipelines;
- surface water management infrastructure;
- services and utilities infrastructure (eg electricity infrastructure);
- haul roads for heavy machinery and service roads for light vehicles; and
- other ancillary equipment and infrastructure.

The location of infrastructure at the West Balranald and Nepean mines would vary over the life of the Balranald Project according to the stage of mining.

2.2.2 Injection borefields

The Balranald Project requires a network of injection borefields in the project area for the return of hypersaline groundwater to the Loxton Parilla Sands aquifer. Within each borefield, infrastructure is generally located in two 50 m wide corridors (approximately 350 m apart) and typically comprises:

- a network of pipelines with a graded windrow on either side;
- access roads for vehicle access during construction and operation;
- rows of injection wells, with wells spaced at approximately 100 m intervals; and
- a series of water storage dams to store water during well development.

2.2.3 Access roads

There are two primary access roads within the project area to provide access to the Balranald Project:

- West Balranald access road – a private access road to be constructed from the Balranald Ivanhoe Road to the West Balranald mine.
- Nepean access road – a route comprising private access roads and existing public roads. A private access road would be constructed from the southern end of the West Balranald mine to the Burke and Wills Road. The middle section of the route would be two public roads, Burke and Wills Road and Arumpo Road. A private access road would be constructed from Arumpo Road to the Nepean mine.

The West Balranald access road would be the primary access point to the project area, and would be used by heavy vehicles transporting HMC and ilmenite. The Nepean access road would primarily be used by heavy vehicles transporting ore mined at the Nepean mine to the processing area at the West Balranald mine.

During the initial construction phase, existing access tracks through the project area from the local road network may also be used temporarily until the West Balranald and Nepean access roads and internal access roads within the project are established.

2.2.4 Accommodation facility

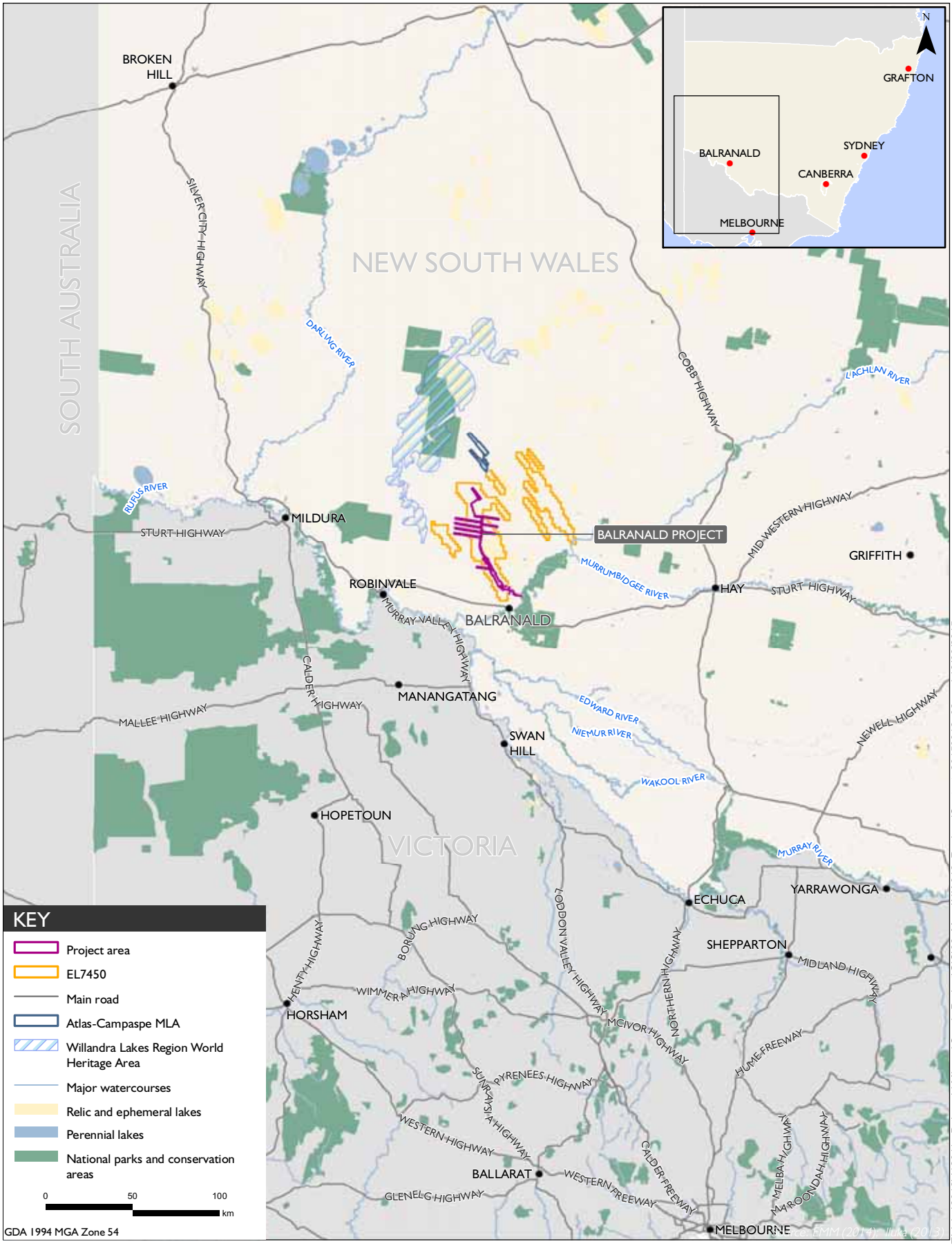
An accommodation facility would be constructed for the Balranald Project workforce. It would operate throughout the construction and operation phases of the project. It would be located adjacent to the West Balranald mine near the intersection of the West Balranald access road with the Balranald Ivanhoe Road.

2.2.5 Water supply pipeline

A water supply pipeline would be constructed to supply water from the Murrumbidgee River for operation of the Balranald Project.

2.2.6 Gravel extraction

Gravel would be required during the construction and operational phases of the Balranald Project. Local sources of gravel (borrow pits) have been included in the project area to provide gravel during the construction phase. During the construction phase, gravel would be required for the construction of the West Balranald access road, internal haul roads and service roads, and hardstand areas for infrastructure. Processing operations, such as crushing and screening activities (if required) would also be undertaken at the borrow pits. Gravel for the operational phase would be obtained from external sources.



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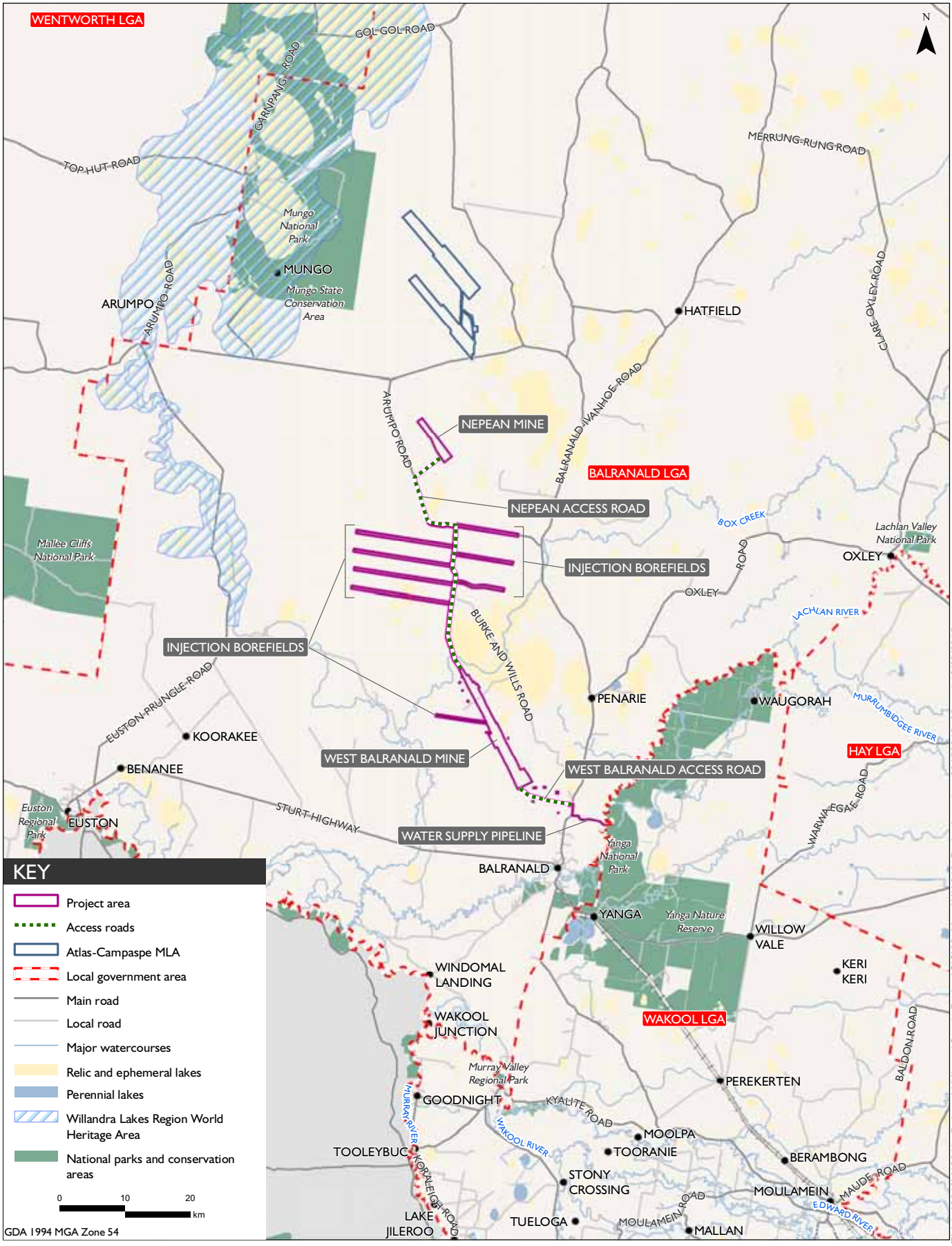
Regional context

Balranald Mineral Sands Project

Noise Impact Assessment

Figure 2.1



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Location of the project area

Balranald Mineral Sands Project

Noise Impact Assessment

Figure 2.2

2.3 Assessment locations

Noise from mining operations has been predicted for privately owned assessment locations surrounding the Balranald Project. No other sensitive land uses were identified within the Balranald Project noise catchment which has been conservatively defined as 10 km from any noise source.

A total of 47 assessment locations have been identified within the potential noise catchment for the Balranald Project and are presented in Table 2.2 and in Figure 2.3.

Table 2.2 Assessment locations

Assessment location ID	Easting[1]	Northing[1]	Assessment location type
R2	727253.4	6197483	Homestead
R5[3]	720457	6188284	Homestead
R7	737624.7	6180476	Homestead
R11	725618.3	6222584	Homestead
R12	724083.5	6221740	Shearer's Quarters
R13	716915.8	6217832	Homestead
R19	714568.2	6206861	Homestead
R24	741312.8	6178438	Shearer's Quarters
R25	743460.9	6180042	Homestead
R32	720744.9	6213679	Homestead
R36	732568.8	6182762	Shearing Shed
R40	729734.6	6166498	Homestead
R41	729415.8	6166705	Shearers Quarters
R45	740323.1	6176723	Unknown
R54	738333.2	6172592	Homestead
R57	737115.5	6170324	Unknown
R92	736180.9	6182610	Unknown
R95	737707.1	6180611	Unknown
R108	740344.5	6173973	Unknown
R151	734181.8	6165100	House
R153	734079.5	6164978	Unknown
R162	735524.4	6166108	Unknown
R192	734023.9	6164931	Unknown
R193	734060.8	6164960	Unknown
R194	733941	6164898	Unknown
R195	733981.4	6164885	Unknown
R197	733916.2	6164790	Unknown
R200	733405.5	6164720	Unknown
R202	733289.6	6164651	Unknown
R203	733326.5	6164573	Unknown
R208	733207.3	6164508	Unknown
R213	733306.6	6164450	Unknown
R224	733092.5	6164295	Unknown
R225	733114.2	6164290	Unknown

Table 2.2 Assessment locations

Assessment location ID	Easting[1]	Northing[1]	Assessment location type
R276	730802	6181794	Shed
R277	731163.6	6182572	Shed
R281	731964.1	6175482	Shed
R284	732598	6165070	Unknown
R362	712896.4	6188906	Unknown
R402	727154.7	6197495	Shed
R403	727063.8	6197495	Shed
R405	727770.6	6197280	Shed
R406	720716.3	6213873	Shed
R419	723970.5	6221765	Unknown
R1042	734536.2	6165202	House
R1043	734396.6	6165219	House
R1044	735704.3	6164370	House

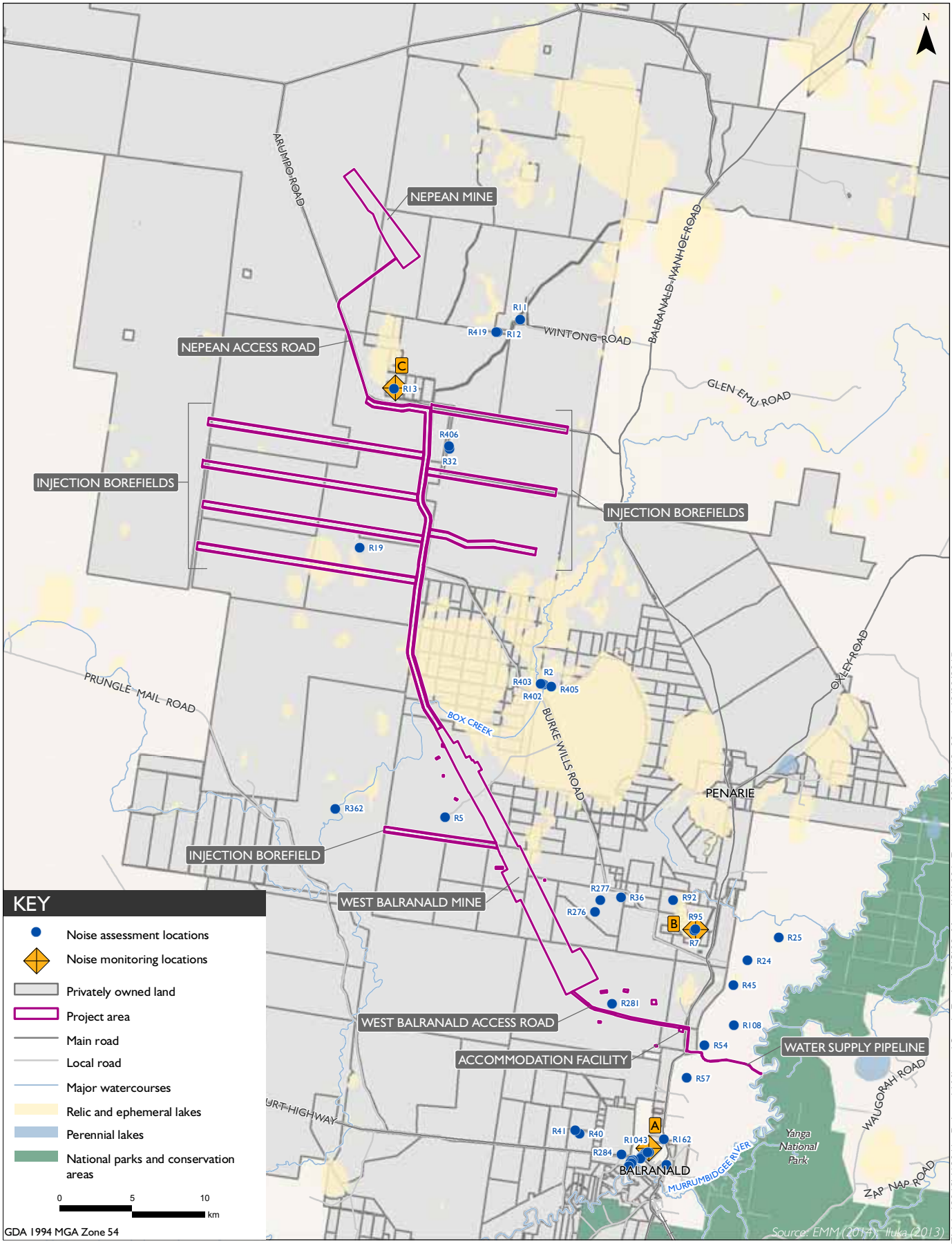
Notes: 1. GDA 1994MGA Zone 54.

2. Properties identified as 'Unknown' have been included as they may potentially be a private residences.

3. Residence currently uninhabited.

2.3.1 Privately owned land

Privately owned land parcels considered in the noise impact assessment are shown in Figure 2.3. These include vacant land and those with dwellings (ie assessment locations).



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Noise assessment locations, privately owned land parcels & noise monitoring locations

Balranald Mineral Sands Project

Noise Impact Assessment

Figure 2.3

3 Existing acoustic environment

3.1 Background noise survey

In order to establish the existing ambient noise environment of the project area, noise monitoring was conducted. The location of noise monitoring is representative of the nearest assessment locations and was selected after inspection of the project area, giving due consideration to other noise sources which may influence the readings, the proximity of assessment locations, security issues for the noise monitoring devices and gaining permission for access from the residents or landowners. The selected monitoring locations are presented in Figure 2.3.

In order to establish the ambient noise levels in the area, both unattended and short-term operator-attended noise surveys were conducted at the monitoring locations in general accordance with the procedures described in Australian Standard AS 1055-1997, "Acoustics - Description and Measurement of Environmental Noise".

The measurements were carried out using Acoustic Research Laboratories (ARL) ARL EL-316 environmental noise loggers (S/N 15-203-504, 15-203-506 and 16-203-502). The loggers were in place from 16 July to 1 August 2012 (17 days). Operator attended measurements were conducted using a SVAN 957 integrating sound level meter (serial number 2414605) to both quantify and qualify the existing noise sources and were conducted on 16 July 2012 during noise logger deployment.

The noise loggers were programmed to record statistical noise level indices continuously in 15 minute intervals, including the L_{Amax}, L_{A1}, L_{A10}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and the L_{Aeq}. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5 dB(A). All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Weather data for the survey period was obtained from the nearest Bureau of Meteorology stations at Mildura, Swan Hill and Hay. The wind speed and the rainfall data from the three stations was used to exclude noise data during periods of any rainfall and/or wind speed in excess of 5 m/s (approximately 9 knots) in accordance with INP methods. A summary of existing background and ambient noise levels is given in Table 3.1. Results are provided graphically in Appendix A.

Ambient noise levels at all three locations were dominated by natural noise sources such as birds and insects with little traffic noise. There was no existing industrial noise contribution at any of the monitoring locations at the time of monitoring.

Table 3.1 Summary of existing background and ambient noise levels, dB(A)

Monitoring location	Period	Rating background level[1] (RBL)	Measured existing L_{Aeq} noise level[2]	Existing L_{Aeq} industrial contribution
A	Day	< 30	41	nil
	Evening	< 30	37	nil
	Night	< 30	40	nil
B	Day	31	46	nil
	Evening	< 30	44	nil
	Night	< 30	38	nil
C	Day	< 30	43	nil
	Evening	< 30	40	nil
	Night	< 30	36	nil

Notes: 1. The RBL is an INP term and is used represent the background noise level.

2. The energy averaged noise level over the measurement period and representative of general ambient noise.

4 Noise assessment criteria

4.1 Operation

The INP provides a framework and process for deriving noise criteria for consents and licences that enables the Environmental Protection Authority (EPA) to regulate premises that are scheduled under the NSW *Protection of the Environment Operations Act 1997* (POEO Act). The INP objectives are:

- to establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses;
- to use the criteria as the basis for deriving project specific noise levels;
- to promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects;
- to outline a range of mitigation measures that could be used to minimise noise impacts;
- to provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with the economic, social and environmental considerations of industrial development; and
- to carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the POEO Act.

The INP provides two criteria to assess industrial noise sources, namely, the intrusiveness criteria and the amenity criteria.

4.1.1 Assessing intrusiveness

For assessing intrusiveness, the background noise level must be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5dB(A) above the measured background level (L_{A90}).

The minimum background noise level of 30 dB(A) has been adopted for all assessment locations surrounding the project area, which is based on monitoring data as summarised in Table 3.1, albeit with a measured 31 dB(A) daytime noise level at NM2.

4.1.2 Assessing amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail or community noise. The existing noise level from industry must be quantified. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion.

An extract from the INP that relates to the residential amenity criteria relevant to the Balranald Project is given in Table 4.1. No other receiver type as described in the INP is within the defined study area.

Table 4.1 Residential amenity criteria - Recommended L_{Aeq} noise levels from industrial noise sources

Type of receptor	Indicative noise amenity area	Time of day[1]	Recommended $L_{Aeq(Period)}$ noise level, dB(A)	
			Acceptable	Recommended maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
Commercial premises	All	When in use	65	70

Notes: 1. Daytime 7 am to 6 pm; Evening 6 pm to 10 pm; Night-time 10 pm to 7 am. On Sundays and Public Holidays, Daytime 8 am - 6 pm; Evening 6 pm - 10 pm; Night-time 10 pm - 8 am.

The L_{Aeq} corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

4.1.3 Project specific noise levels (PSNL)

Project specific noise level (PSNL) criteria for the operation of the Balranald Project are provided in Table 4.2. The PSNL is equal to the lower of the derived intrusiveness and amenity criteria.

Table 4.2 Project specific noise levels, dB(A)

Description	Amenity area	Period	Rating background level (RBL)[1]	Intrusive criteria[2], $L_{Aeq,15minute}$	Amenity criteria[3], $L_{Aeq,period}$	Project specific noise level (PSNL)
Assessment locations	Rural	Day	30	35	50	35 $L_{Aeq,15minute}$
		Evening	30	35	45	35 $L_{Aeq,15minute}$
		Night	30	35	40	35 $L_{Aeq,15minute}$

Notes: 1. RBL value taken from Table 3.1.

2. Equal to the RBL plus 5 dB.

3. Representative of the acceptable amenity noise level for a rural residence from Table 4.1.

4.1.4 Voluntary Land Acquisition and Mitigation Policy

The NSW Government has developed the *Voluntary Land Acquisition and Mitigation Policy* (VLAMP, November 2014). The VLAMP has been formally adopted by the NSW Government and seeks to balance acquisition and mitigation obligations for mining operators that provide appropriate protections for landholders, where impacts are significant.

Figure 4.1 provides the general decision making process that will be applied by consent authorities at the development application stage when assigning voluntary mitigation and acquisition obligations.

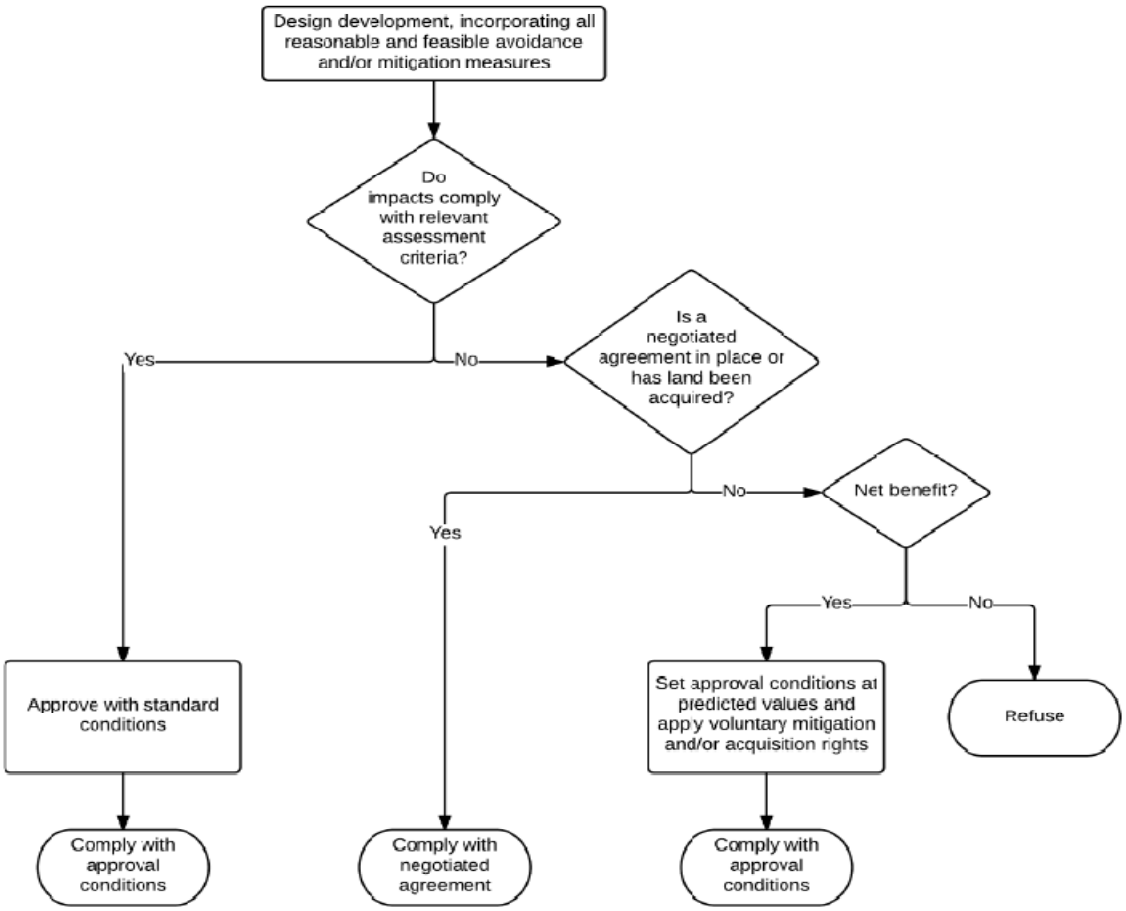

Figure 4.1 General approach to decision making during the assessment process (Figure 1 from VLAMP)

i Characterisation of noise impacts

Voluntary mitigation and acquisition rights in the VLAMP are assigned to privately owned dwellings based on the level of predicted noise above the project noise criteria, or the PSNL. This is explained in Table 4.3.

Table 4.3 Characterisation of noise impacts and potential treatments

Residual noise exceeds INP criteria by	Characterisation of impacts	Potential treatment
0-2dB(A) PSNL	Impacts are considered to be **negligible**	The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls.
3-5dB(A) above the PSNL in the INP but the development would contribute less than 1dB to the total industrial noise level	Impacts are considered to be **marginal**	Provide mechanical ventilation / comfort condition systems to enable windows to be closed without compromising internal air quality / amenity.

Table 4.3 Characterisation of noise impacts and potential treatments

Residual noise exceeds INP criteria by	Characterisation of impacts	Potential treatment
3-5dB(A) above the PSNL in the INP and the development would contribute more than 1dB to the total industrial noise level	Impacts are considered to be **moderate**	As for marginal impacts but also upgraded façade elements like windows, doors, roof insulation etc. to further increase the ability of the building façade to reduce noise levels.
>5dB(A) above the PSNL in the INP	Impacts are considered to be **significant**	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions.

The impact characterisations that are most likely to apply to the Balranald Project are *negligible*, *moderate* and *significant* as there are generally no existing industrial noise sources surrounding this option that could trigger the *marginal* impact characterisation.

ii Acquisition of privately owned land

The VLAMP provides noise acquisition criteria for privately owned land parcels. The policy assigns acquisition rights if the noise generated by a development contributes to an exceedance of the recommended maximum noise levels in Table 2.1 of the INP (refer Table 4.1 in this report) on more than 25% of any privately owned land, where a dwelling could be built on the land under existing planning controls.

The VLAMP defines land as "...the whole of a lot, including contiguous lots owned by the same landowner".

For the Balranald Project this results in acquisition criteria of 55 dB(A), 50 dB(A) and 45 dB(A) ($L_{eq, period}$) for the day, evening and night periods, respectively, on more than 25% of any privately owned land.

4.1.5 Low frequency noise

Section 4 of the INP provides guidelines for applying 'modifying factor' adjustments to account for low frequency noise emissions. The INP states that where there is a difference of 15 dB or more between the measured 'C' weighted (dB(C)) and measured 'A' weighted (dB(A)) levels, then a correction factor of 5 dB is applicable. It is our experience that low frequency noise is not a common characteristic of mining operations generally. Sources that could contain relatively higher components of low frequency noise energy may include pumps, screens, centrifuges and other plant typically found in a material processing facility.

It is understood that the INP's low frequency criteria are being reviewed in light of problematic issues in practice at large distances. For example, sounds that do not poses low frequency dominated spectra at close range, would by virtue of enough distance loss factors, unfairly attract the INP penalty for low frequency, as higher frequencies in their spectra are considerably more abated than the lower frequencies. The INP low frequency criteria were originally intended for testing sources at relatively close range. It is understood that the current INP low frequency criteria is to be replaced with an absolute level limit.

A paper by Dr Norm Broner, "*A Simple Outdoor Criterion for Assessment of Low Frequency Noise Emission*" published in Acoustics Australia Vol. 39, April 2011, provides absolute level criteria for frequency noise. The paper presents the following targets external to a residence:

- For the daytime or when source operates intermittently (1-2 hours):
  - desirable 65 dB(C) L_{eq}; and
  - maximum 70 dB(C) L_{eq}.
- For the night time or when the source operates continuously:
  - desirable 60 dB(C) L_{eq}; and
  - maximum 65 dB(C) L_{eq}.

This assessment will review low frequency noise against both the INP and the 'Broner' approach.

4.1.6 Sleep disturbance criteria

The operational criterion described in Section 4.1 considers the average noise emission over a 15 minute period and is appropriate for assessing the general continuum noise of sources operating. Noise from activities such as trucks dumping in to metallic hoppers (for example) is intermittent and impulsive (rather than continuous) in nature and maximum noise levels from such events have potential to cause sleep disturbance at assessment locations.

The most important potential impact of intermittent noise that needs to be considered is disturbing the sleep of nearby residents. While the INP does not specify a criterion for assessing sleep disturbance, various studies including the EPA's Road Noise Policy (RNP) (EPA, 2011) indicate that levels below 50 to 55 dB(A) inside homes are unlikely to wake sleeping occupants. If bedroom windows are open, this corresponds to an external maximum noise level of approximately 60 to 65 dB(A) L_{max}.

The EPA's current guideline on sleep disturbance is that maximum (L_{max}) noise from industrial sources should not exceed background plus 15 dB. Based on an RBL of 30 dB(A), this assessment has adopted an external sleep disturbance criterion of 45 dB(A) L_{max} for all assessment locations.

4.2 Construction

The Interim Construction Noise Guideline (ICNG) (DECC 2009) has been jointly developed by NSW Government agencies including the EPA and DPE. The objectives of the guideline relevant to the planning process are to promote a clear understanding of ways to identify and minimise noise from construction and to identify 'feasible' and 'reasonable' work practices. The guideline recommends standard construction hours where noise from construction activities is audible at residential premises (ie assessment locations):

- Monday to Friday 7 am to 6 pm;
- Saturday 8 am to 1 pm; and
- no construction work is to take place on Sundays or public holidays.

The ICNG provides two methodologies to assess construction noise emissions. The first is a quantitative approach, which is suited to major construction projects with typical durations of more than three weeks. This method requires noise emission predictions from construction activities at the nearest assessment locations and assessment against ICNG recommended noise levels.

The second is a qualitative approach, which is a simplified assessment process that relies more on noise management strategies. This method is suited to short-term infrastructure and maintenance projects of less than three weeks.

This assessment has adopted a quantitative approach. The qualitative aspects of the assessment include identification of assessment locations, description of works involved and proposed management measures that include a complaints handling procedure.

i Noise management level

Table 4.4 provides noise management levels for assessment locations provided in the ICNG which have been adopted for the quantitative construction noise assessment.

Table 4.4 Noise at residences using quantitative assessment

Time of day	Management level $L_{eq,15min}$	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm, No work on Sundays or public holidays	Noise-affected RBL + 10 dB	The noise-affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{eq,15min}$ is greater than the noise-affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level; and • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise-affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: i) 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); and ii) if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Table 4.4 Noise at residences using quantitative assessment

Time of day	Management level $L_{eq,15min}$	How to apply
Outside recommended standard hours	Noise-affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours; • The proponent should apply all feasible and reasonable work practices to meet the noise affected level; • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise-affected level, the proponent should negotiate with the community; and • For guidance on negotiating agreements see Section 7.2.2 of the ICNG.

Source: ICNG (EPA, 2009).

Construction of the Balranald Project is proposed 24 hours, seven days per week. The resulting ICNG noise management levels (NMLs) that will apply are provided in Table 4.5.

Table 4.5 Construction noise management level for the project

Assessment location	Time of day	Management level	Measured RBL	Management level $L_{eq,15min}$
Residential	Recommended standard hours: Monday to Friday 7 am to 6 pm, Saturday 8 am to 1 pm, No work on Sundays or public holidays	Noise affected	30 dB(A)	40 dB(A)
		Highly noise affected	n/a	75 dB(A)
	Outside recommended standard hours[1]	Noise affected	30 dB(A)	35 dB(A)

Notes: 1. A strong justification would typically be required for works outside the recommended standard hours.

The EPA's sleep disturbance criteria of 45 dB(A), L_{max} has also been used to assess construction noise during the night-time period (10:00 pm to 7:00 am Monday to Saturday, and 10:00 pm to 8:00 am on Sundays).

It is noted that the ICNG requires a strong justification for works outside of recommended standard hours. The Balranald Project is located in a relatively remote area, and is some 12 km at its closest point to Balranald town. Properties outside Balranald town are typically large rural land holdings, and dwellings are sparsely located on these properties. The closest dwellings to the project area are assessment location R13 located approximately 1 km from the Nepean access road (Arumpo Road) and adjacent injection borefield, assessment location R32 approximately 1.3 km from the Nepean access road (Burke and Wills Road) and adjacent injection borefield, and assessment location R5 location approximately 2.3 km from the West Balranald mine. Other buildings such as sheds, shearers quarters and outbuildings are also sparsely located.

Given the remote nature of the project area, a 24 hour, seven day per week construction program provides the greatest level of efficiency for the Balranald Project. This is influenced by a number of factors including:

- best utilisation of the construction workforce. Many personnel would be required to travel long distances to Balranald and would reside at the accommodation facility for several weeks at a time, therefore it is more efficient to utilise the available workforce for the maximum possible time;
- the nature of some construction activities, such as commissioning of plant and other infrastructure would necessitate 24 hour activities; and
- the need to commence the operational (mining) phase as soon as possible to facilitate continuous HMC feed to the Hamilton mineral separation plant in Victoria.

4.3 Road traffic noise

The principle guidance to assess the impact of road traffic noise on assessment locations is in the NSW RNP. Table 4.6 presents the road noise assessment criteria for residential land uses (ie assessment locations), reproduced from Table 3 of the RNP for road categories relevant to the project.

Table 4.6 Road traffic noise assessment criteria for residential land uses

Road Category	Type of project/development	Assessment criteria – dB(A)	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use developments.	$L_{eq,15hr}$ 60 (external)	$L_{eq,9hr}$ 55 (external)
Local Roads	Existing residences affected by additional traffic on existing local roads generated by land use developments.	$L_{eq,1hr}$ 55 (external)	$L_{eq,1hr}$ 50 (external)

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to +2 dB.

Further to meeting the assessment criteria (Table 4.6), any significant increase in total traffic noise at assessment locations must be considered. Assessment locations experiencing increases in total traffic noise levels above those presented in Table 4.7 should be considered for mitigation according to the RNP.

Table 4.7 Relative increase criteria for residential land uses

Road Category	Type of project/development	Total traffic noise level increase - dB(A)	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Freeway/arterial/sub-arterial roads and transitways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $L_{eq,15hr}$+12 dB (external)	Existing traffic $L_{eq,9hr}$+ 12 dB (external)

Lastly, the RNP also provides guidance on how to treat road category transition zones, for example where an arterial road transitions into a local road. Where this occurs the RNP recommends that:

- where the existing noise levels are between the lower criteria and the higher criteria, the existing noise levels are the target; or
- where the existing noise levels exceed the higher criterion, the higher criterion is the target.

This is relevant to McCabe Street, Balranald, as it transitions into arterial road, Sturt Highway.

5 Noise assessment methods

This section presents the methods and base parameters used to model noise emissions from the Balranald Project, including the effect of prevailing meteorological conditions.

Noise modelling was based on three-dimensional digitised ground contours of the project area and surrounding land, mine pits and overburden emplacement areas for three mine stages of the Balranald Project, Years 1, 4 and 8. The mine plans represent snapshots, with equipment placed at various locations and heights, representing realistic operating scenarios for each stage of the mine.

Noise predictions were carried out using the Brüel and Kjær Predictor Version 8.14 software. 'Predictor' calculates total noise levels at assessment locations from concurrent operation of multiple noise sources. The model considers factors such as the lateral and vertical location of plant, source-to-receptor distances, ground effects, atmospheric absorption, topography of the mine and surrounding area and applicable meteorological conditions.

5.1 Meteorological effects on noise

The INP provides procedures for identifying and combining prevailing meteorological conditions at a site (referred to in the INP as a 'feature' of the area) and assessing the noise levels against the relevant criteria.

Site specific weather data was provided from the Balranald Project air quality consultants *Environ* which was generated using atmospheric modelling software, CALMET for the 2011 calendar year. This data was further analysed to determine the presence of prevailing winds and temperature inversions.

5.1.1 Winds

During certain wind conditions, noise levels at assessment locations may increase or decrease compared with noise during calm conditions. This is due to refraction caused by the varying speed of sound with increasing height above ground. The received noise level increases when the wind blows from the source to the assessment location, and conversely, decreases when the wind blows from the assessment location to the source.

As per the INP, winds of up to 3 m/s must be considered in noise predictions when they occur for greater than 30% of the time during day, evening or night periods. Winds were analysed to determine the percentage occurrence. The analysis is provided in Appendix B.

5.1.2 Temperature inversions

Temperature inversions (ie where atmospheric temperature increases with altitude) typically occur during the night-time period in the winter months and can also increase (ie focus) mine noise levels at surrounding assessment locations. As per the INP, temperature inversions are to be assessed when they are found to occur for 30% of the time (about two nights per week) or greater during the winter months.

Drainage flow winds (ie localised cold air travelling in a direction of decreasing altitude) can occur during temperature inversion conditions. The increase of noise levels caused by a drainage flow wind needs consideration if a development (ie noise source) is at a higher altitude to surrounding assessment locations, and where there is no intervening topography.

Table 5.1 provides a summary of stability class occurrence (or temperature inversions).

Table 5.1 Percentage occurrence of Pasquil stability class, night-time

Stability class	Percentage occurrence				
	Annual	Summer	Autumn	Winter	Spring
A	0.0%	0.0%	0.0%	0.0%	0.0%
B	0.3%	0.9%	0.0%	0.0%	0.2%
C	4.5%	7.3%	2.8%	1.3%	6.6%
D	18.4%	24.4%	16.7%	11.0%	21.6%
E	23.5%	22.6%	20.5%	27.4%	23.2%
F	16.1%	9.2%	21.5%	22.5%	11.2%
G	**37.3%**	**35.6%**	**38.5%**	**37.8%**	**37.1%**
Total	100%	100%	100%	100%	100%

The results indicate that 'G' class temperature inversions are a feature of the area as they occur for more than 30% of the time, most frequently during the winter, and therefore have been considered in the assessment.

5.1.3 Meteorological conditions considered in modelling

A summary of calm and identified prevailing weather conditions that were considered in the noise modelling are provided in Table 5.2, determined as required by the INP.

Table 5.2 Relevant site-specific meteorological parameters

Assessment condition	Period	Temperature	Wind speed (m/s)/ direction	Relative humidity	Temperature gradient
Calm	Day/Evening/Night	10°C	nil	90%	nil
Prevailing winds	Night	10°C	2.4 / ESE (112.5°)	90%	nil
			2.6 / SE (135°)		
			2.7 / SSE (157.5°)		
			2.7 / S (180)		
			2.8 / SSW (202.5°)		
			2.5 / SW (225°)		
			2.5 / WSW (247.5°)		
			2.5 / W (270°)		
'G' class temperature inversion	Night	10°C	nil	90%	4 °/100 m^1

Notes: 1. The site and surrounds are classified as semi-arid based on the definition provided by the Department of Environment. Hence the adoption of the INP default 'G' class temperature inversion value of 4°/100m.

The area surrounding the project is generally flat with noise sources typically at a similar elevation to surrounding assessment locations. The potential for source to receptor drainage flow winds to occur is therefore not relevant and has not been considered in the assessment.

5.2 Plant and equipment noise levels

Acoustically significant fixed and mobile plant items considered in the noise model are provided for each of the modelled scenarios (Year 1, 4 and 8) in Table 4.2. Modelling has assumed all plant and equipment to operate continuously and at full duty throughout the respective operating periods (day, evening and night) as applicable, therefore providing a conservative prediction of noise levels.

Sound power level data for the MUP and process plant is based on measurement taken by EMM at Iluka's Woornack, Rownack and Pirro (WRP) mineral sands mine in Victoria. This plant will be relocated to the Balranald Project and therefore provides and accurate representation of operating noise levels from these plant items. In all other cases, plant and equipment sound power levels have been taken from an EMM database and this data have been benchmarked against noise levels at similar mining operations in NSW.

Table 5.3 Indicative operations plant and equipment quantities and sound power levels

Item	Sound power level (Lw), dB	Year 1		Year 4		Year 8			
	$L_{Aeq(15\text{-}min)}$	West Balranald		West Balranald		West Balranald		Nepean	
		D	E/N	D	E/N	D	E/N	D	E/N
CAT789/793 Haul Truck	117	42	42	50	50	15	15	31	31
R996 Excavator	117	7	7	7	7	1	1	6	6
Dozer	115	7	7	7	7	1	1	5	5
Rubber tyre dozer	118	1	1	1	1	1	1	1	1
Grader (24M)	114	6	6	6	6	1	1	5	5
CAT785C Water Cart	115	6	6	6	6	2	2	5	5
CAT992/998 Loader	118	2	2	2	2	2	2	2	2
Mining Unit Plant (MUP)[3]	105	1	1	1	1	1	1	-	-
Wet concentrator plant	111	1	1	1	1	1	1	-	-
Pre-concentrator plant	111	1	1	1	1	1	1	-	-
WHIMS	111	1	1	1	1	1	1	-	-
MU10	105	1	1	1	1	1	1	-	-
Road train (Prod. haul)[1]	102	-	-	-	-	-	-	20	20
Roller	101	1	1	1	1	-	-	-	-
Feller Buncher	118	1	-	1	-	-	-	-	-
Carry grader	116	10	6	10	6	-	-	5	3
Screen Unit	105	-	-	-	-	-	-	1	1
Booster	95	11	11	11	11	11	11	-	-
Pump	95	6	6	8	8	8	8	-	-
Tails Stacker	95	1	1	1	1	1	1	-	-

Notes: 1. Lw measured by EMM at Iluka WRP site.

5.3 Construction noise

Construction activities (as displayed in Table 5.4) differ from mining activity and therefore have been assessed separately using ICNG noise criteria. These will occur prior to and in isolation of mining operations. Construction is proposed 24 hours a day and will fall outside the ICNG standard construction hours listed in Section 4.2.

Activities such as removal and stockpiling of topsoil and overburden have not been considered in the construction noise assessment as such activities are already assessed as operation under more stringent criteria.

Construction noise predictions were carried out using the Brüel and Kjær Predictor Version 8.14 software. Table 5.4 details the construction scenarios, typical equipment types, associated sound power level and the quantity of items considered in the construction noise assessment. Equipment sound power levels have been taken from an EMM database and this data have been benchmarked against noise levels at similar construction projects in NSW. All scenarios have been considered to occur simultaneously 24 hours a day and therefore represent worst case noise levels throughout the construction programme.

Table 5.4 24 hour construction activity considered in the impact assessment

Scenario	Construction activity[1]	Plant items	Lw, $L_{eq,15min}$, dB(A)	Quantity considered in assessment
1	Accommodation village for construction workers	Excavator/backhoe	104	1
		Trucks (deliveries, general movements)	103	1
		Concrete truck	111	1
		Generator	98	1
2	Delivery of ground water borefield materials to site. Installation of extraction and injection bores and piping.	Trucks (deliveries, general movements)	103	1
		Drill	110	7
		Compressor	98	7
		Crane	109	7
		Generator	98	14
		Power tools	98	7
3	Installation of temporary generators	Trucks (deliveries, general movements)	103	1
4	Truck and shovel fleet mobilisation for strip and site establishment.	Trucks (deliveries, general movements)	103	4
		Mobile crane	109	2
		Hand tools/grinding	98	2
		Generator	98	2
		Compressor	98	2
5	Dewatering of pit.	Trucks (deliveries, general movements)	103	1
		Generator	98	31
6	Processing area site establishment. (The construction activities will include: site access roads, site internal roads, site bulk earthworks, drainage infrastructure, above ground and below ground services, water storage dams, reverse osmosis plant, site power reticulation, concrete foundations, buildings and workshops, security fencing, waste water treatment and communications.)	Trucks (deliveries, general movements)	103	2
		Excavator/backhoe	104	1
		Concrete truck	111	2
		Impact hammer (small)	112	5
		Mobile crane	109	4
		Hand drill/grinding	110	5
		Hammering	99	5
		Generator	98	4
		Compressor	98	2
		Grader	114	2
		Compactor	112	2
		Roller	109	2

Table 5.4 24 hour construction activity considered in the impact assessment

Scenario	Construction activity[1]	Plant items	Lw, $L_{eq,15min}$, dB(A)	Quantity considered in assessment
7	Processing plant relocation and commissioning.	Trucks (deliveries, general movements)	103	2
		Mobile crane	109	3
		Hand drill/grinding	110	5
		Hammering	99	1
		Generator	98	4
		Compressor	98	5
8	Gravel extraction	Dozer	114	3
		Front end loader	112	3
		Dump trucks	115	3
		Excavators	104	3
		Crushing and screening plant	123	3

Notes: 1. Construction activity, plant and equipment exclude any mining related activity such as initial stripping of overburden etc. Such activities have been considered in detail in the operational noise impact assessment section.

Potential sleep disturbance impacts caused by maximum noise level events from construction activity during the night-time period (10.00 pm to 7.00 am) have been assessed using a nominal sound power level of 125 dB(A), L_{max} for each construction scenario listed in Table 5.4.

6 Noise impact assessment

6.1 Operation noise modelling results

The predicted noise levels at each assessment location for each meteorological condition are provided in Table 6.1.

The green, blue and orange shading indicates assessment locations where noise predictions fall into negligible (green - 1 to 2 dB above PSNL), moderate (blue - 3 to 5 dB above PSNL) or significant (orange - greater than 5 dB above PSNL) noise impact characterisations (respectively) as described in the VLAMP (Table 4.3).

Noise contours (Appendix E) have been prepared for the following mine stages and meteorological conditions:

- Year 1 for calm, prevailing wind and inversion meteorological conditions, $L_{eq,15min}$ dB(A);
- Year 4 for calm, prevailing wind and inversion meteorological conditions, $L_{eq,15min}$ dB(A); and
- Year 8 for calm, prevailing wind and inversion meteorological conditions, $L_{eq,15min}$ dB(A).

The noise contours provide a visual guide of potential operational noise levels in relation to the PSNL (35 dB(A) contour) and where significant noise level impacts are predicted to occur (ie greater than 40 dB(A) contour).

Table 6.1 Predicted operational noise levels at assessment locations during calm, prevailing and temperature inversion meteorology - dB(A), $L_{eq,15\text{-}min}$

Assessment location	Year 1				Year 4				Year 8				PSNL all periods	Voluntary acquisition noise level trigger
	Day	Night			Day	Night			Day	Night				
	Calm	Calm	Winds	Inversion	Calm	Calm	Winds	Inversion	Calm	Calm	Winds	Inversion		
R2	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R5[2]	<30	<30	<30	<30	35	38	45	46	<30	<30	36	37	35	>40
R7	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R11	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R12	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R13	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R19	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R24	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R25	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R32	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R36[1]	30	31	37	37	<30	<30	<30	<30	<30	<30	35	34	35	>40
R40	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R41	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R45	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R54	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R57	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R92	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R95	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R108	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R151	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R153	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R162	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40

Table 6.1 Predicted operational noise levels at assessment locations during calm, prevailing and temperature inversion meteorology - dB(A), $L_{eq,15\text{-}min}$

Assessment location	Year 1				Year 4				Year 8				PSNL all periods	Voluntary acquisition noise level trigger
	Day	Night			Day	Night			Day	Night				
	Calm	Calm	Winds	Inversion	Calm	Calm	Winds	Inversion	Calm	Calm	Winds	Inversion		
R192	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R193	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R194	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R195	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R197	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R200	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R202	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R203	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R208	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R213	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R224	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R225	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R276 [1]	37	39	44	44	<30	<30	32	32	30	31	42	41	n/a	n/a
R277 [1]	34	35	42	41	<30	<30	<30	30	<30	<30	38	38	n/a	n/a
R281 [1]	<30	<30	36	37	<30	<30	<30	<30	31	33	42	43	n/a	n/a
R284	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R362	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	65	>40
R402 [1]	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	n/a	n/a
R403 [1]	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	n/a	n/a
R405 [1]	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	n/a	n/a
R406 [1]	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	n/a	n/a
R419	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40

Table 6.1 Predicted operational noise levels at assessment locations during calm, prevailing and temperature inversion meteorology - dB(A), $L_{eq,15\text{-}min}$

Assessment location	Year 1				Year 4				Year 8				PSNL all periods	Voluntary acquisition noise level trigger
	Day	Night			Day	Night			Day	Night				
	Calm	Calm	Winds	Inversion	Calm	Calm	Winds	Inversion	Calm	Calm	Winds	Inversion		
R1042	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R1043	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40
R1044	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	35	>40

Notes: 1. PSNL and/ or voluntary acquisition noise level trigger do not apply as these assessment locations have been identified as sheds.

2. Residence currently uninhabited.

The noise model predictions have been assessed by comparing the higher of the calm, winds and temperature inversion results to the INP criteria. Assessment locations predicted with negligible, moderate or significant noise impacts are presented in Table 6.2. Note that assessment locations R36, R276, R277 and R281 have been confirmed as sheds.

Table 6.2 Characterisation of impacts where predicted noise levels are above PSNL, adverse weather conditions, all years

Negligible (1 to 2 dB above PSNL)	Moderate (3 to 5 dB above PSNL)[1]	Significant (>5 dB above PSNL)[2]
Nil	Nil	R5

Notes: 1. Assessment locations entitled to voluntary noise mitigation in the form of mechanical ventilation / comfort condition systems and upgraded facade elements to reduce internal noise levels.

2. Assessment locations entitled to voluntary acquisition.

During adverse weather conditions for all assessment periods, for all stages of the mining life, one assessment location (R5) within the area modelled is predicted to experience noise levels above the PSNL (ie>35 dB(A)).

This location (R5) is predicted to experience significant noise impacts during Year 4. At other times predicted noise levels at this location are either below the PSNL (Year 1) or marginally above the PSNL (Year 8). Nonetheless, the significant noise impact predicted in Year 4 entitles R5 to voluntary acquisition upon request in accordance with the VLAMP. It is understood that this property is currently uninhabited.

6.2 Privately owned land assessment

The $L_{eq,period}$ noise contours derived from all three modelled operational stages for adverse weather conditions are presented in Appendix F. The night-time contour of 45 dB(A), $L_{eq,period}$ has been provided only as this will present the worst case operating period.

Appendix F shows there are no privately owned land parcels that exceed criteria outside the land parcels that will be directly impacted by the Balranald Project. That is, only the properties Pine Lodge and Hugh Dale (highlighted blue in Appendix F), which are all within the project area, will exceed the 25% area voluntary land acquisition criteria as defined in the VLAMP.

The project area spans over a portion of these two land parcels and it is therefore expected most of this land would be subject to acquisition and/or compensation agreements irrespective of the noise impact assessment.

Table 6.3 provides a summary list of properties which exceed the voluntary acquisition criteria for privately owned land.

Table 6.3 Summary of privately owned land identified to be within the affectation zone

Lot/DP Number	Property Name
1222/DP762707	Hugh Dale
88/DP760470	Pine lodge

6.3 Low frequency operational noise modelling results

As discussed earlier in the Chapter 4 of this report, low frequency noise from mining is typically not at levels high enough to impact assessment locations.

Nonetheless, an assessment has been undertaken to quantify low frequency noise impacts. C-weighted noise levels at assessment locations have been calculated by applying the octave band C-weightings to the predicted octave band noise levels.

The assessment has been limited to assessment locations with predicted operational noise levels greater than 30 dB(A), as the 5 dB(A) penalty (if low frequency noise was identified), would not lead to noise levels over the 35 dB(A) PSNL. Furthermore, noise levels have been provided for worst case meteorological conditions for each assessment location only. Predicted noise levels are provided in Table 6.4.

Table 6.4 Predicted operational low frequency noise levels during worst case meteorological conditions, $L_{eq,15min}$

Assessment location ID	Year 1			Year 4			Year 7		
	dB(A)	dB(C)	A-C	dB(A)	dB(C)	A-C	dB(A)	dB(C)	A-C
R5	<30	n/a	n/a	46	55	9	37	50	13
R36[1]	37	51	14	<30	n/a	n/a	35	48	13
R276[1]	44	56	12	32	54	**22**	42	52	10
R277[1]	42	55	13	30	52	**22**	38	51	13
R281[1]	37	49	12	<30	n/a	n/a	43	51	8
Criteria	35	60	≤15	35	60	≤15	35	60	≤15

Notes: 1. These assessment locations have been identified as sheds.

n/a denotes predicted dB(A) noise levels below 30 where a low frequency adjustment would not cause a penalty corrected noise level over the PSNL.

Bold text denotes a difference between dB(A) and dB(C) noise levels of greater than 15 dB.

Results predict that low frequency noise levels (dB(C)) for all assessment locations satisfy the most stringent 60 dB(C) night-time criteria as described in Section 4.1.6.

For assessment locations R276 and R277, the difference between dB(A) and dB(C) noise levels predicted at these locations is greater than 15 dB. Notwithstanding, the difference between the dB(A) and dB(C) sound power levels for all plant and equipment (as in Appendix C) is less than 15 dB. It is therefore considered unduly stringent for all plant and equipment to be subject to a 5 dB 'modifying factor' adjustment, given also that the absolute dB(C) noise level is well below what is considered to cause adverse low frequency noise impacts, as discussed in the 'Broner' technical paper. Furthermore, R276, R277 and R281 have been identified as sheds, and therefore, potential low frequency noise impacts do not apply.

As part of overall site management, Iluka will monitor and manage operational noise levels, which will include the monitoring of low frequency noise emissions. This is discussed further in Section 7.

6.4 Sleep disturbance assessment

Intermittent noises, such as bulldozer track plates, reversing alarms or truck pass-by or loading activity should be assessed against sleep disturbance criteria. Typical noise levels from the loudest of these events are presented in Table 6.5 which has been obtained from measurements undertaken on similar projects.

Table 6.5 Maximum noise from typical intermittent sources

Noise source	Measured L_{max} noise level, dB(A)
Haul truck	125
Reverse alarm	105 to 115 (with maximum modifying factor adjustment)
Bulldozer with reversing alarm	115

Table 6.5 indicates the highest maximum noise levels that would likely result from haul trucks. The maximum (at source) sound power level of unmitigated haul trucks has previously been measured to be typically 125 dB(A)L_{max}. Maximum noise levels at each assessment location were calculated under adverse meteorological conditions.

Predicted L_{max} noise levels from trucks at assessment locations were based on the typical equipment positions used for mining operations. Predictions were based on a single event, rather than the simultaneous operation of a number of plant items, because of the low probability of more than one maximum noise event occurring concurrently. The criterion used to assess sleep disturbance is based on the EPA's strict background noise level plus 15 dB criteria for maximum (L_{max}) noise sources.

Predicted maximum noise levels for the night-time period during calm and adverse meteorological conditions are provided in Table 6.6. Predictions shown are limited to assessment locations with L_{max} noise levels over 30 dB(A). Noise levels at the remaining assessment locations are predicted to be below this threshold and are not presented in Table 6.6.

Table 6.6 Maximum noise from intermittent sources at assessment locations, dB(A)

Assessment location ID	Modelled L_{max} night time noise level									L_{max} criterion
	2015			2018			2021			
	Calm	Winds	Inversion	Calm	Winds	Inversion	Calm	Winds	Inversion	
R5	< 30	< 30	< 30	36	40	42	< 30	37	38	45
R36[1]	< 30	34	34	< 30	< 30	< 30	< 30	31	31	45
R276[1]	37	41	41	< 30	< 30	< 30	< 30	40	40	n/a
R277[1]	34	39	38	< 30	< 30	< 30	< 30	37	36	n/a
R281[1]	<30	32	33	< 30	< 30	< 30	33	40	41	n/a

Notes: 1. These properties have been identified as sheds and therefore sleep disturbance impacts do not apply.

Predictions in Table 6.6 show that maximum noise levels from the site are expected to be below the 45 dB(A) noise criterion at all assessment locations during calm and adverse weather conditions.

6.5 Construction noise

A combined construction scenario assuming the simultaneous construction of all activities shown in Table 5.4 was completed to quantify potential impacts during the initial construction phase of the Balranald Project. The results of the construction noise assessment should be considered conservative.

Construction noise levels have been predicted during calm and prevailing meteorological conditions listed in Table 5.2.

The construction noise modelling results are presented in Table 6.7 for the four assessment locations where total noise levels are predicted above 30 dB(A) during any of the eight construction scenarios. The level presented for each assessment location and for each construction scenario represent the highest predicted $L_{Aeq,15min}$ noise level (or the energy-average noise level over a 15 minute period) from all valid meteorological conditions (calm, prevailing winds and temperature inversion).

Table 6.7 Predicted 24 hour construction noise levels, dB(A)

Assessment location ID	Construction scenario (from Table 5.4) predicted noise level, $L_{eq,15min}$ [2]								Total $L_{eq,15min}$ noise level[1]	NML, $L_{eq,15min}$	
	1	2	3	4	5	6	7	8		Standard Hours	Out of hours
R13	<30	<30	<30	<30	<30	**38**	<30	<30	**38**	40	35
R32	<30	<30	<30	<30	<30	34	<30	<30	34	40	35
R281	<30	<30	<30	<30	<30	32	<30	<30	34	40	35
R406	<30	<30	<30	<30	<30	34	<30	<30	34	40	35

Notes: 1. Total noise level from simultaneous construction of scenarios 1 to 8.

2. Bold indicates exceedance of standard NML, highlight indicates exceedance of out of hours NML.

Based on predicted noise levels in Table 6.7, it is evident that predicted construction noise levels will satisfy the ICNG noise management levels at all but one assessment locations (R13).

Predicted construction noise levels are marginally above the ICNG out of hours NML by 3 dB(A) during construction scenario 6. This level is generated by construction of the Nepean access road, which would be approximately 1 km from this assessment location. Construction of the Nepean access road at this location would involve improvements to the existing Arumpo Road, and would be relatively short in duration.

It is anticipated that noise from the scenario 6 activity could be managed appropriately to below ICNG NMLs and is discussed further in Section 7.3.

Predicted maximum (L_{max}) noise levels from construction activities are provided in Table 6.8 for the nine assessment locations where levels are predicted above 30 dB(A) during any of the eight construction scenarios. The level presented for each assessment location and for each construction scenario represent the highest predicted maximum (L_{max}) noise level from all valid meteorological conditions (calm, prevailing winds and temperature inversion).The predicted levels have been assessed against the sleep disturbance criteria of 45 dB(A), L_{max}.

Table 6.8 Predicted maximum construction noise levels, dB(A)

Assessment location ID	Construction scenario (from Table 5.4) predicted noise level, $L_{eq,15min}$								Maximum noise level, all scenarios[1]	Night time sleep disturbance noise criteria, L_{max}
	1	2	3	4	5	6	7	8		
R5	<30	33	<30	30	<30	<30	<30	<30	33	45
R13	<30	15	<30	<30	<30	**46**	<30	<30	**46**	45
R19	<30	41	<30	<30	<30	22	<30	<30	41	45
R32	<30	39	<30	<30	<30	42	<30	<30	42	45
R54	35	<30	<30	<30	<30	30	<30	<30	35	45
R57	36	<30	<30	<30	<30	21	<30	<30	36	45
R276	<30	<30	<30	<30	30	<30	<30	<30	30	45
R281	<30	<30	45	36	<30	39	37	<30	45	45
R406	<30	37	<30	<30	<30	43	<30	<30	43	45

Notes: 1. Maximum predicted noise level from scenarios 1 to 8.

2. OOH = out of hours

3. Bold indicates exceedance of sleep disturbance criteria.

Based on predicted maximum noise levels in Table 6.8, predicted maximum construction noise levels will satisfy the EPA's strict sleep disturbance criteria at most assessment locations, with the exception being R13.

The predicted exceedance at R13 of 1 dB during construction Scenario 6 is minor. As described above, this noise level is generated by construction of the Nepean access road, which would be approximately 1 km from this assessment location. Construction of the Nepean access road in the this location would involve improvements to the existing Arumpo Road, and would be relatively short in duration.

This level at assessment location R13 would translate to an internal noise level of 36 dB(A) (assuming windows open as a worst case) which is less than maximum internal noise levels that have been demonstrated to cause sleep arousal (as discussed in Section 4.1.6).

Nonetheless, it is anticipated noise from the access road construction could be managed appropriately to below sleep disturbance criteria, and is discussed further in Section 7.3.

6.6 Road traffic noise

The Calculation of Road Traffic Noise (CoRTN) (UK Department of Transport) method was used to predict the L_{eq} noise levels at nearest assessment locations for additional traffic from construction and operation of the Balranald Project. CoRTN, which was developed by the UK Department of Transport, considers traffic flow volume, average speed, percentage of heavy vehicles and road gradient to establish noise source strength, and includes attenuation due to distance, ground and screening from buildings or barriers.

Road traffic movements associated with operation and construction of the Balranald Project have been referenced from the *Balranald Project Transport Assessment* (EMM 2014).

6.6.1 Operational road traffic

The traffic movements that have been assessed include employee vehicles travelling to/from site and vehicles associated with product haulage travelling from the project area to Victoria.

The assessment has assumed product haulage traffic movements are distributed over a 24 hour period. Employee traffic movements have been assumed to occur in a peak hour period coinciding with a project shift changeover, expected to occur daily between 6 am to 7 am. This provides a conservative assessment, as peak traffic volumes during this time will fall into the night time assessment period where a more stringent criterion applies.

All public roads used by employees and for product haulage have been classified as arterial, with the exception of Piper Street which has been classified as a local road. Accordingly, road noise assessment criteria for residential land uses (ie assessment locations) adjacent to these roadways have been allocated as per the RNP (refer Table 4.5) and are detailed in Table 6.8.

Further, the nearest and only residential assessment location on McCabe Street (a local road) is located on the corner with Market Street (an arterial road). Therefore an arterial road noise criterion has been adopted for this location due to the level of total existing road traffic noise (ie from both roads) being more commensurate with this category - this approach is recommended in the RNP where setting a road category is unclear. This assessment has been undertaken for the west facade of this dwelling as this will present worst case noise levels due to the Balranald Project.

Table 6.8 presents predicted existing and project related road traffic noise levels to nearest assessment locations to each road. Predictions have been provided for the night time as this presents the worst case period for potential project related traffic noise impacts.

Table 6.9 Operational road traffic noise levels (Year 4), night-time, dB(A)

Road	Distance to nearest assessment location	Existing		Proposal[5]		Total traffic noise level	Change from existing traffic noise level	Night time criteria
		Traffic volume per period	Noise level	Traffic volume per period	Noise level			
		Cars (HV[1])		Cars (HV[1])				
Balranald-Ivanhoe Rd[3]	55 m	68 (18)	46 $L_{eq,9hr}$	57 (76)	50 $L_{eq,9hr}$	51 $L_{eq,9hr}$	5	55 $L_{eq,9hr}$
Balranald to Tooleybuc Rd (Southern section)[3]	40 m	51 (16)	47 $L_{eq,9hr}$	6 (58)	50 $L_{eq,9hr}$	54 $L_{eq,9hr}$	7	55 $L_{eq,9hr}$
Balranald Tooleybuc Rd (at Tooleybuc Bridge)[3]	20 m	140 (31)	50 $L_{eq,9hr}$	6 (58)	51 $L_{eq,9hr}$	54 $L_{eq,9hr}$	4	55 $L_{eq,9hr}$
Mayall Street[3]	15 m	119 (13)	49 $L_{eq,9hr}$	23 (6)	45 $L_{eq,9hr}$	50 $L_{eq,9hr}$	1	55 $L_{eq,9hr}$
Piper St[4]	25 m	3 (2)	45 $L_{eq,1hr}$	0 (2)	45 $L_{eq,1hr}$	48 $L_{eq,9hr}$	3	50 $L_{eq,1hr}$

Table 6.9 Operational road traffic noise levels (Year 4), night-time, dB(A)

Road	Distance to nearest assessment location	Existing		Proposal[5]		Total traffic noise level	Change from existing traffic noise level	Night time criteria
		Traffic volume per period	Noise level	Traffic volume per period	Noise level			
		Cars (HV[1])		Cars (HV[1])				
McCabe St[3]	15 m	15 (10)	45 $L_{eq,9hr}$	11 (60)	53 $L_{eq,9hr}$	53 $L_{eq,9hr}$	8	55 $L_{eq,9hr}$
Market St[3]	15 m	413 (94)	53 $L_{eq,9hr}$	8 (2)	36 $L_{eq,9hr}$	53 $L_{eq,9hr}$	0	55 $L_{eq,9hr}$
Total at the corner of McCabe and Market St (west facade)	-	-	54 $L_{eq,9hr}$	-	53 $L_{eq,9hr}$	56 $L_{eq,9hr}$	2	55 $L_{eq,9hr}$

Notes: *1. HV = heavy vehicles.*

2. Bold text denotes exceedance of RNP noise criteria.

3. Existing night-time traffic is based 15% of AADT. Proposed Light and heavy vehicles are assumed to be distributed evenly over 24 hours.

4. Existing hourly peak traffic is based on tube counts projected for year 4 and assume proposed traffic from other mines. Proposed hourly peak traffic assumes 50% of all predicted light vehicle traffic and 10% of all predicted heavy vehicle traffic occur during peak hour.

5. Balranald Project traffic only.

Predicted road traffic noise levels satisfy the RNP noise criteria at all nearest assessment locations to all assessed roads.

Total predicted road traffic noise levels on the corner of McCabe Street and Market Street are within 2 dB of existing levels and therefore within RNP noise guidelines.

6.6.2 Construction road traffic noise

The vehicle movements that have been assessed include construction workforce employee vehicles travelling to/from site and associated construction traffic such as truck deliveries.

The majority of road traffic movements associated with construction have been assumed to occur between 6 am to 7 am and 6 pm to 7 pm. The period between 6 am and 7 am will fall within the RNP night-time period and will therefore present the worst case assessment period for the Balranald Project.

Calculation of road traffic noise levels for this period are provided in Table 6.9, which include the same assumptions relating to road category and criteria as the operational road traffic noise assessment.

Table 6.10 Construction road traffic noise levels (2018), night-time, dB(A)

Road	Distance to nearest assessment location	Existing		Proposal[5]		Total traffic noise level	Change from existing traffic noise level	Night time criteria
		Traffic volume per period	Noise level	Traffic volume per period	Noise level			
		Cars (HV[1])		Cars (HV[1])				
Balranald to Ivanhoe Rd[3]	55 m	69 (18)	46 $L_{eq,9hr}$	50 (65)	50 $L_{eq,9hr}$	51 $L_{eq,9hr}$	5	55 $L_{eq,9hr}$
Sturt Highway (Euston)[3]	35 m	162 (83)	55 $L_{eq,9hr}$	18 (10)	45 $L_{eq,9hr}$	55 $L_{eq,9hr}$	0	55 $L_{eq,9hr}$
Balranald to Tooleybuc Rd (Southern section)[3]	40 m	48 (15)	47 $L_{eq,9hr}$	5 (46)	49 $L_{eq,9hr}$	51 $L_{eq,9hr}$	4	55 $L_{eq,9hr}$
Balranald to Tooleybuc Rd (at Tooleybuc Bridge)[3]	20 m	134 (30)	50 $L_{eq,9hr}$	5 (46)	50 $L_{eq,9hr}$	53 $L_{eq,9hr}$	3	55 $L_{eq,9hr}$
Mayall Street[3]	15 m	113 (13)	49 $L_{eq,9hr}$	22 (6)	45 $L_{eq,9hr}$	50 $L_{eq,9hr}$	1	55 $L_{eq,9hr}$
Piper St[4]	25 m	2 (2)	47 $L_{eq,1hr}$	0 (3)	47 $L_{eq,1hr}$	50 $L_{eq,9hr}$	3	50 $L_{eq,1hr}$
McCabe St[3]	15 m	14 (10)	45 $L_{eq,9hr}$	9 (48)	52 $L_{eq,9hr}$	53 $L_{eq,9hr}$	8	55 $L_{eq,9hr}$
Market St[3]	15 m	398 (90)	53 $L_{eq,9hr}$	7 (2)	36 $L_{eq,9hr}$	53 $L_{eq,9hr}$	0	55 $L_{eq,9hr}$
Total at the corner of McCabe and Market St			54 $L_{eq,9hr}$		52 $L_{eq,9hr}$	56 $L_{eq,9hr}$	2	55 $L_{eq,9hr}$

Notes: *1. HV = heavy vehicles.*

2. Bold text denotes exceedance of RNP noise criteria.

3. Existing night-time hourly traffic is based 15% of AADT. Proposed Light and heavy vehicles are assumed to be distributed evenly.

4. Existing hourly peak traffic is based on tube counts projected for year 2020 and assume proposed traffic from other mines. Proposed hourly peak traffic assumes 50% of all predicted light vehicle traffic and 10% of all predicted heavy vehicle traffic occur during peak hour.

5. Balranald Project traffic only.

Predicted road traffic noise levels satisfy the RNP noise criteria at all nearest assessment locations for all assessed roads.

Total predicted road traffic noise levels at the nearest assessment location on the corner of McCabe Street and Market Street are within 2 dB of existing levels and therefore within RNP noise guidelines.

7 Noise management and mitigation

7.1 Operational noise

7.1.1 Reasonable and feasible measures

The INP states the following with respect to reasonable and feasible noise management measures:

> "Feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgment in arriving at a decision, taking into account the following factors:
>
> - noise mitigation benefits (amount of noise reduction provided, number of people protected);
> - cost of mitigation (cost of mitigation versus benefit provided);
> - community views (aesthetic impacts and community wishes);and
> - noise levels for affected land uses (existing and future levels, and changes in noise levels)."

The assessment of the Balranald Project under the INP will enable noise monitoring and management at the mine in accordance with contemporary standards.

The noise model assumed worst case plant and equipment locations and therefore represents the worst case noise 'envelope' from the project area over the mine life.

Given the minor extent of predicted noise impacts identified (ie one assessment location with noise levels over the PSNL), regular attended and unattended noise monitoring is considered the most practical and reasonable approach to managing noise levels to ensure that noise is minimised outside the project area.

Iluka is committed to managing noise emissions to all assessment locations, including those identified to fall within the noise management zone (between 35 dB(A) and ≤40 dB(A)) and negotiating acquisition of properties where assessment locations are identified to be above acquisition levels (>40 dB(A)), if requested by the owner.

7.2 Noise management plan

A noise management plan (NMP) will detail activities to manage noise emissions from operations. The NMP will:

- identify noise affected properties consistent with the environmental assessment and any subsequent assessments;
- outline mitigation measures to achieve the noise limits established;
- schedule heavy vehicle movements during least sensitive times of day (7:00 am to 10:00 pm);
- minimise heavy vehicle engine brake noise when passing residential areas, especially areas that are relatively highly populated (eg Balranald Town);

- outline measures to reduce the impact of intermittent, low frequency and tonal noise (including truck reversing alarms using broadband quakers);
- specify measures to document any higher level of impacts or patterns of temperature inversions, and detail actions to quantify and ameliorate enhanced impacts if they occur;
- specify protocols for routine, regular attended and unattended noise monitoring of the Balranald Project, including provision for regular low frequency noise monitoring;
- outline the procedure to notify property owners and occupiers that could be affected by noise from the mine;
- establish a protocol to handle noise complaints that includes recording, reporting and acting on complaints;
- specify procedures for undertaking independent noise investigations; and
- describe proactive and predictive modelling, and management protocols for managing noise during adverse meteorological conditions.

7.3 Construction noise

A construction environmental management plan (CEMP) that will address noise and vibration management and mitigation options (where required) will be completed prior to construction.

The main objective of the CEMP would be to ensure that as far as practicable construction activities meet construction ICNG NMLs across the proposed 24 hour construction period.

The CEMP will describe how construction noise levels will be managed at assessment location R13 where predicted noise levels above the NMLs have been identified. This would include:

- Measure construction noise levels at early stages of the Nepean access road construction to validate the predicted construction noise levels.
- Re-evaluate the predicted construction noise levels at assessment locations near the Nepean access road, and where required review noise management and mitigation measures to reduce levels below the NMLs. This may include (but is not limited to):
    - limiting road construction within a certain distance of assessment locations during the evening and night time period;
    - selecting quieter equipment or reduced equipment fleet during the evening and night period; or
    - measuring construction noise levels at assessment locations during the evening and night-time period and implementing real-time noise management and mitigation measures where exceedance of NMLs is identified.

Affected landholders should be consulted prior to and during construction where exceedance of NMLs has been predicted, and should be notified of proposed mitigation measures that will be used to manage construction noise levels to below ICNG NMLs.

8 Conclusion

The noise assessment shows that during adverse weather conditions for all assessment periods and all stages of the mine life, one assessment locations is predicted to experience noise levels above the PSNL of 35 dB(A). This location is predicted to experience significant noise level impacts of greater than 40 dB(A). Assessment locations where significant noise level impacts are predicted are entitled to voluntary acquisition upon request in accordance with the VLAMP (NSW Government 2014). Iluka therefore intends to enter into an amenity agreement or acquire this property (R5).

The privately owned land assessment has identified two land parcels that fall into the VLAMP voluntary land acquisition criteria over the life of the Balranald Project. The project area physically spans over the majority of these two land parcels and this land would be subject to acquisition and/or compensation agreements irrespective of the noise impact assessment.

The low frequency assessment identified that all assessment locations satisfy the 60 dB(C) 'Broner' criterion, while the INP low frequency noise criteria is achieved at all residential locations. Analysis of sound power levels in Appendix C shows that the difference between dB(A) and dB(C) noise levels for all plant and equipment (ie at source) is less than 15 dB. Low frequency noise impacts from the Balranald Project are considered unlikely, however, Iluka will monitor and manage operating noise levels, which will include provisions for low frequency noise identification.

Potential sleep disturbance impacts from operational maximum noise level events have been assessed and are expected to satisfy the relevant criteria for all assessment locations.

The 24 hour construction noise assessment demonstrates that most assessment locations satisfy the ICNG noise management levels, with the exception being assessment location R13 where predicted noise levels are marginally above the out of hours NML and sleep disturbance criteria. This is associated with the Nepean access road construction. It is expected that with appropriate management and mitigation that noise levels can be managed to below the ICNG NMLs over a 24 hour construction period. Construction noise and vibration management and mitigation will be developed in a CEMP.

Predicted operational and construction road traffic noise levels satisfy RNP noise criteria and guidelines at all nearest assessment locations for all assessed roads.

References

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NSW Government 2014 *Voluntary Land Acquisition and Mitigation Policy.*

Aurecon Australia Pty Ltd, 2012, *Construction and Operational Traffic Impact Assessment*.

Dr Norm Broner, "*A Simple Outdoor Criterion for Assessment of Low Frequency Noise Emission*" Acoustics Australia Vol.39 April 2011.

Glossary of Terms

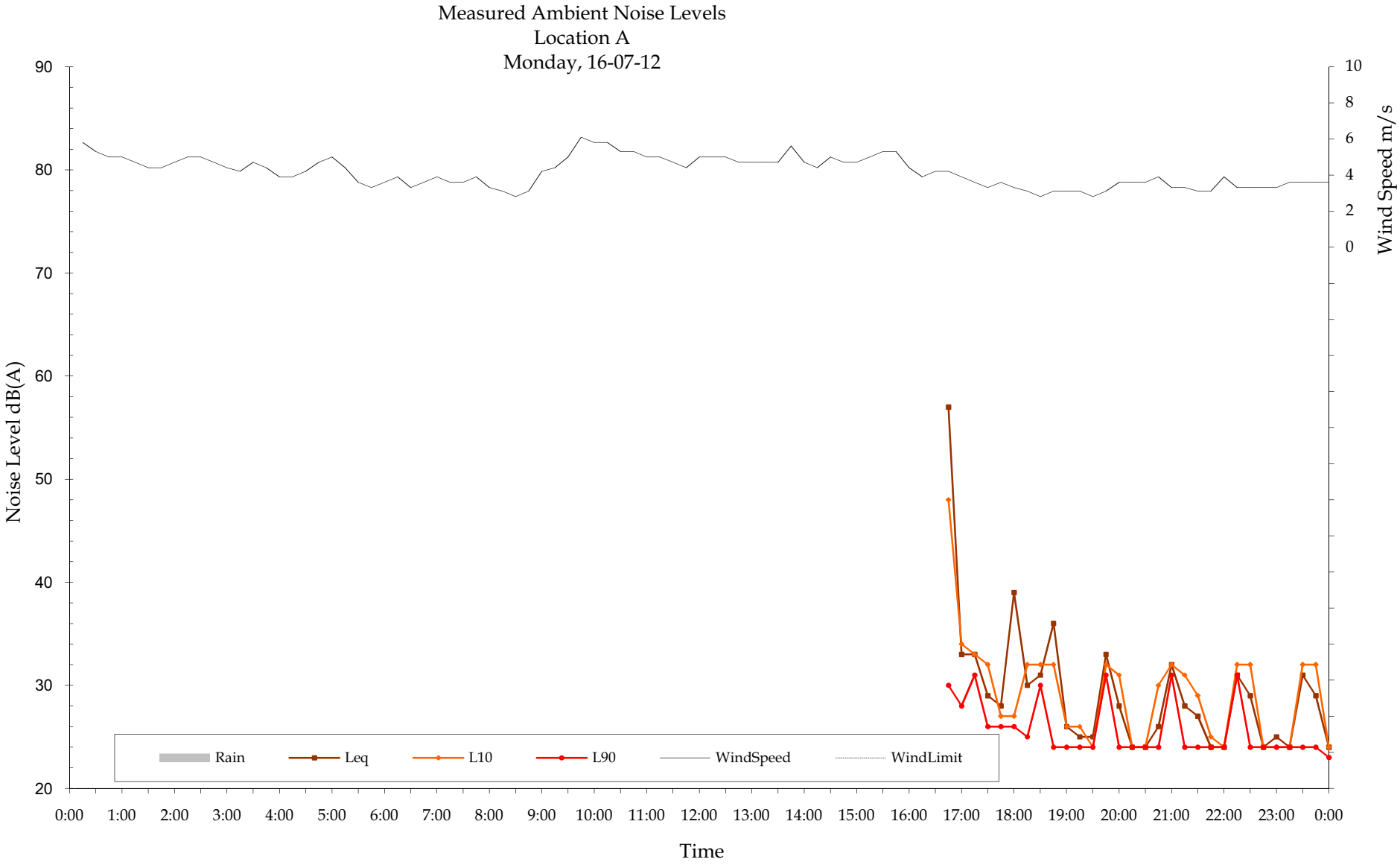
ABL	The assessment background level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Amenity criteria	The amenity criteria relate to existing industrial noise. Where industrial noise approaches base amenity criteria, then noise levels from new industries need to demonstrate that they will not be an additional contributor to existing industrial noise. See Section 2.1.2 for more detail.
CNMP	Construction noise management plan
Day period[1]	Monday–Saturday: 7 am to 6 pm, on Sundays and public holidays: 8 am to 6 pm.
dB(A)	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(C)	Noise is measured in units called decibels (dB). There are several scales for describing noise, with the 'C-weighted' scale typically used to assess low frequency noise.
DP&I	Department of Planning and Infrastructure
EA	Environmental assessment
EMM	EMGA Mitchell McLennan Pty Limited
EPA	The NSW Environmental Protection Authority (formerly the Environment Protection Authority and the Department of Environment, Climate Change and Water).
EP&A Act	*Environmental and Planning Assessment Act 1979* (NSW)
Evening period[1]	Monday–Saturday: 6 pm to 10 pm, on Sundays and public holidays:
ICNG	Interim Construction Noise Guideline
INP	Industrial Noise Policy
Intrusive criteria	The intrusive criteria refers to noise that intrudes above the background level by more than 5 dB. The intrusiveness criterion is described in detail in Section 2.1.1.
L_1	The noise level exceeded for 1% of the time.
L_{10}	The noise level which is exceeded 10% of the time. It is roughly equivalent to the average of maximum noise level.
L_{90}	The noise level that is exceeded 90% of the time. Commonly referred to as the background noise level.
L_{eq}	The energy average noise from a source. This is the equivalent continuous sound pressure level over a given period. The $L_{eq,15min}$ descriptor refers to an L_{eq} noise level measured over a 15minute period.
Linear peak	The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.
L_{max}	The maximum sound pressure level received during a measuring interval.
L_w	Sound power level
Night period[1]	Monday–Saturday: 10 pm to 7 am, on Sundays and public holidays: 10 pm to 8 am.
NMP	Noise management plan
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)
PSNL	The Balranald project-specific noise levels (PSNL) are criteria for a particular industrial noise source or industry. The PSNL is the lower of either the intrusive criteria or amenity criteria.
RBL	The rating background level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the average background levels.
RNP	Road Noise Policy

Sound power level (Lw)	A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.
SEARs	Secretary Environmental Assessment Requirements
Temperature inversion	A meteorological condition where the atmospheric temperature increases with altitude.
the Balranald Project	Balranald Mineral Sands Project

Note: 1. excludes road traffic noise where Day: 7 am to 10 pm; Night: 10 pm to 7 am

Appendix A

Unattended continuous noise monitoring results


Measured Ambient Noise Levels
Location A
Monday, 16-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
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L90
WindSpeed
WindLimit
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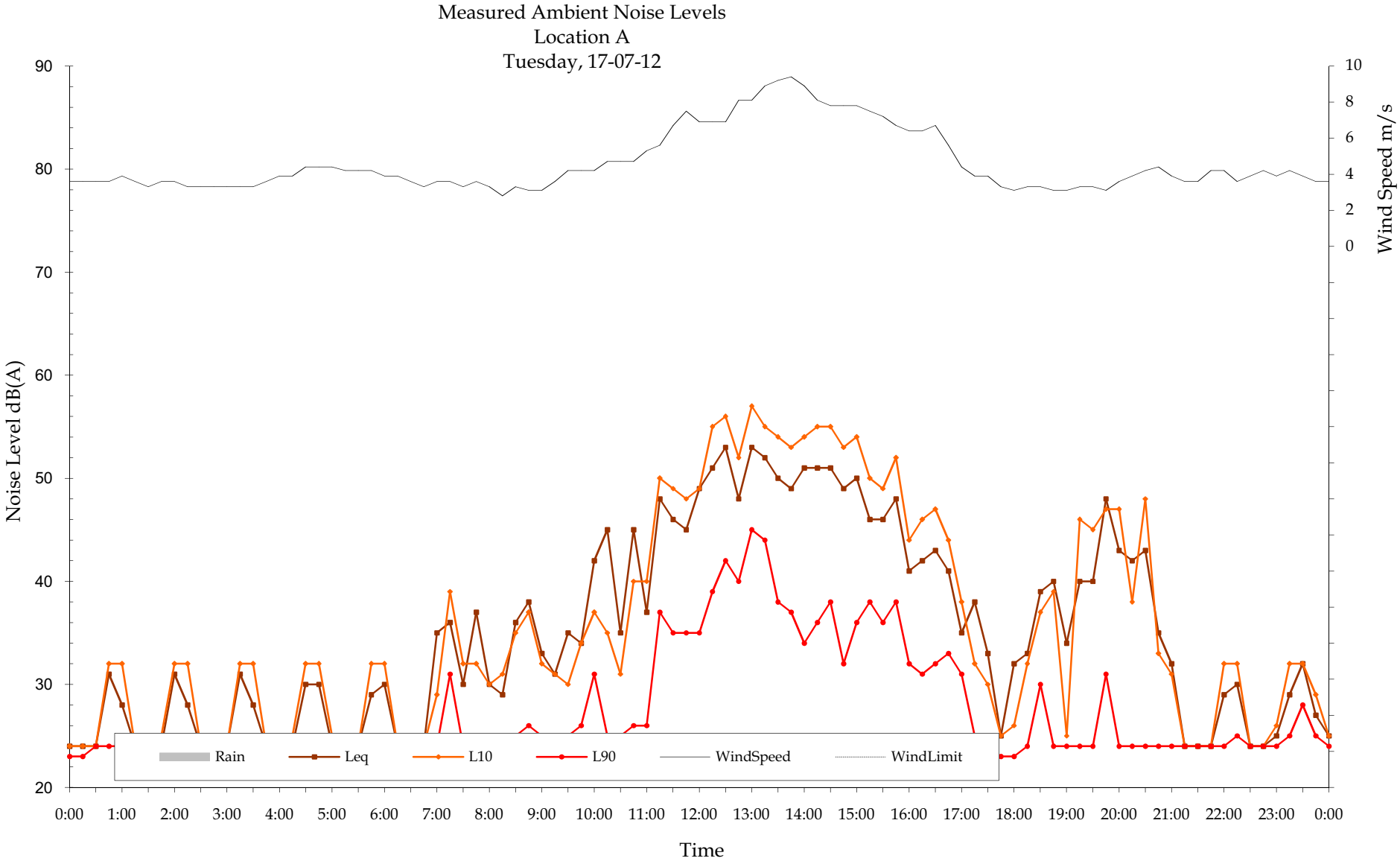
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Location A
Tuesday, 17-07-12
Noise Level dB(A)
Wind Speed m/s
Time
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Leq
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WindSpeed
WindLimit
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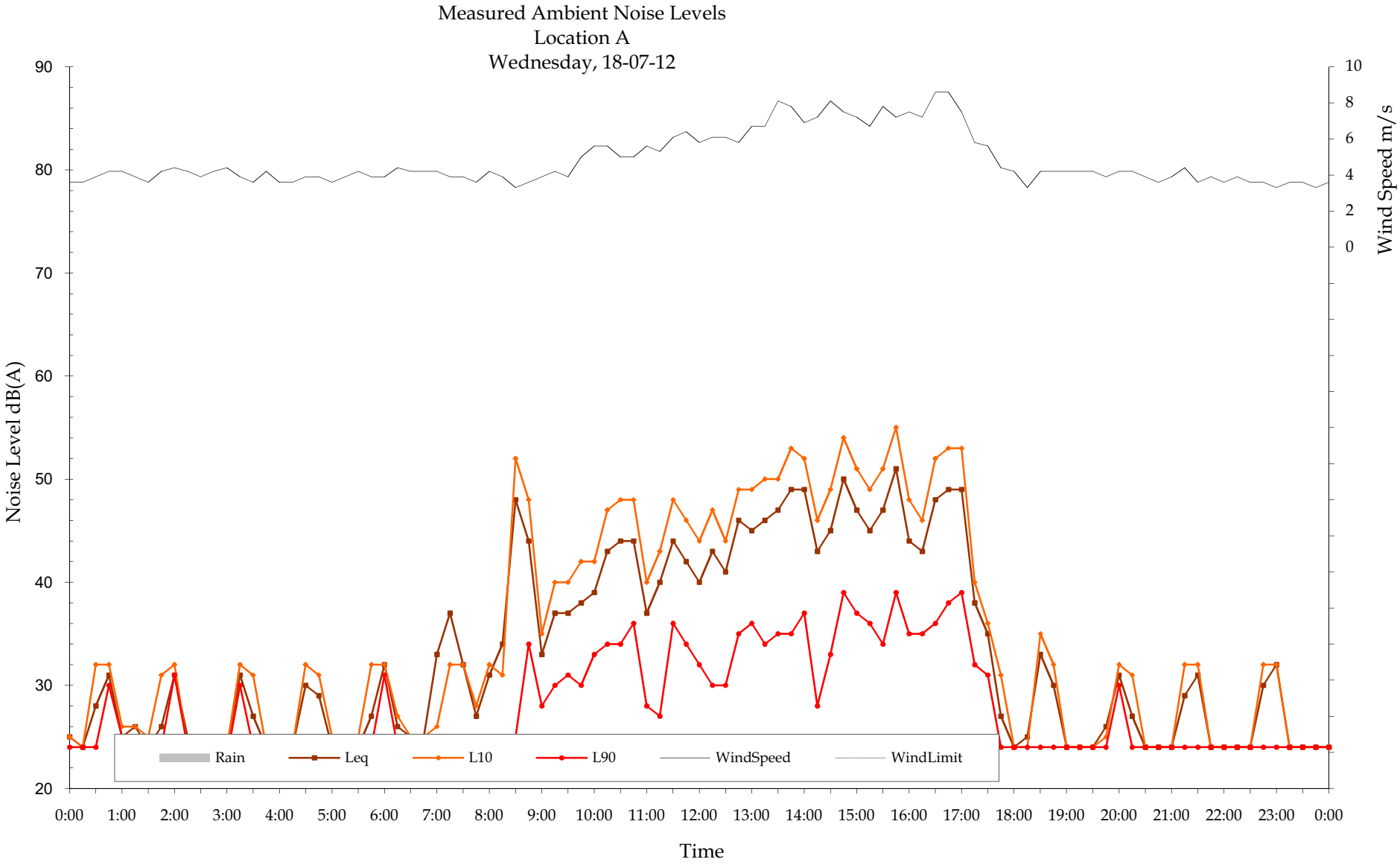
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Wednesday, 18-07-12
Noise Level dB(A)
Wind Speed m/s
Time
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WindSpeed
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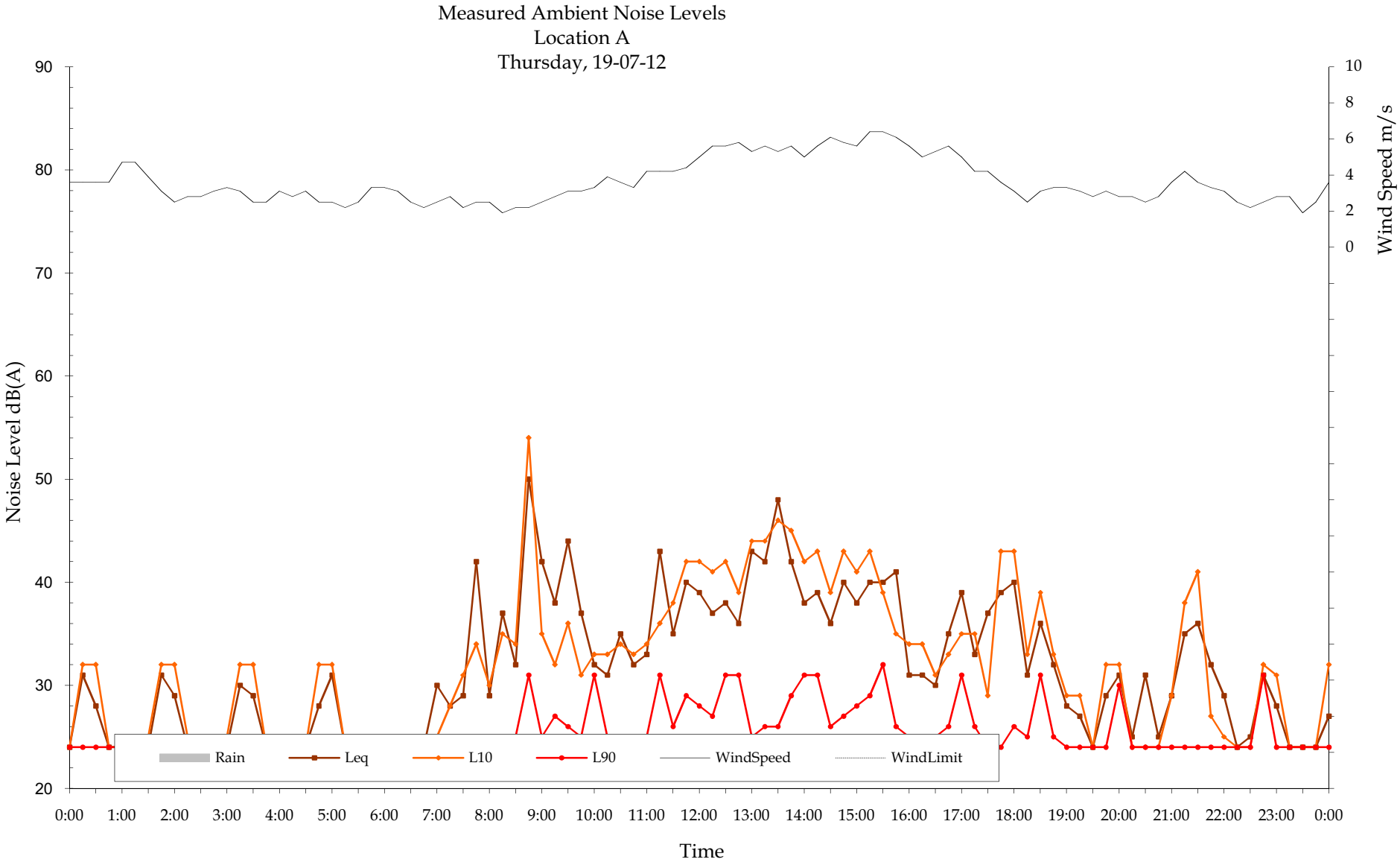
Measured Ambient Noise Levels
Location A
Thursday, 19-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
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WindSpeed
WindLimit
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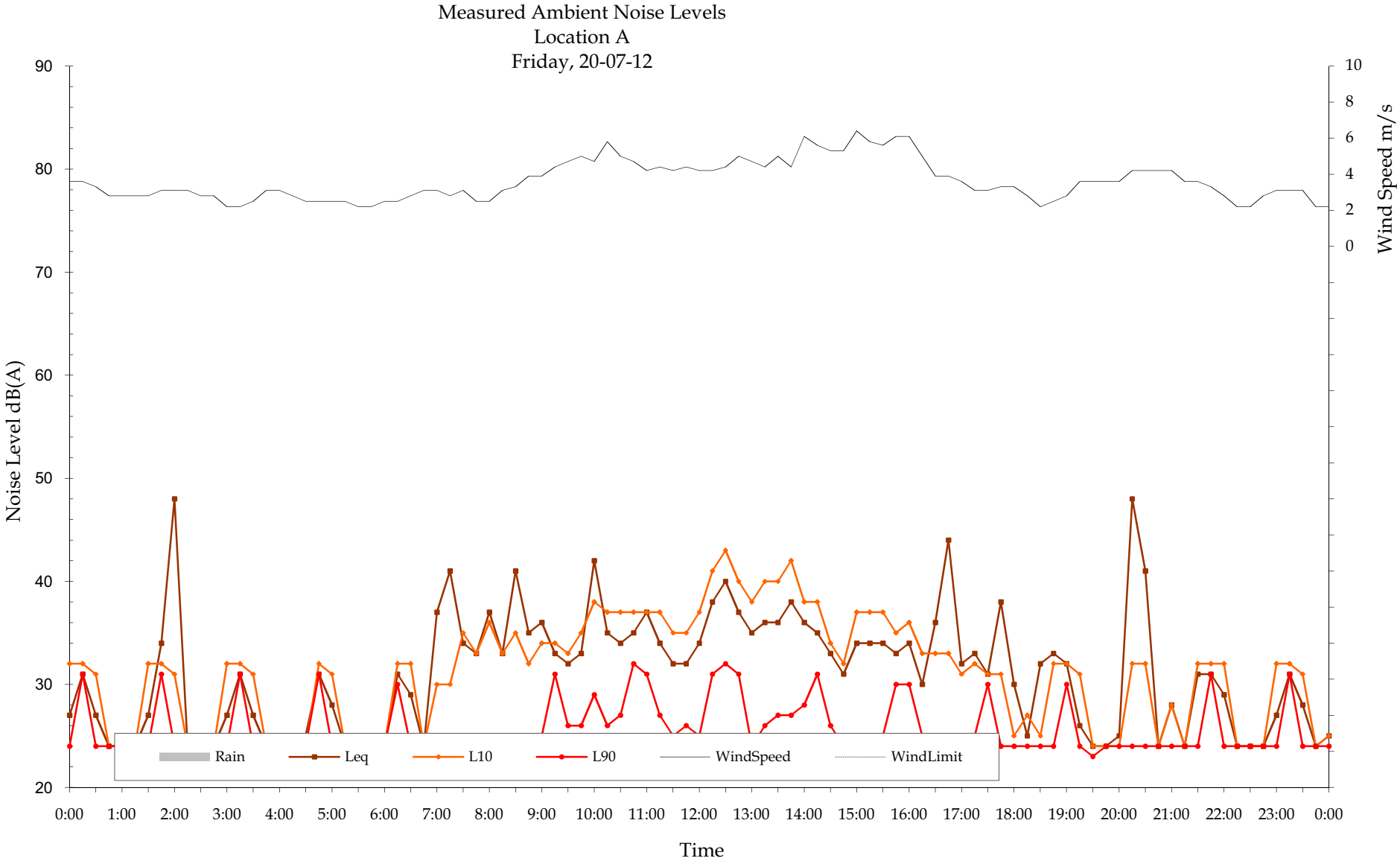
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Location A
Friday, 20-07-12
Noise Level dB(A)
Wind Speed m/s
Time
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WindSpeed
WindLimit
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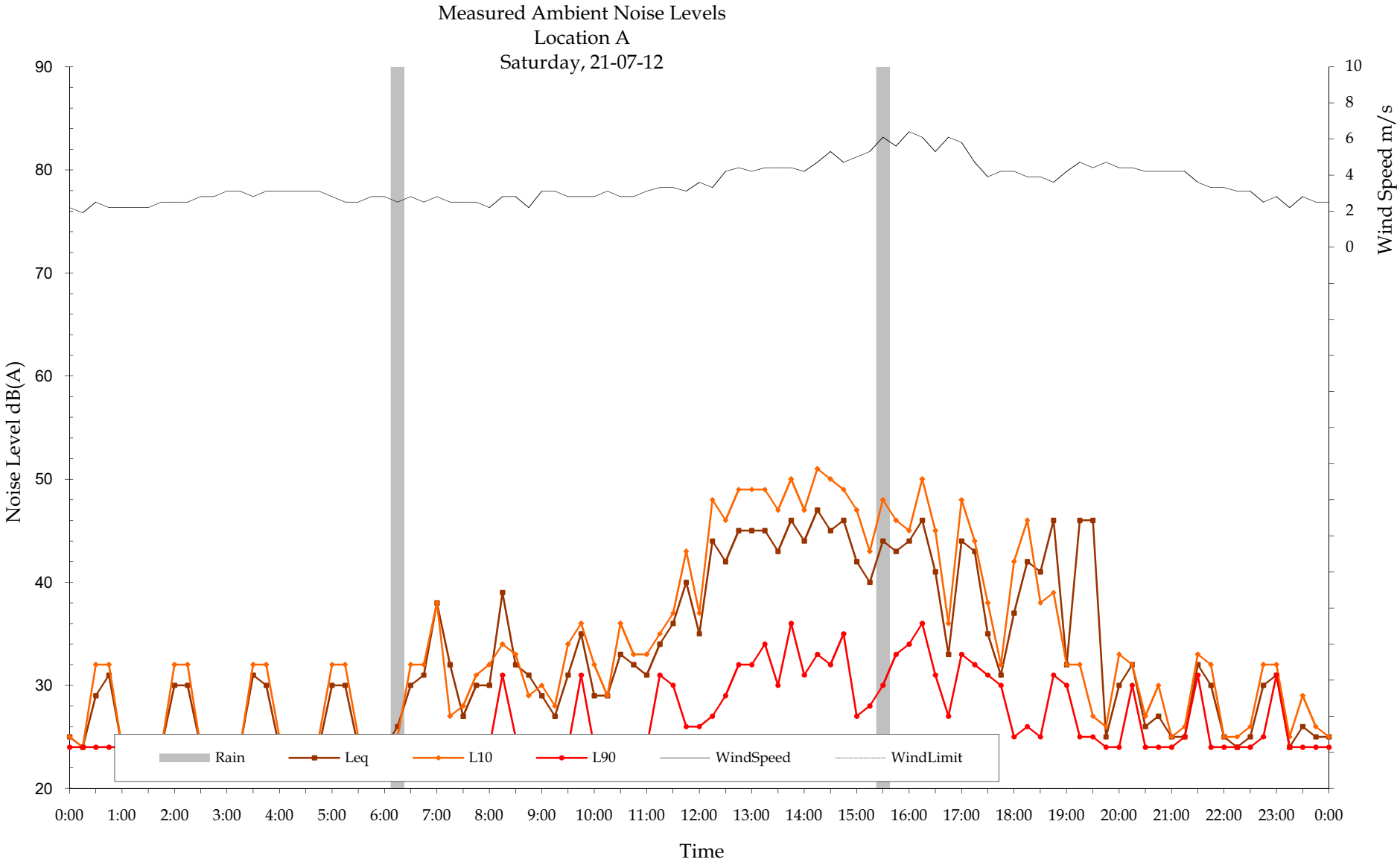
Measured Ambient Noise Levels
Location A
Saturday, 21-07-12
Noise Level dB(A)
Wind Speed m/s
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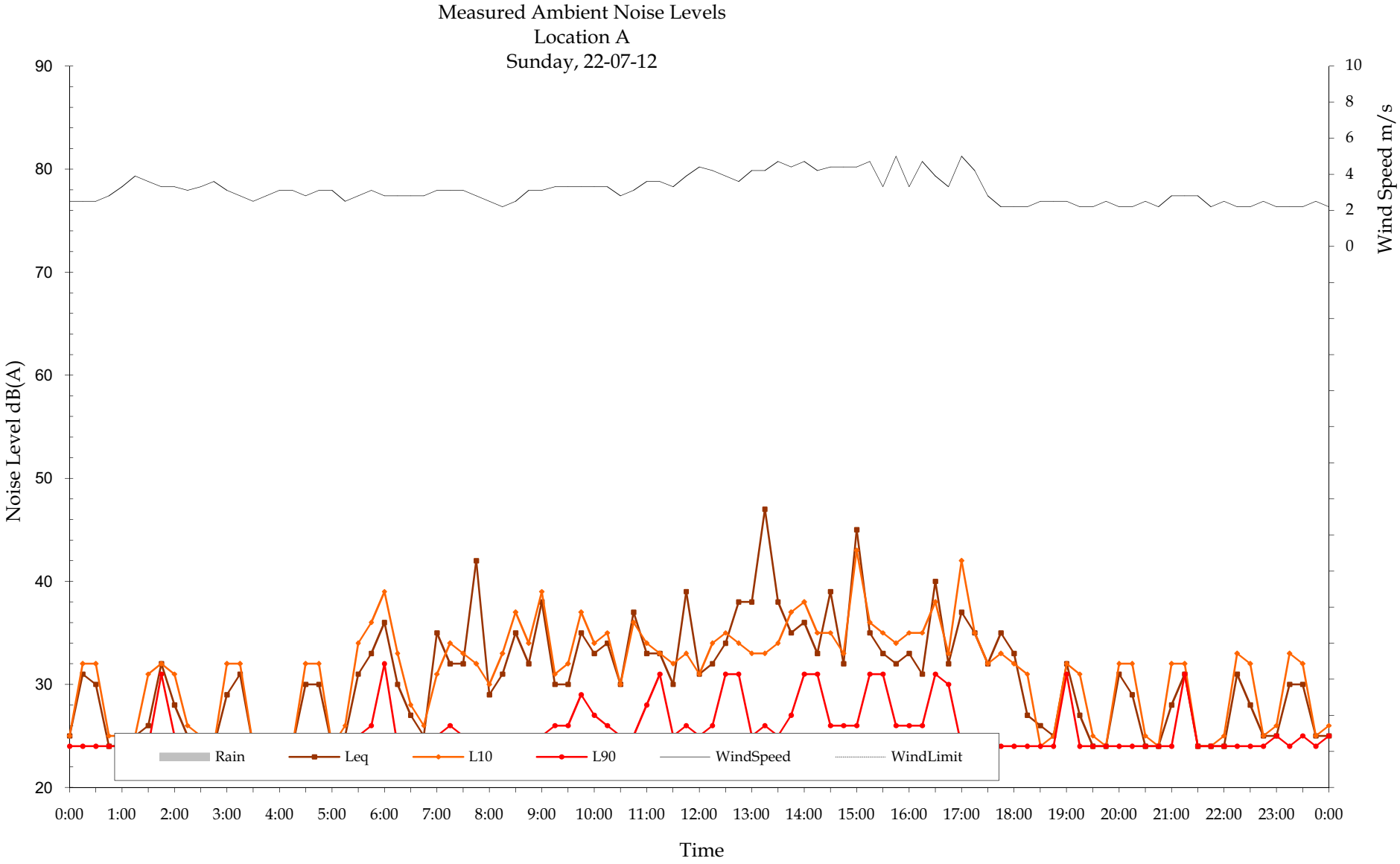
WindLimit


Measured Ambient Noise Levels
Location A
Sunday, 22-07-12
Noise Level dB(A)
Wind Speed m/s
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WindSpeed
WindLimit
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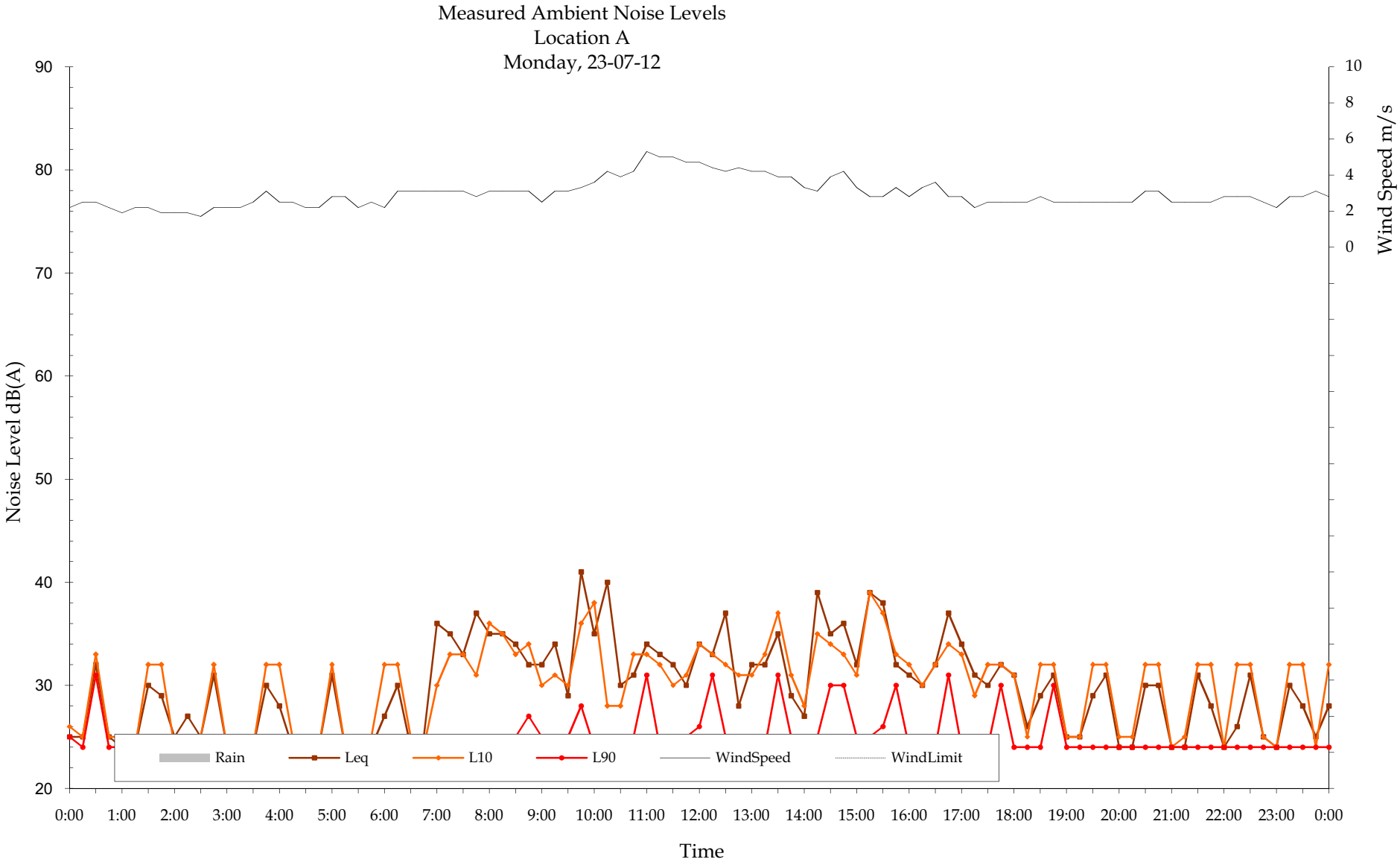
Measured Ambient Noise Levels
Location A
Monday, 23-07-12
Noise Level dB(A)
Wind Speed m/s
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WindSpeed
WindLimit
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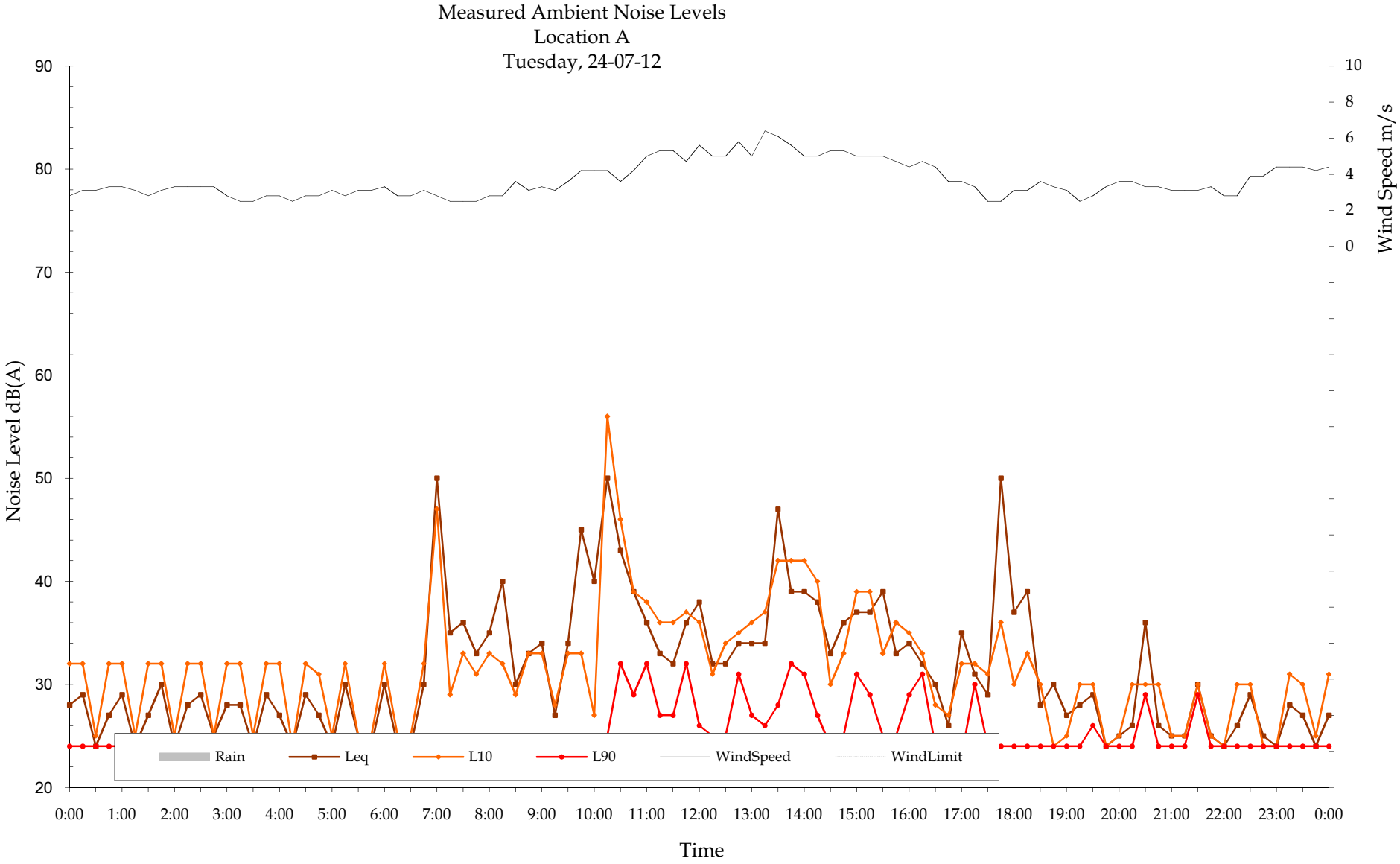
Measured Ambient Noise Levels
Location A
Tuesday, 24-07-12
Noise Level dB(A)
Wind Speed m/s
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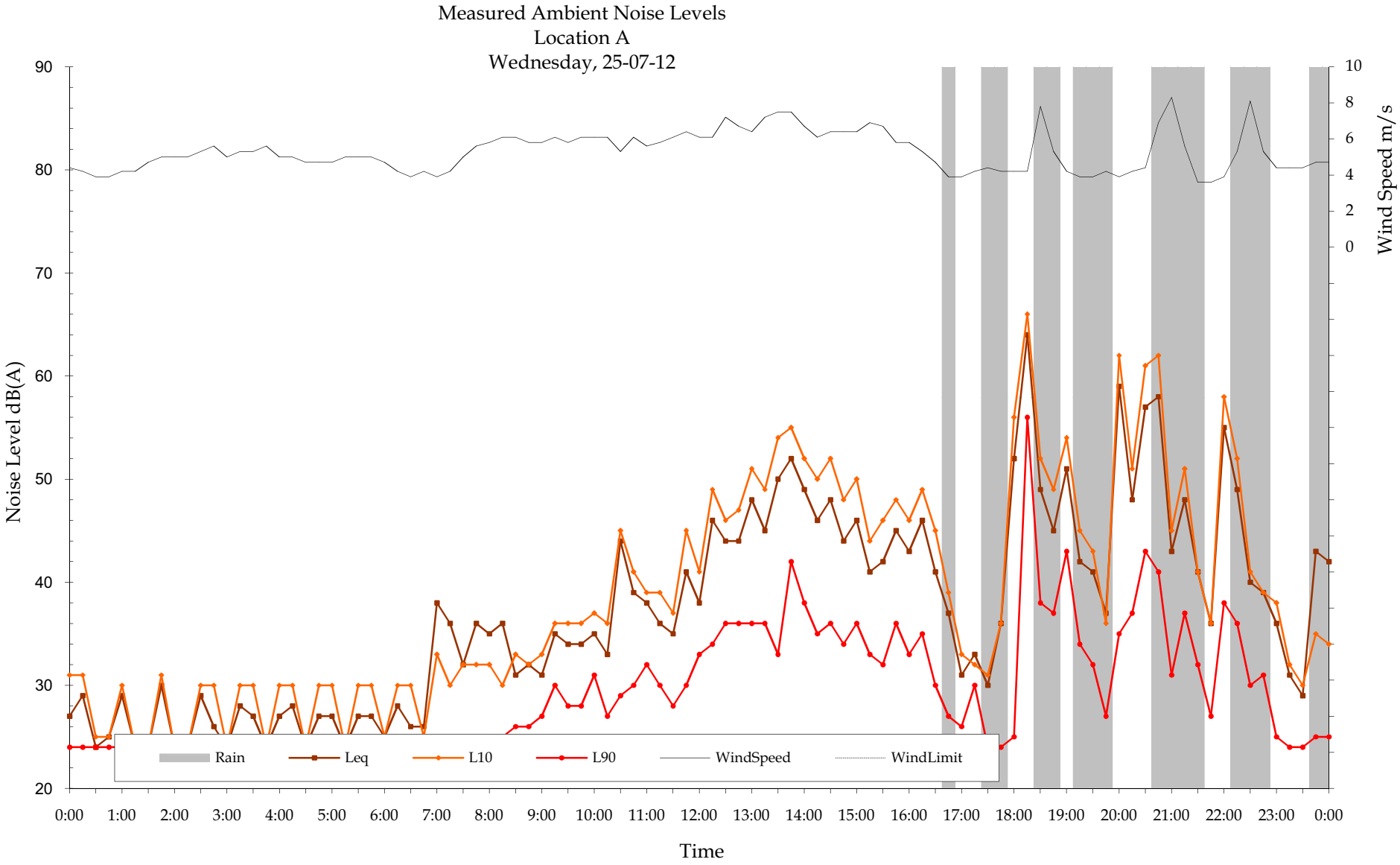
Measured Ambient Noise Levels
Location A
Wednesday, 25-07-12
Noise Level dB(A)
Wind Speed m/s
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WindSpeed
WindLimit
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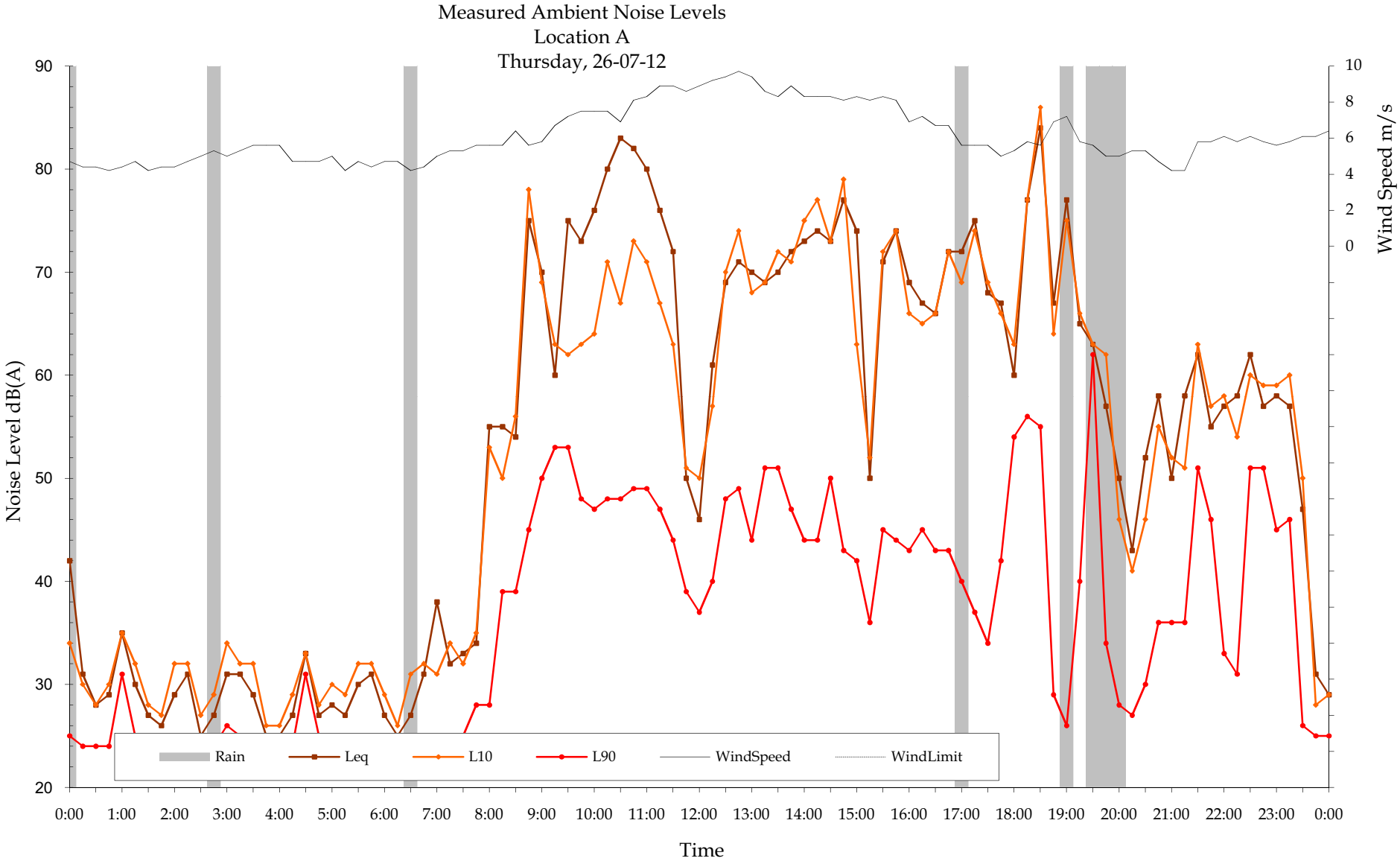
Measured Ambient Noise Levels
Location A
Thursday, 26-07-12
Noise Level dB(A)
Wind Speed m/s
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WindSpeed
WindLimit
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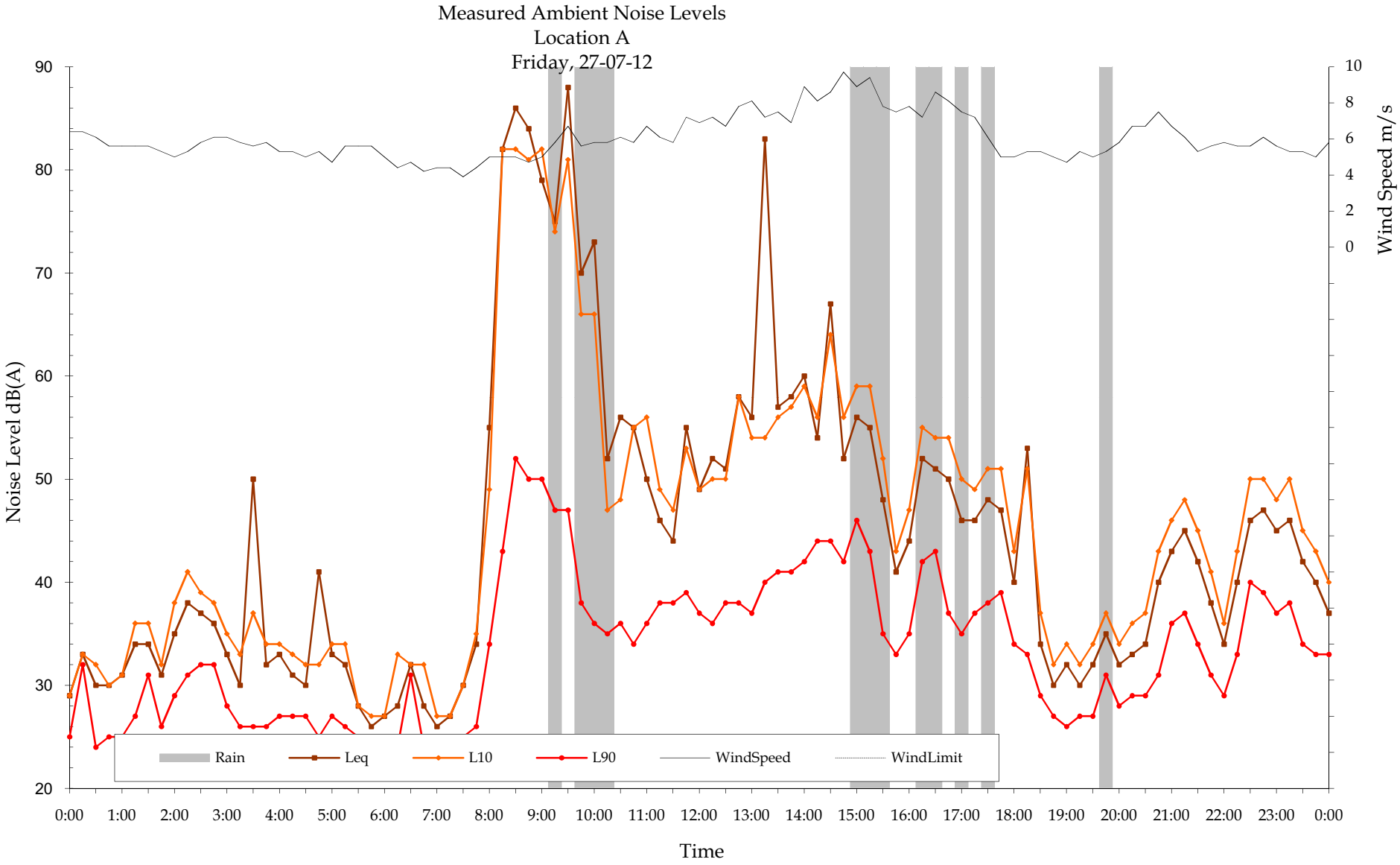
Measured Ambient Noise Levels
Location A
Friday, 27-07-12
Noise Level dB(A)
Wind Speed m/s
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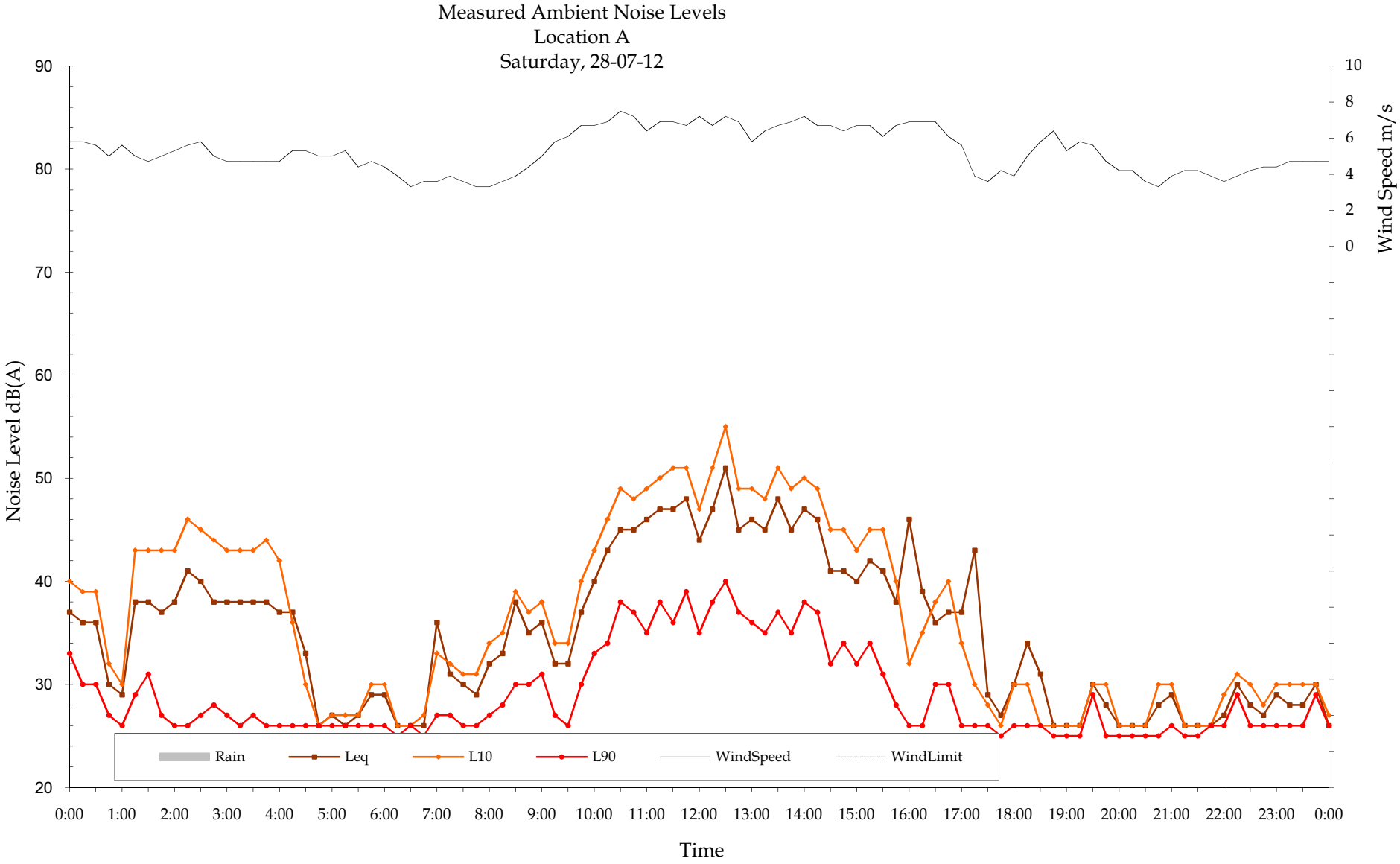
Measured Ambient Noise Levels
Location A
Saturday, 28-07-12
Noise Level dB(A)
Wind Speed m/s
Time
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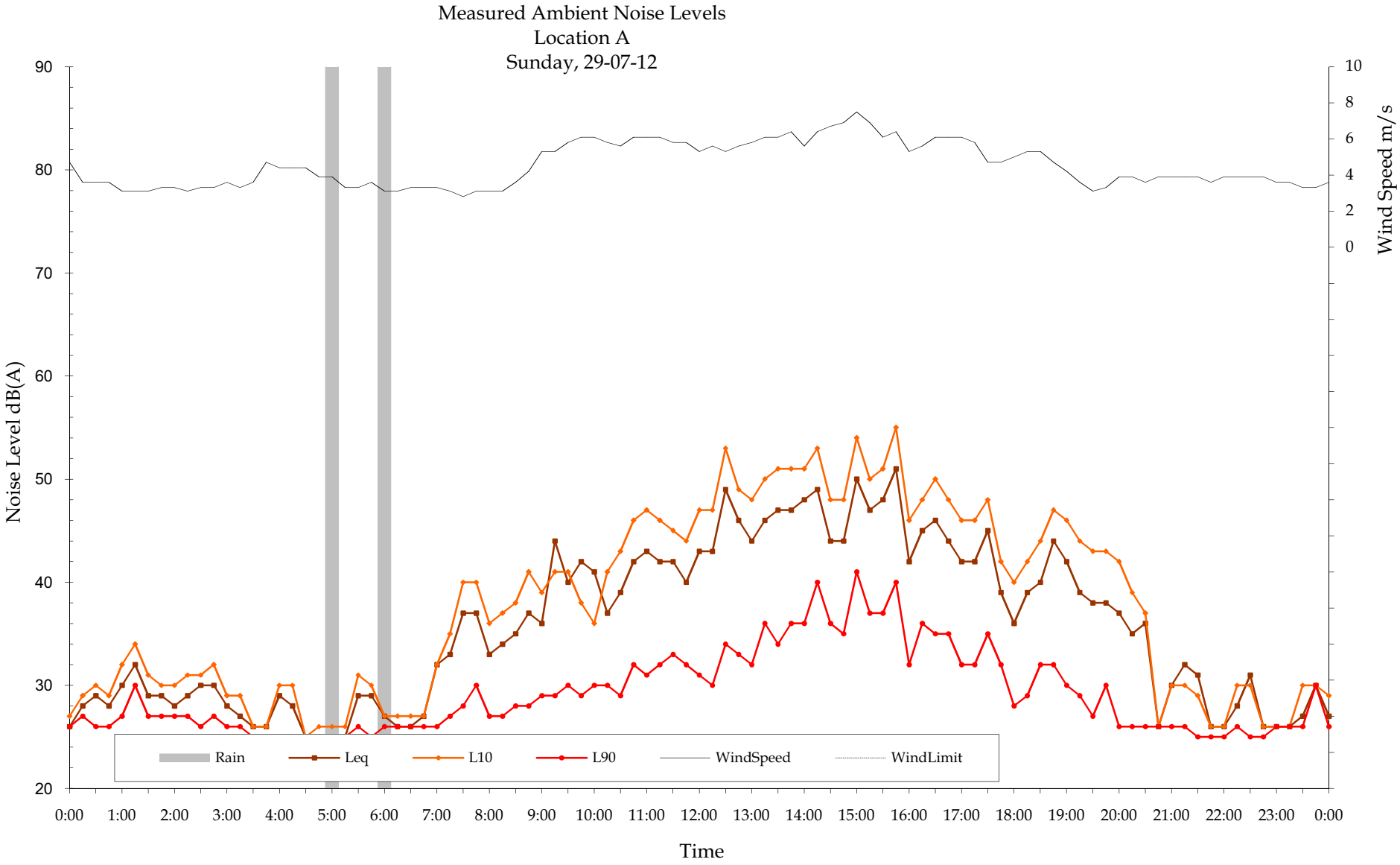
Measured Ambient Noise Levels
Location A
Sunday, 29-07-12
Noise Level dB(A)
Wind Speed m/s
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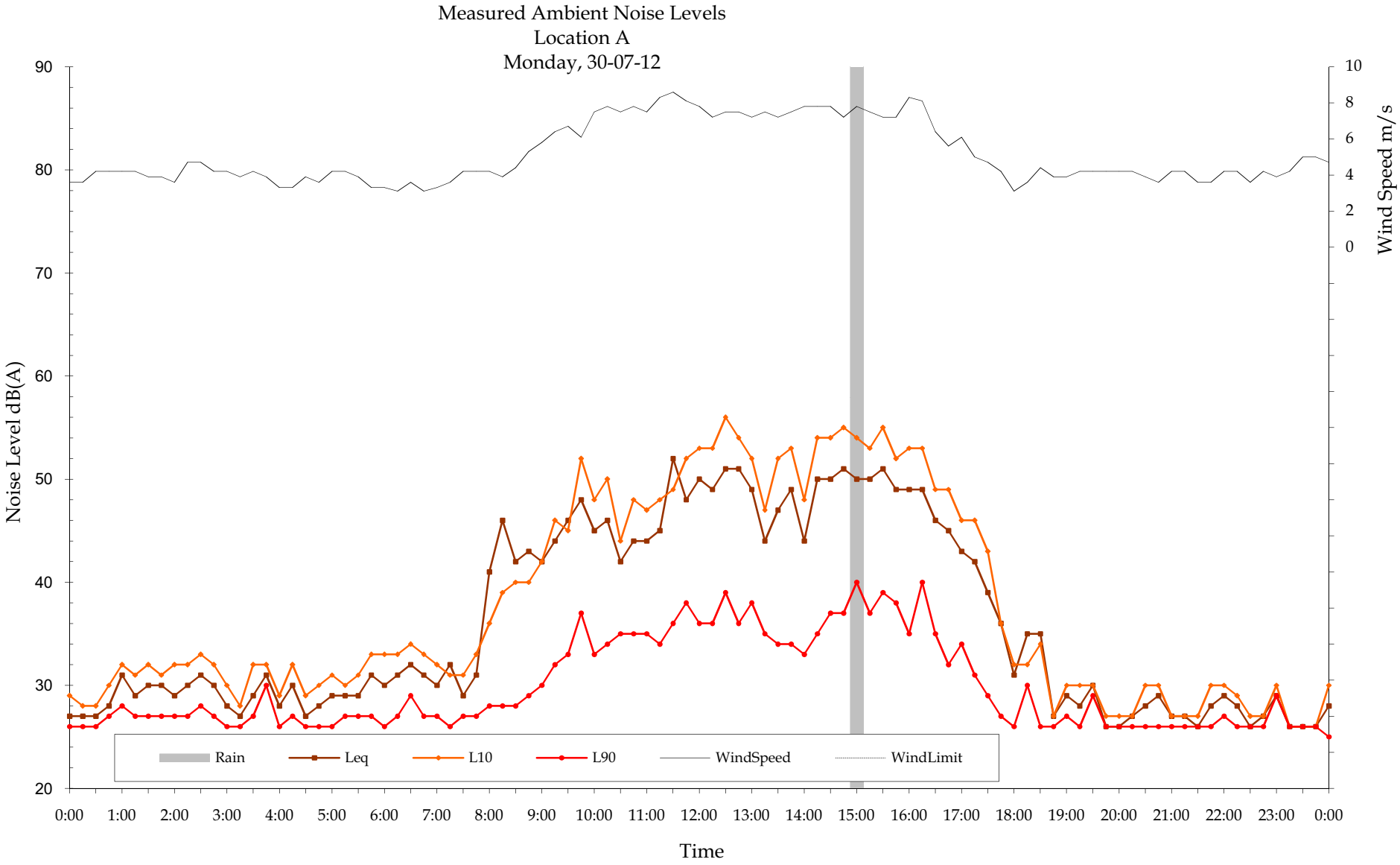
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Noise Level dB(A)
Wind Speed m/s
Time
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WindLimit
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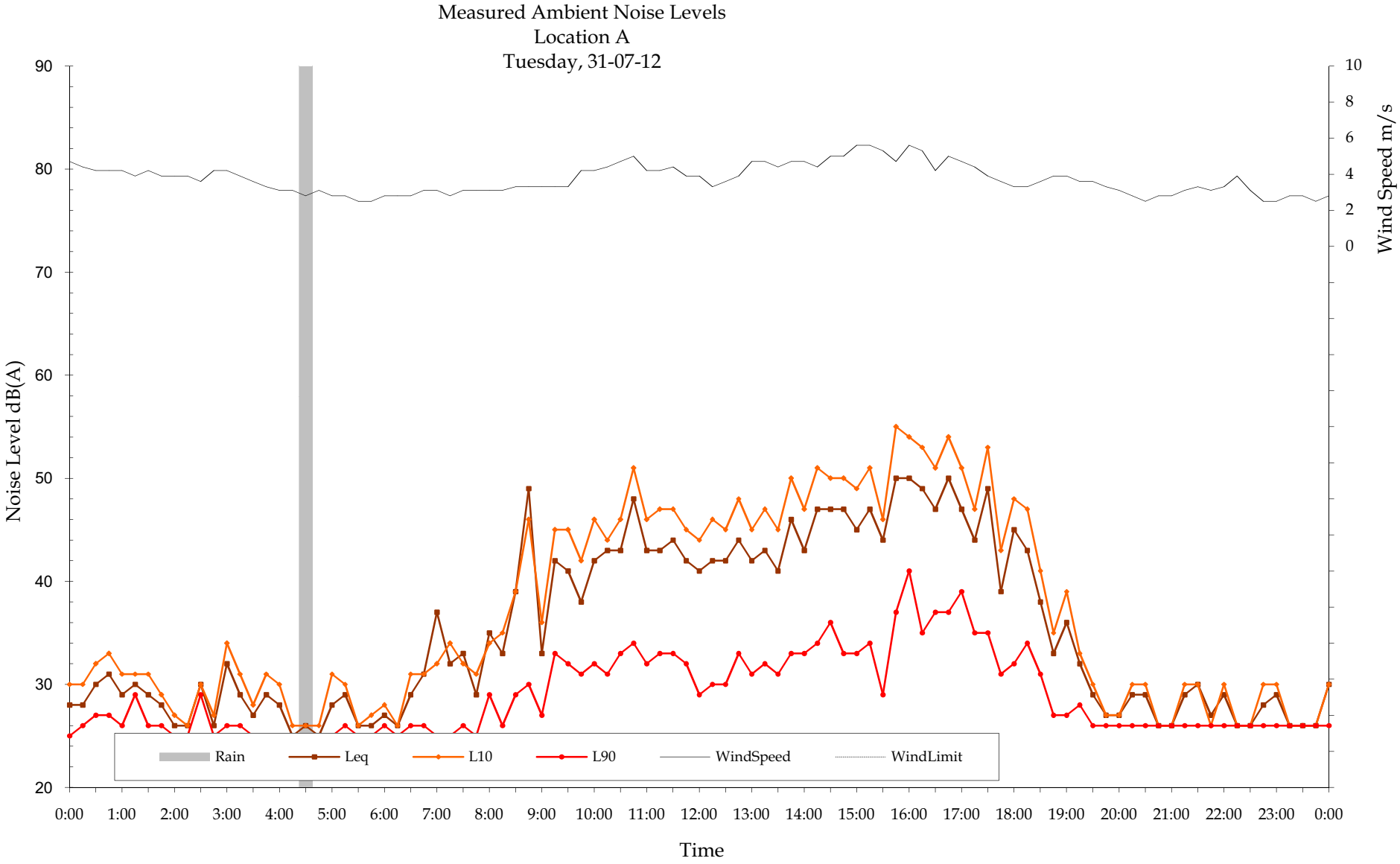
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Tuesday, 31-07-12
Noise Level dB(A)
Wind Speed m/s
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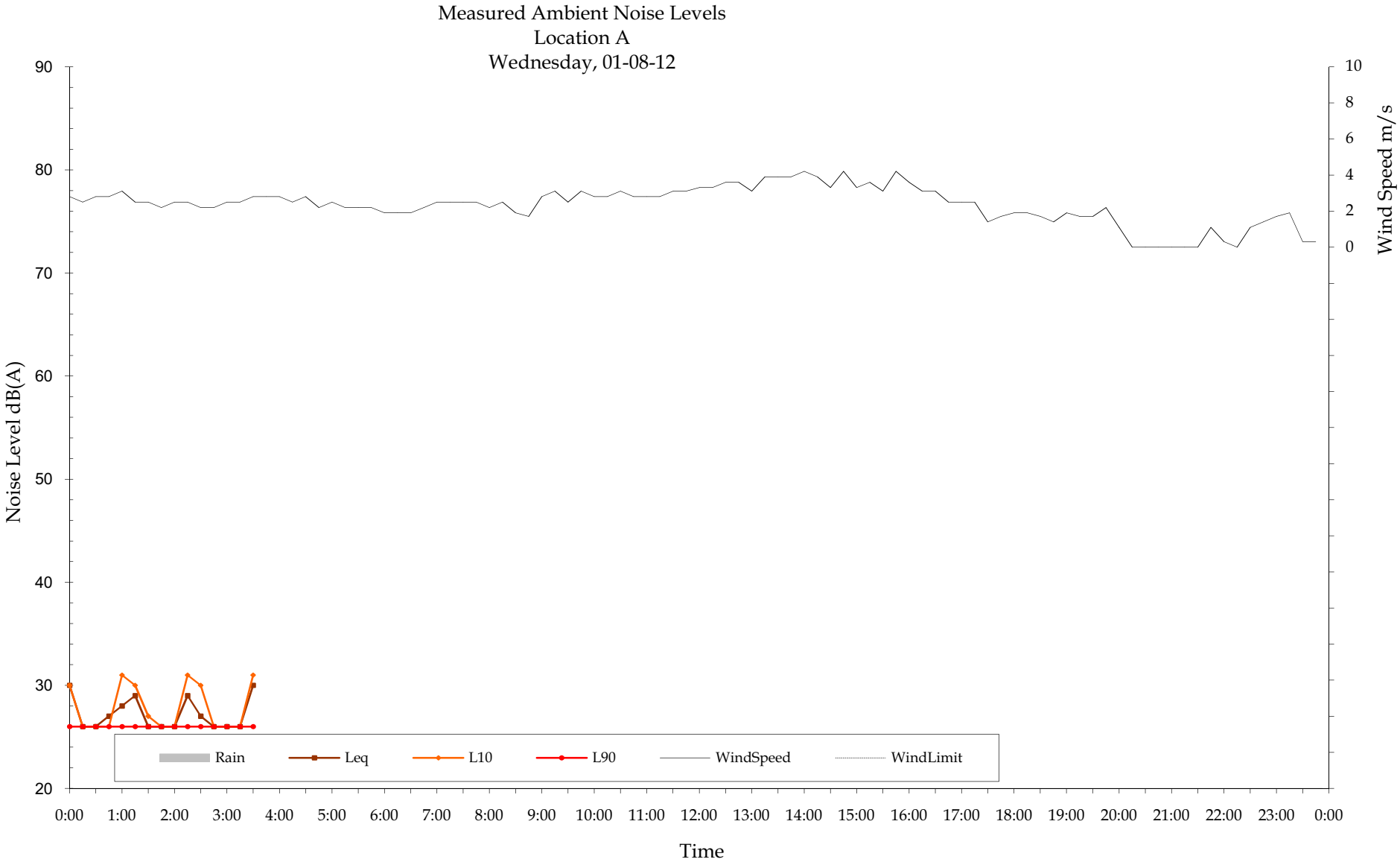
Measured Ambient Noise Levels
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Wednesday, 01-08-12
Noise Level dB(A)
Wind Speed m/s
Time
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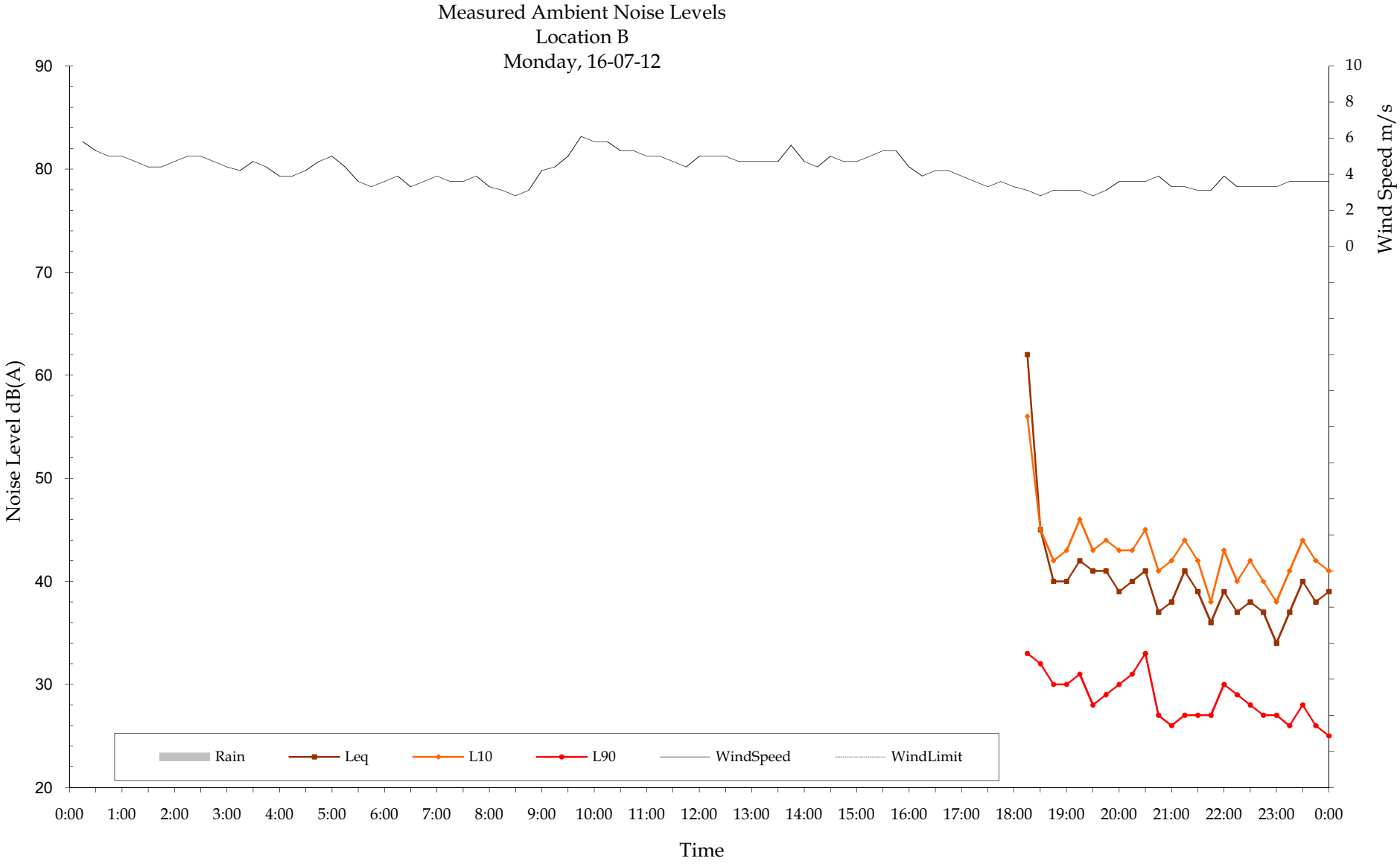
Measured Ambient Noise Levels
Location B
Monday, 16-07-12
Noise Level dB(A)
Wind Speed m/s
Time
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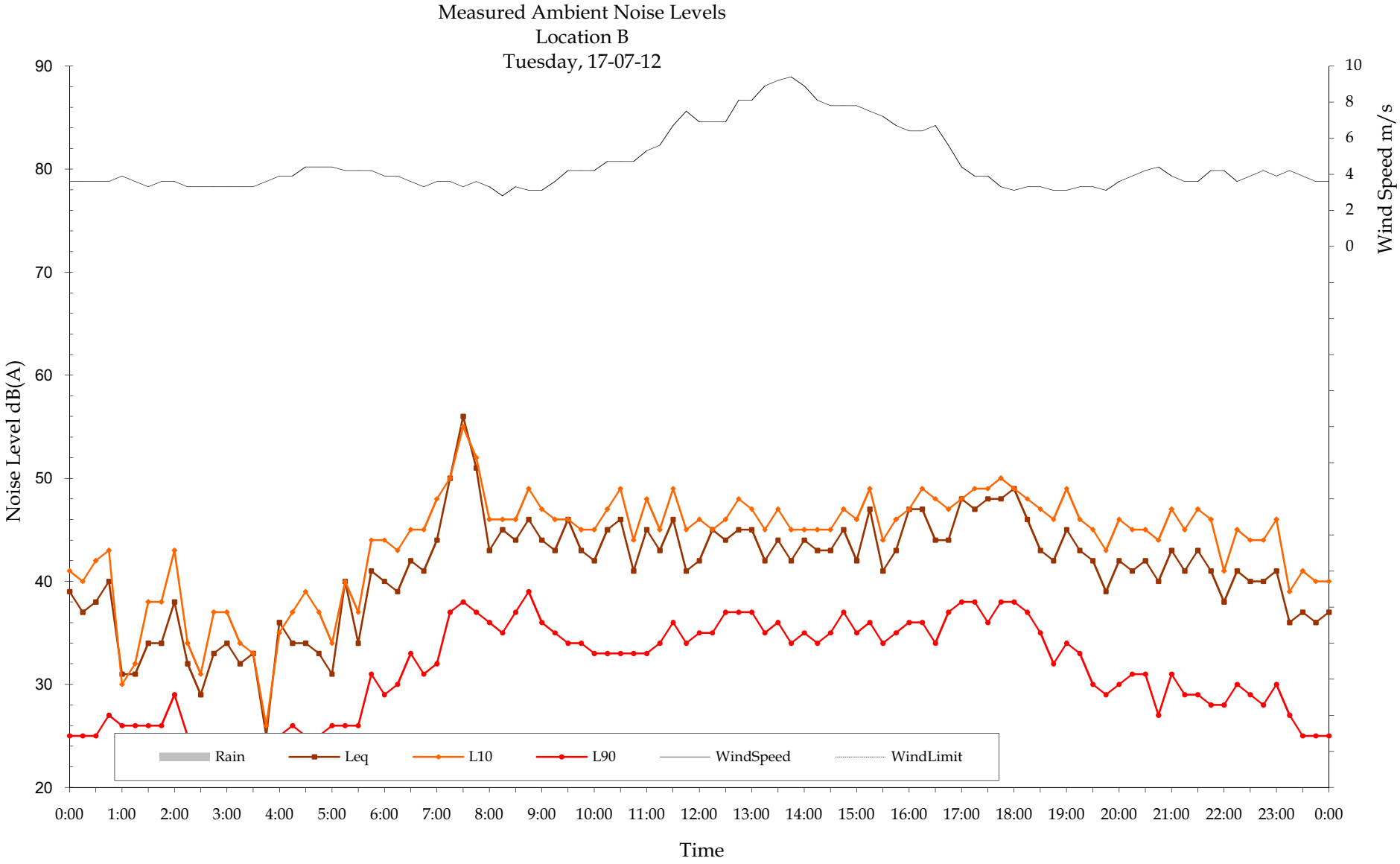
Measured Ambient Noise Levels
Location B
Tuesday, 17-07-12
Noise Level dB(A)
Wind Speed m/s
Time
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WindSpeed
WindLimit
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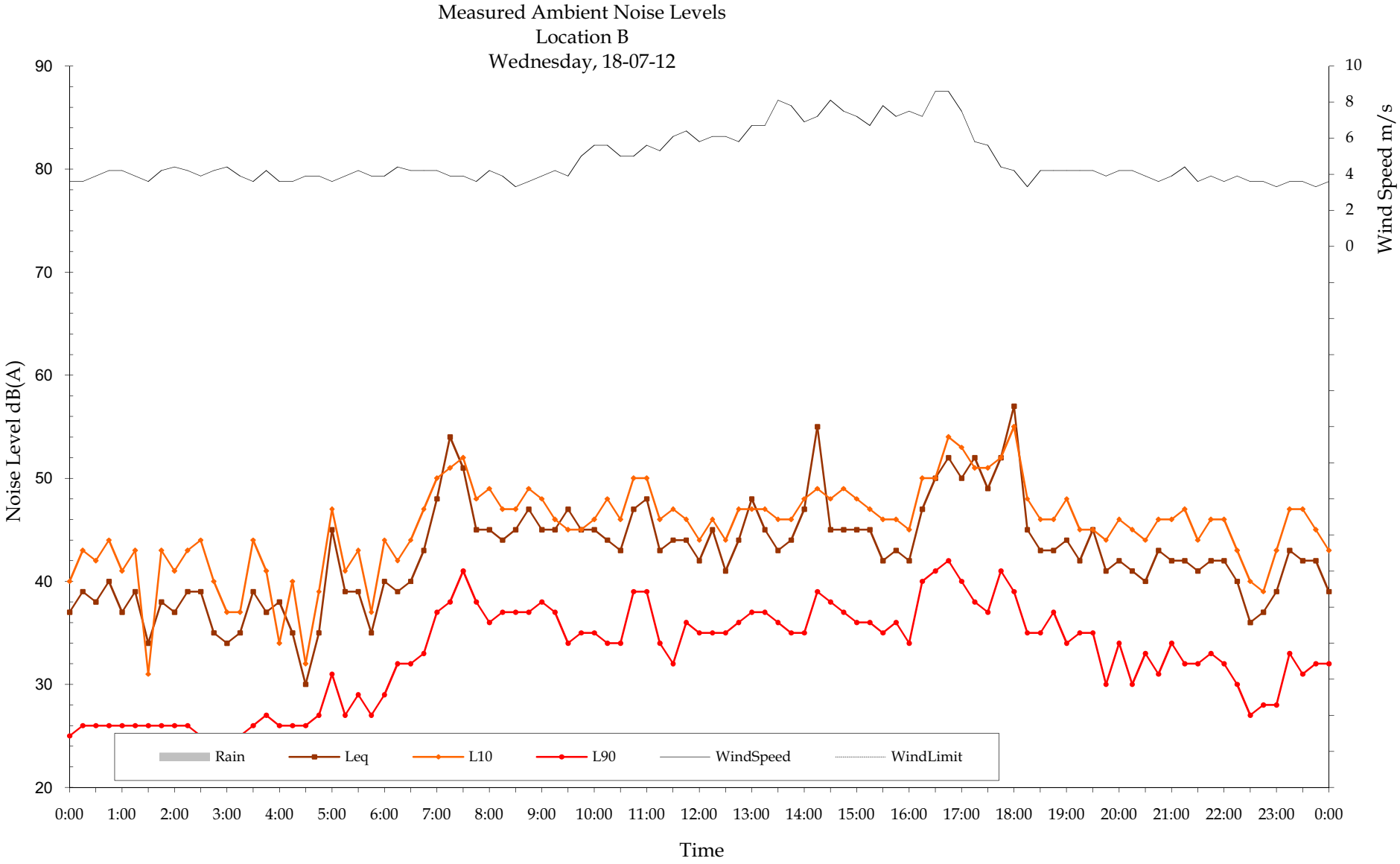
Measured Ambient Noise Levels
Location B
Wednesday, 18-07-12
Noise Level dB(A)
Wind Speed m/s
Time
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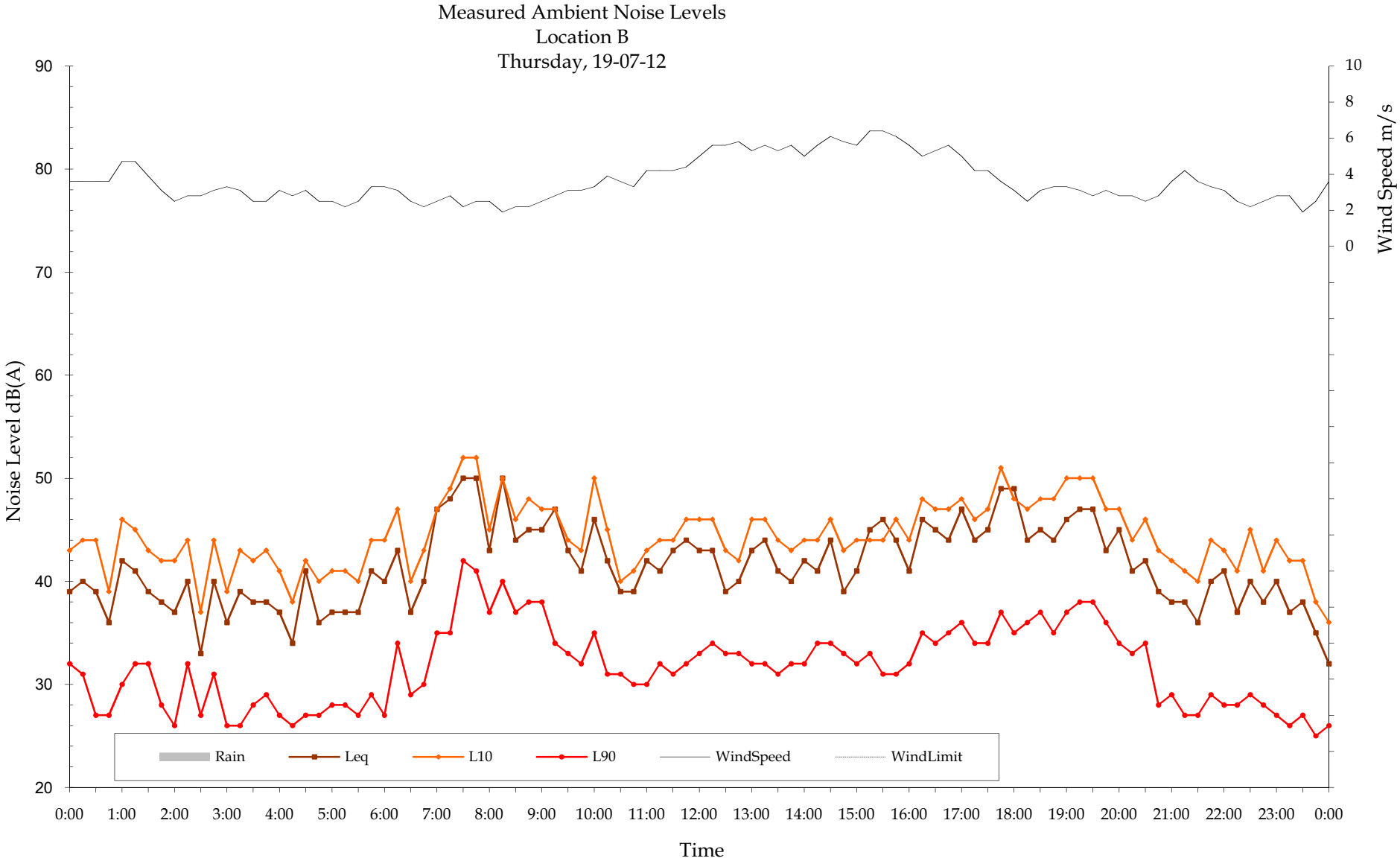
WindSpeed
WindLimit


Measured Ambient Noise Levels
Location B
Thursday, 19-07-12
Noise Level dB(A)
Wind Speed m/s
Time
90
80
70
60
50
40
30
20
10
8
6
4
2
0
0:00
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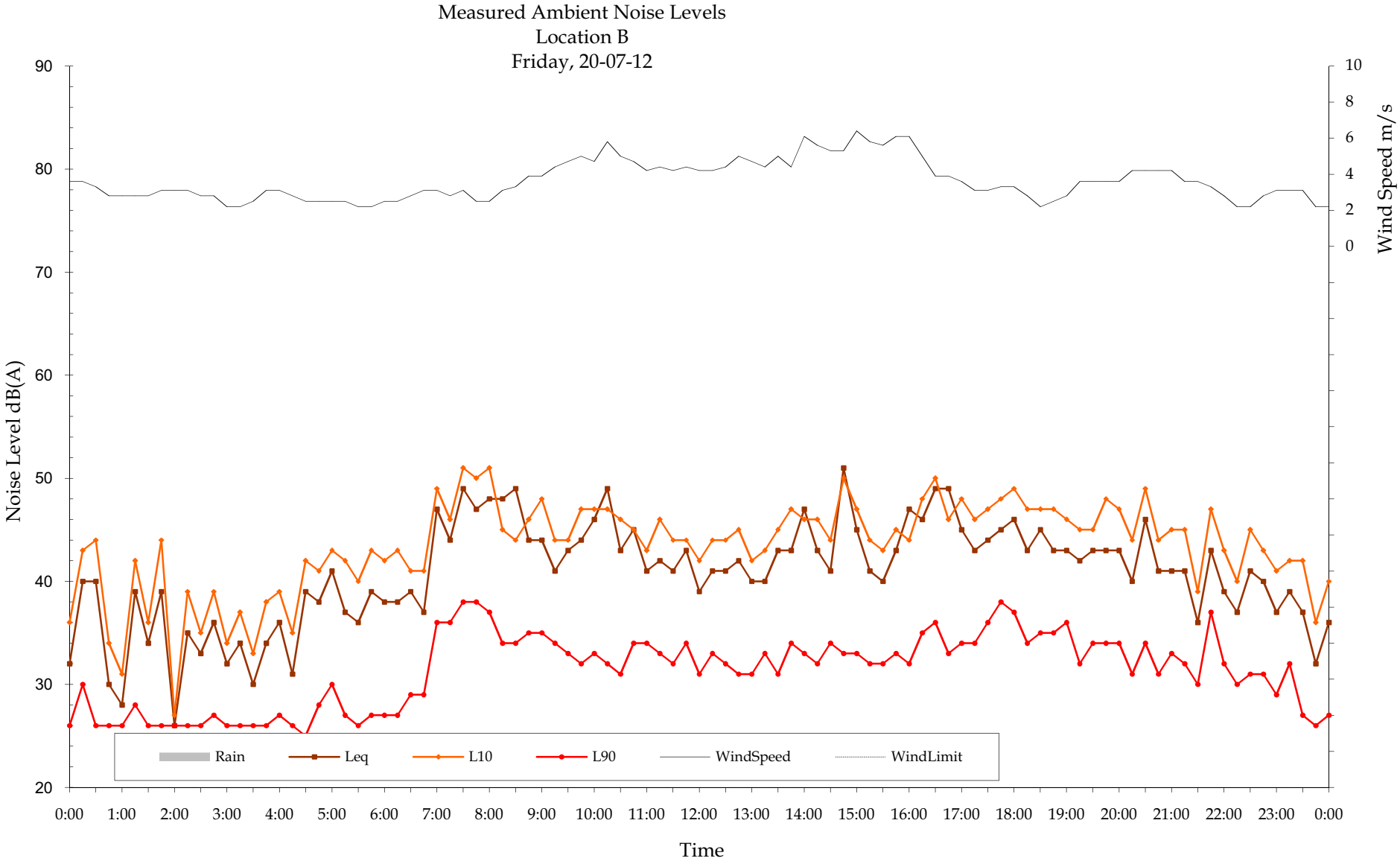
22:00
23:00
0:00
Rain
Leq
L10
L90
WindSpeed
WindLimit


Measured Ambient Noise Levels
Location B
Friday, 20-07-12
Noise Level dB(A)
Wind Speed m/s
Time
90
80
70
60
50
40
30
20
10
8
6
4
2
0
0:00
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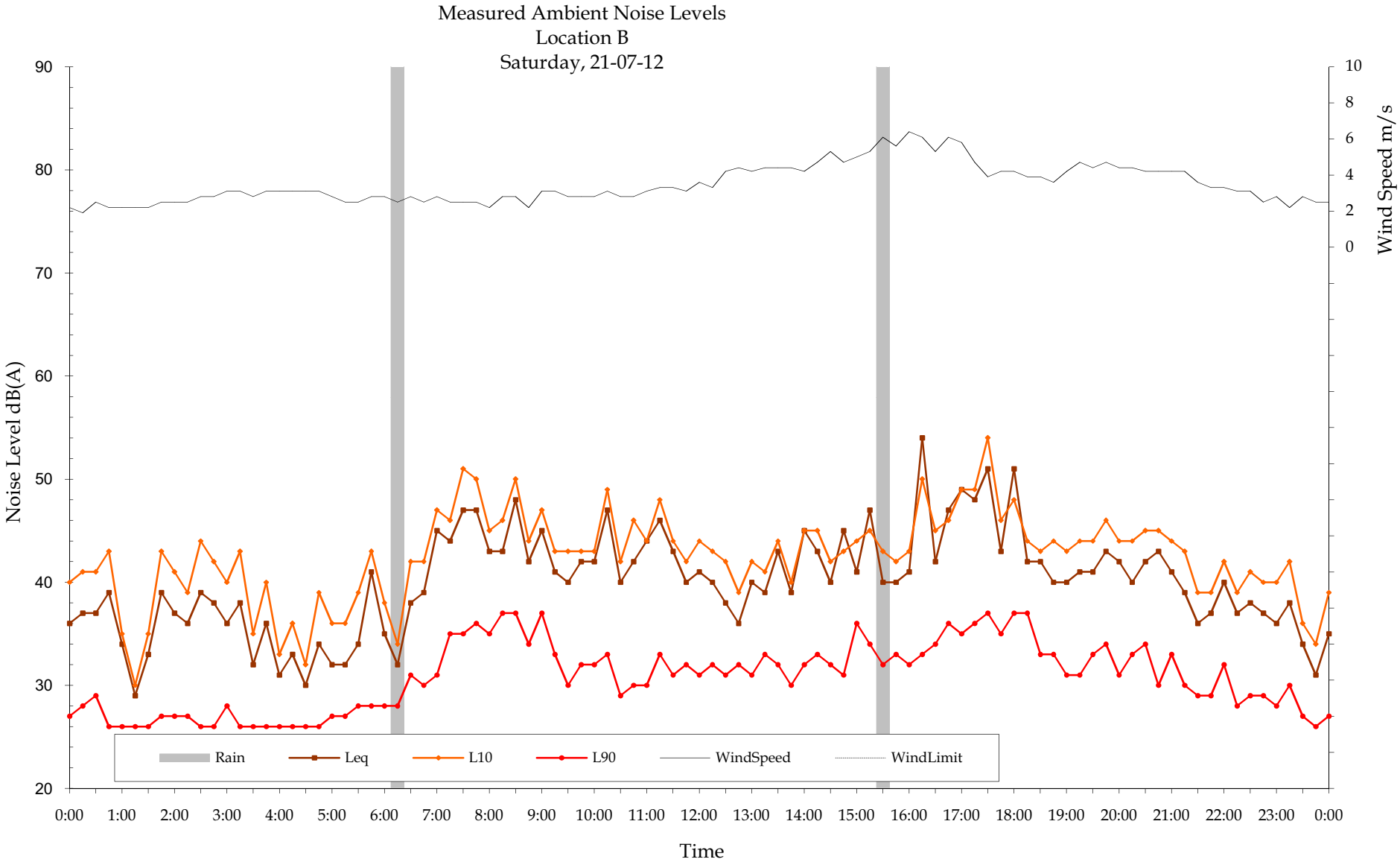
23:00
0:00
Rain
Leq
L10
L90
WindSpeed
WindLimit


Measured Ambient Noise Levels
Location B
Saturday, 21-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
80
70
60
50
40
30
20
10
8
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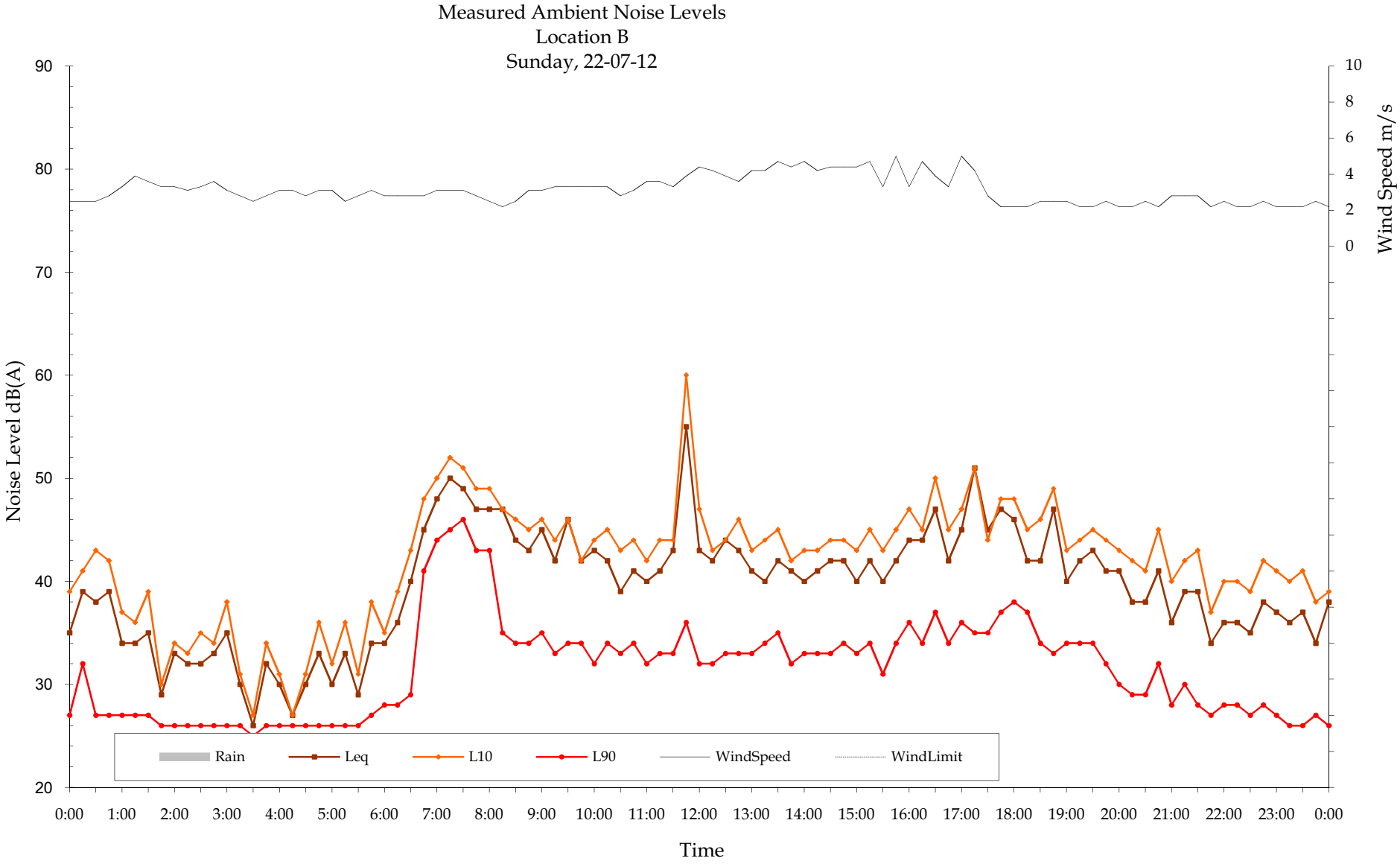
Measured Ambient Noise Levels
Location B
Sunday, 22-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
80
70
60
50
40
30
20
10
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23:00
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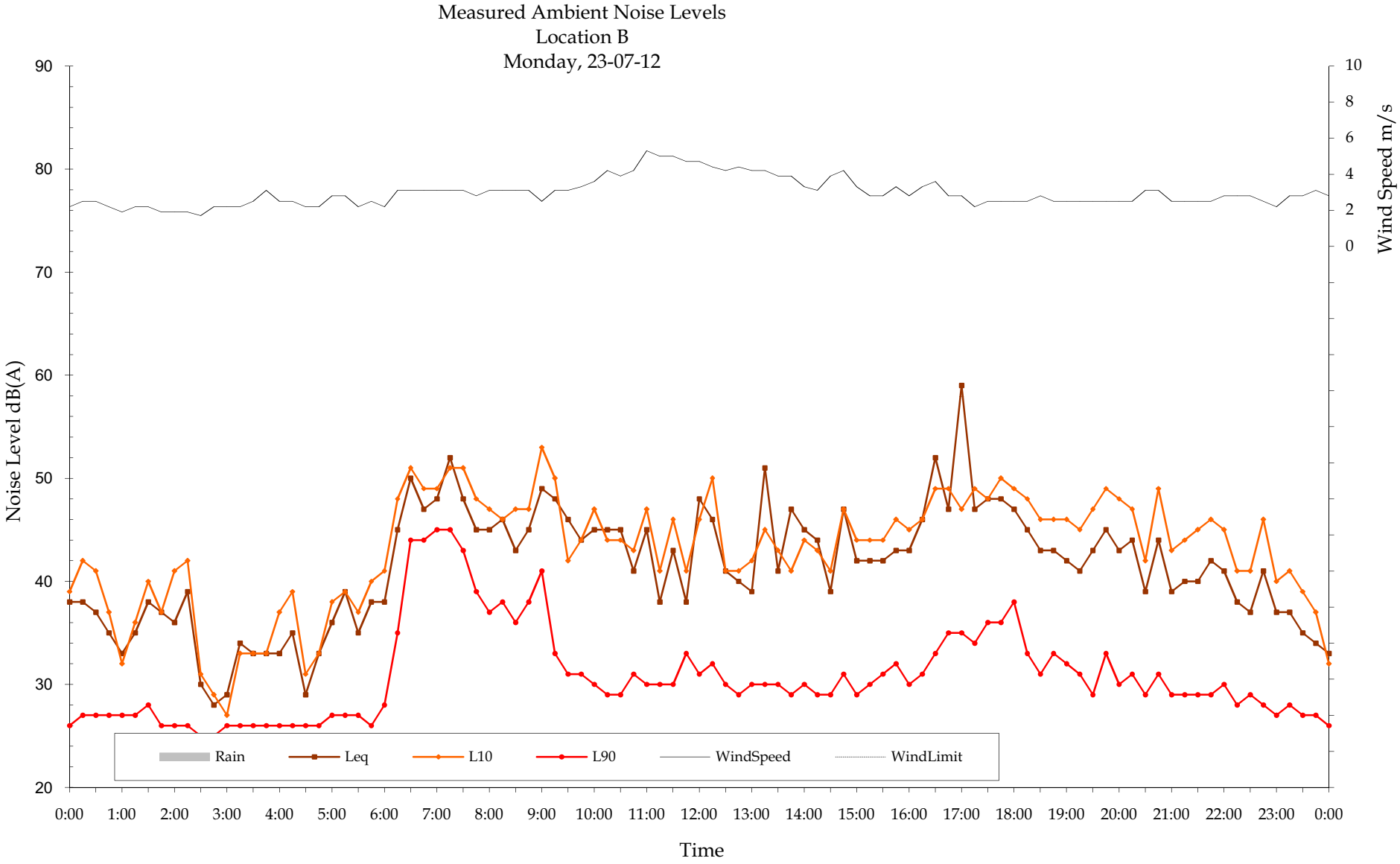
Measured Ambient Noise Levels
Location B
Monday, 23-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
80
70
60
50
40
30
20
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8
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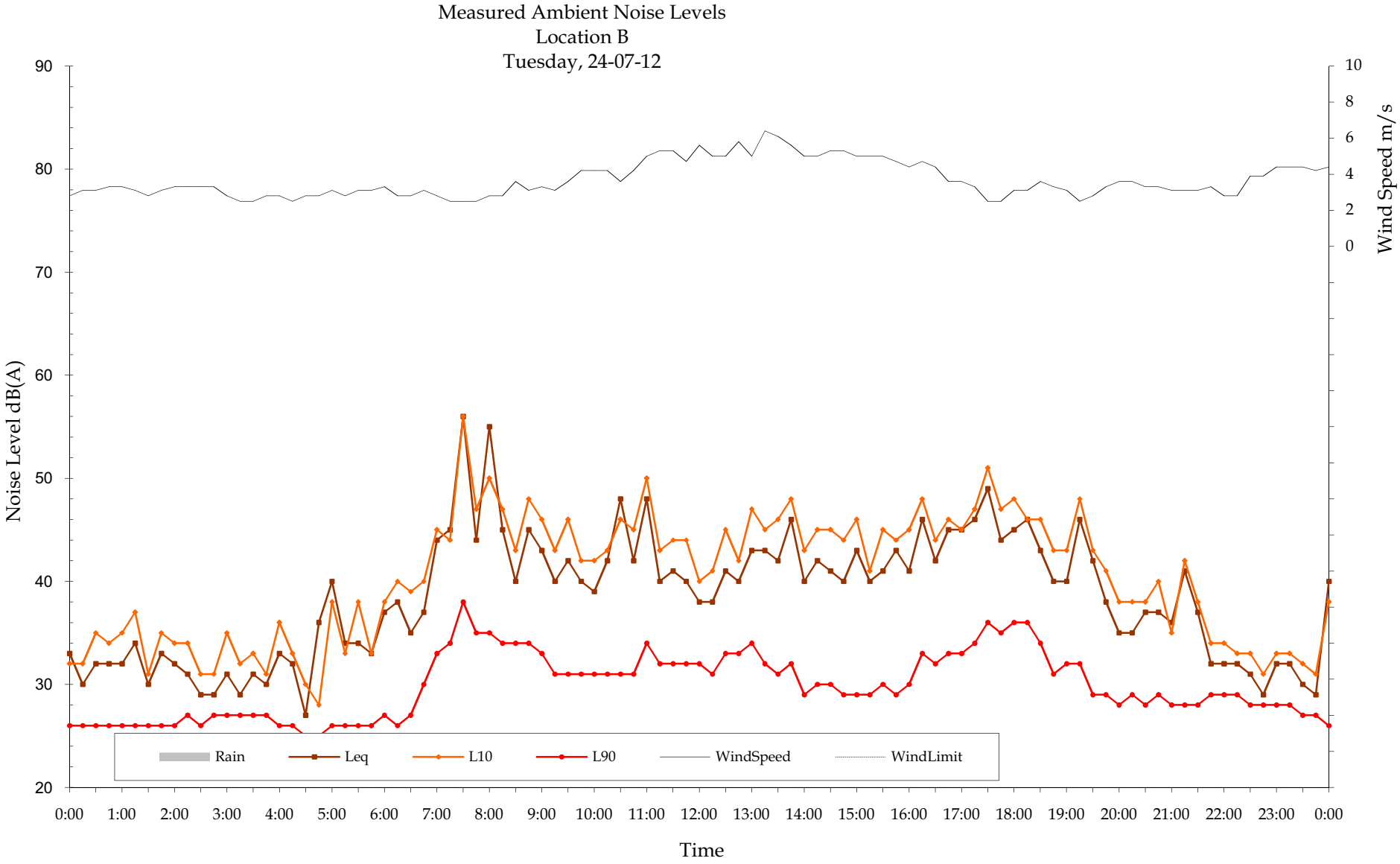
Measured Ambient Noise Levels
Location B
Tuesday, 24-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
80
70
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23:00
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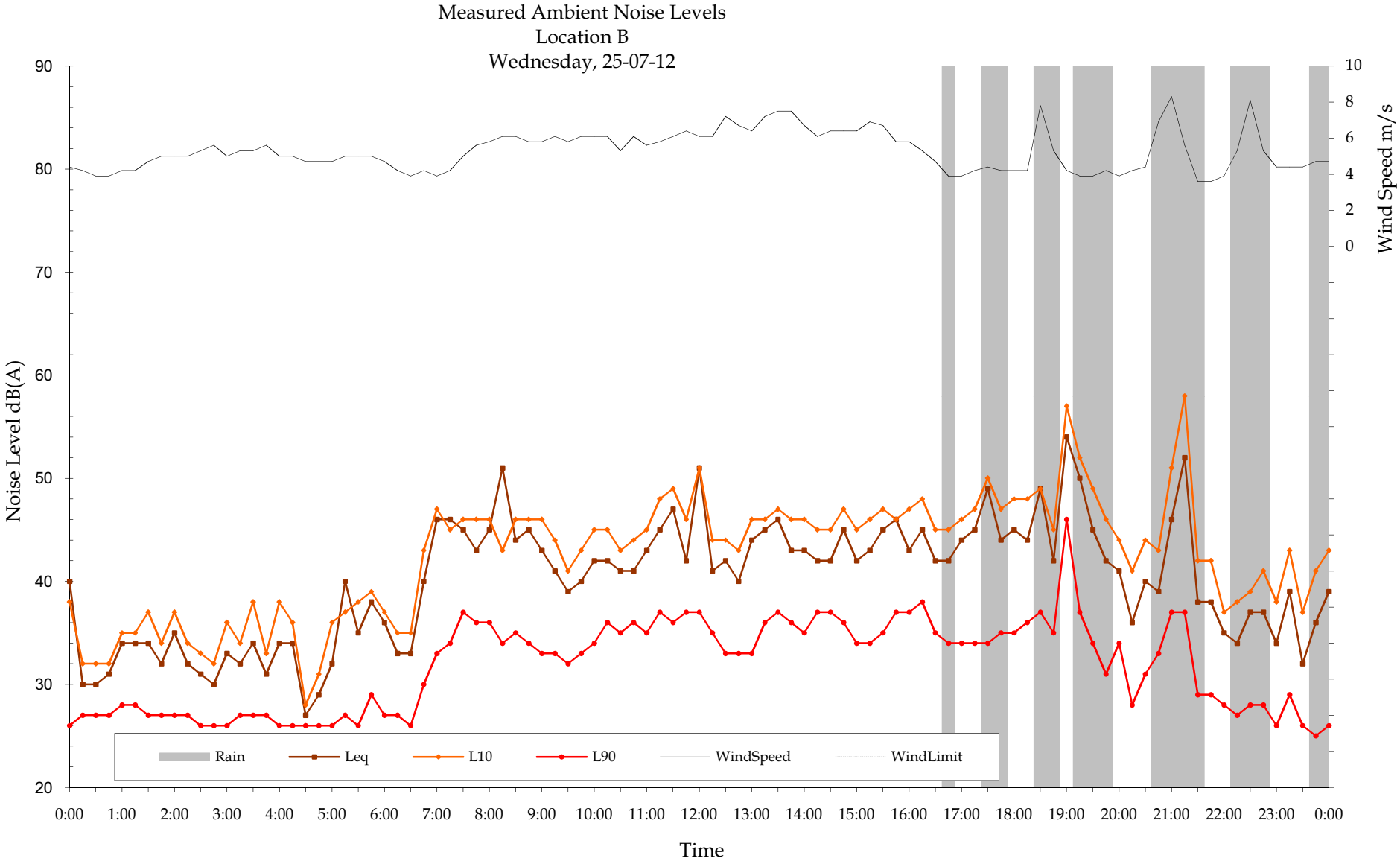
Measured Ambient Noise Levels
Location B
Wednesday, 25-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
80
70
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23:00
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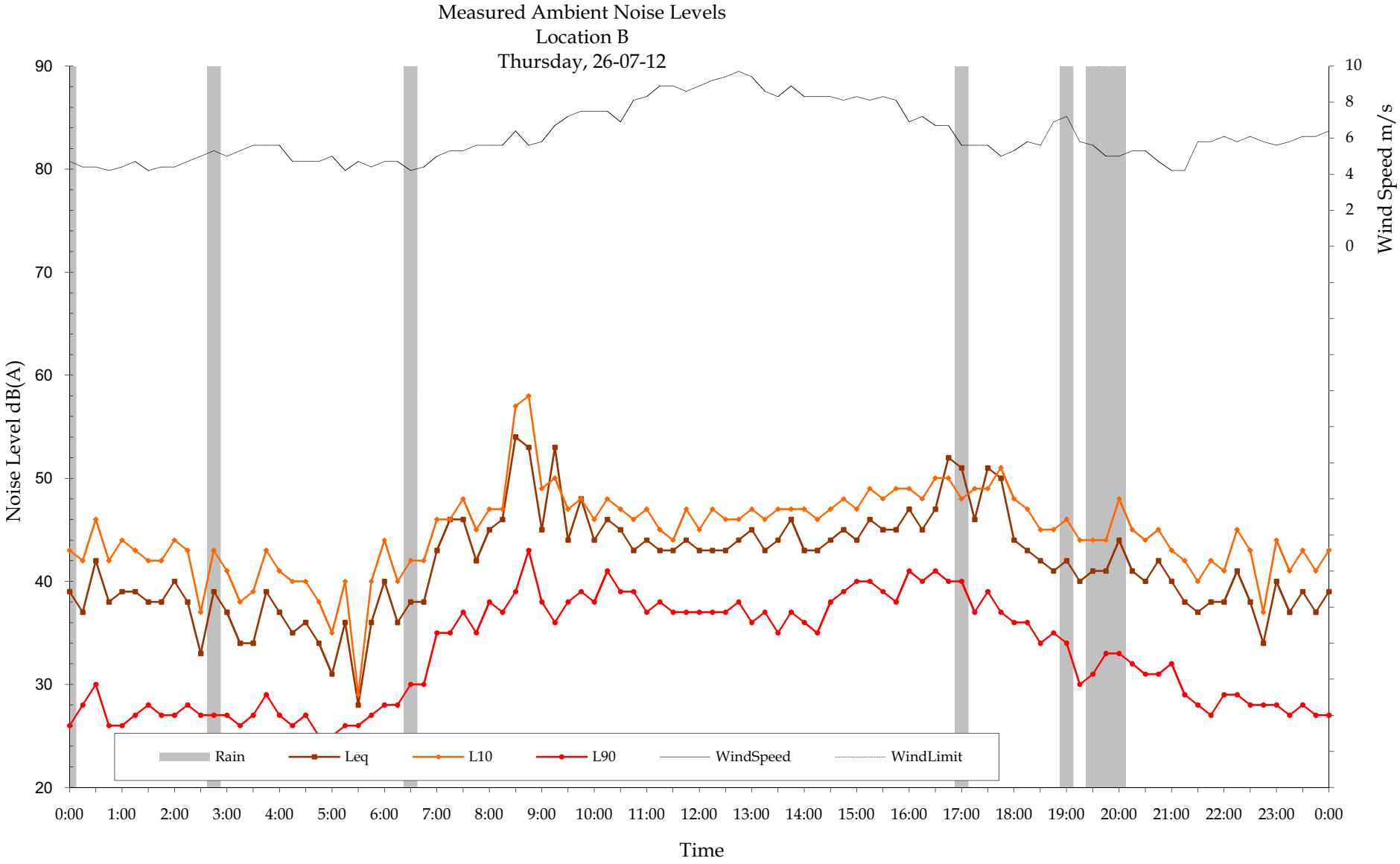
Measured Ambient Noise Levels
Location B
Thursday, 26-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
80
70
60
50
40
30
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10
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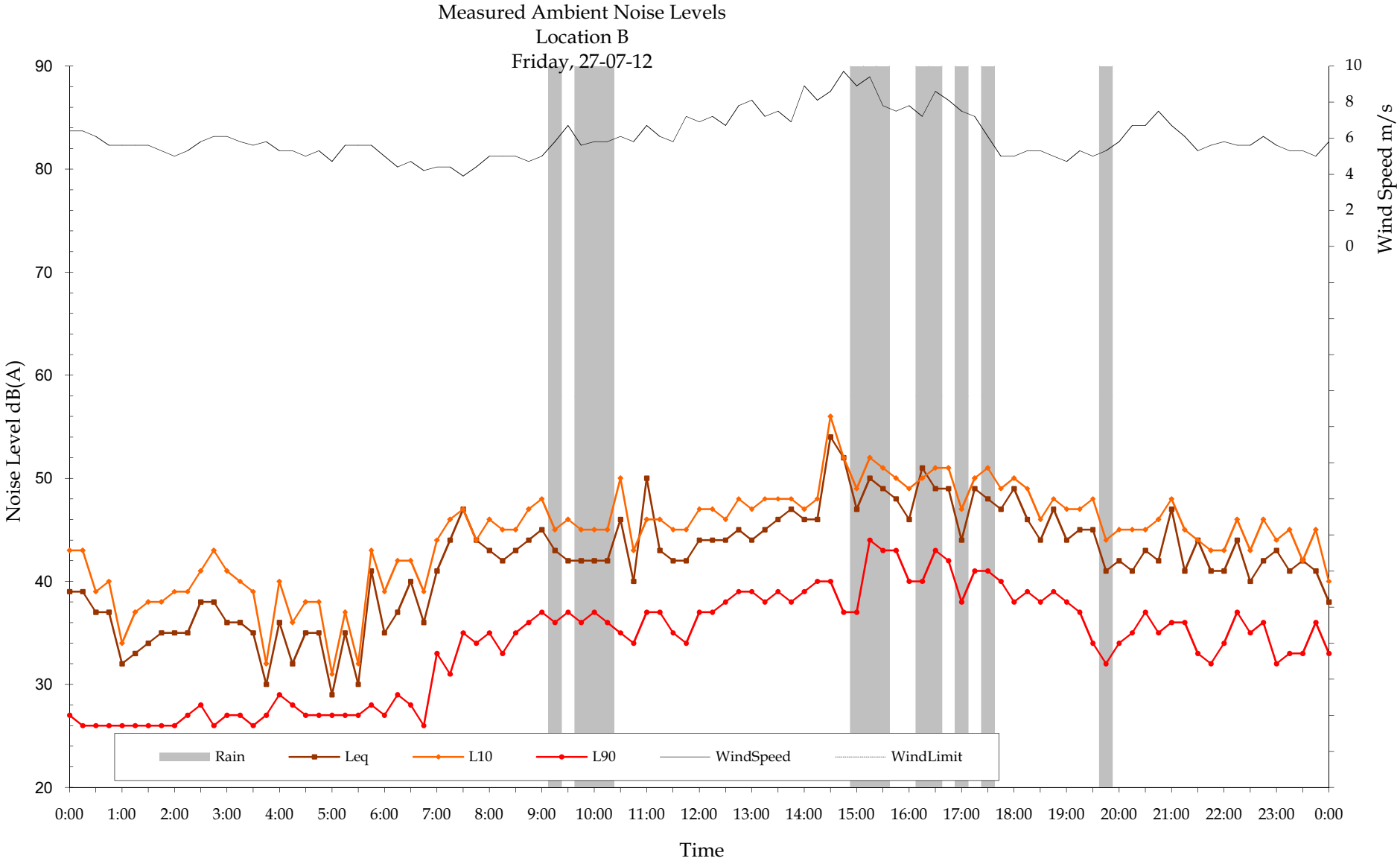
Measured Ambient Noise Levels
Location B
Friday, 27-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
80
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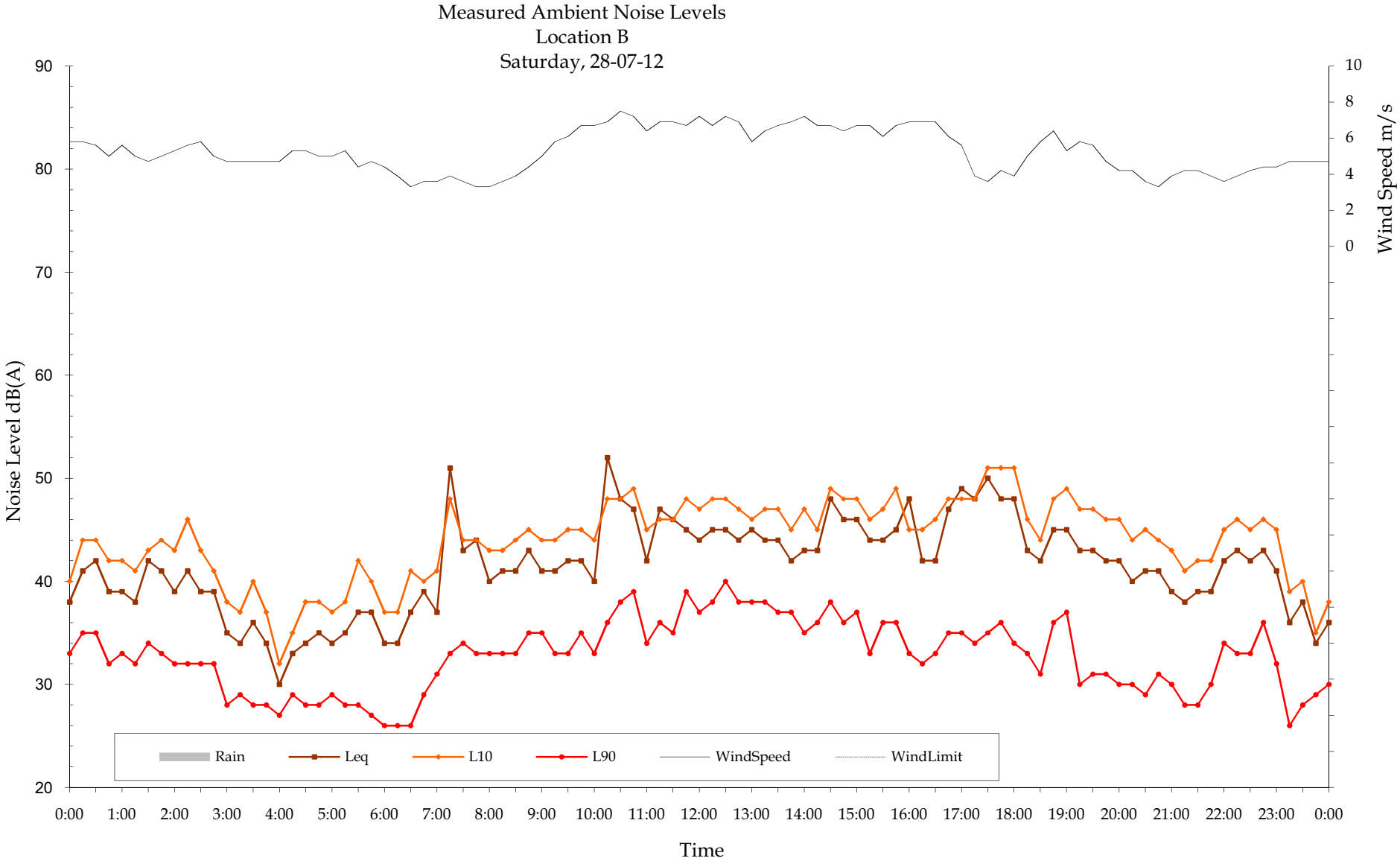
Measured Ambient Noise Levels
Location B
Saturday, 28-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
80
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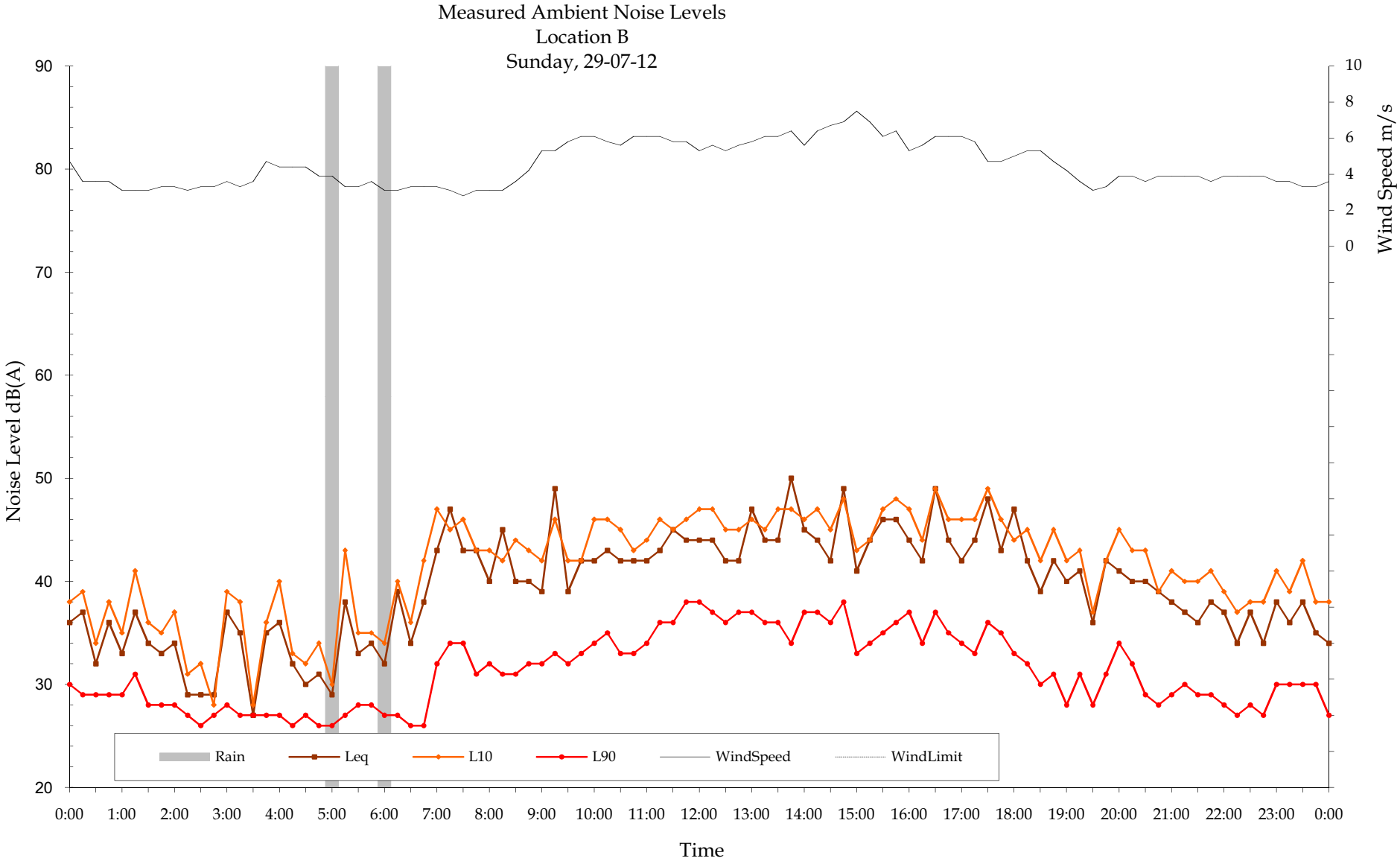
Measured Ambient Noise Levels
Location B
Sunday, 29-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
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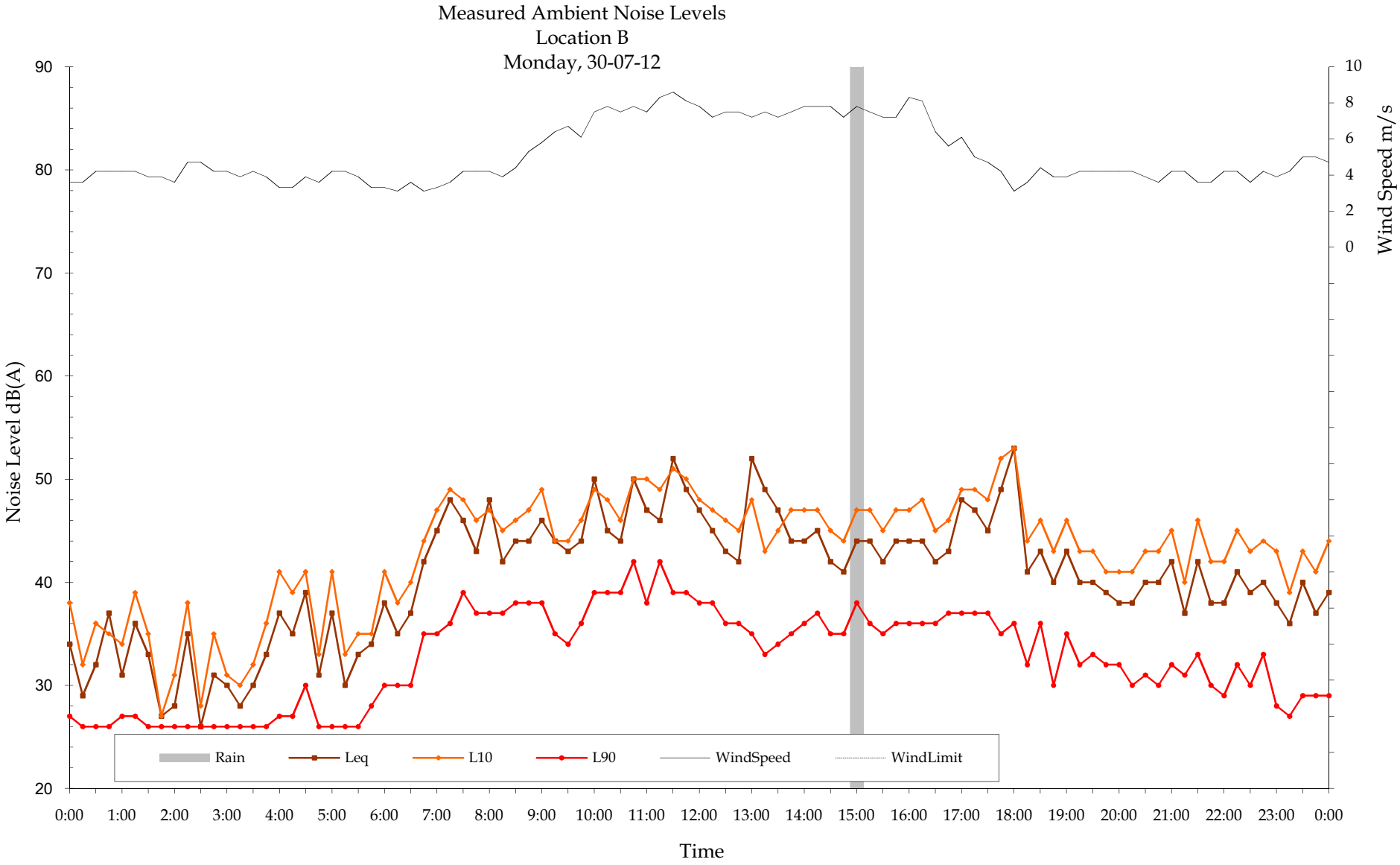
Measured Ambient Noise Levels
Location B
Monday, 30-07-12
Noise Level dB(A)
Wind Speed m/s
Time
90
80
70
60
50
40
30
20
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8
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23:00
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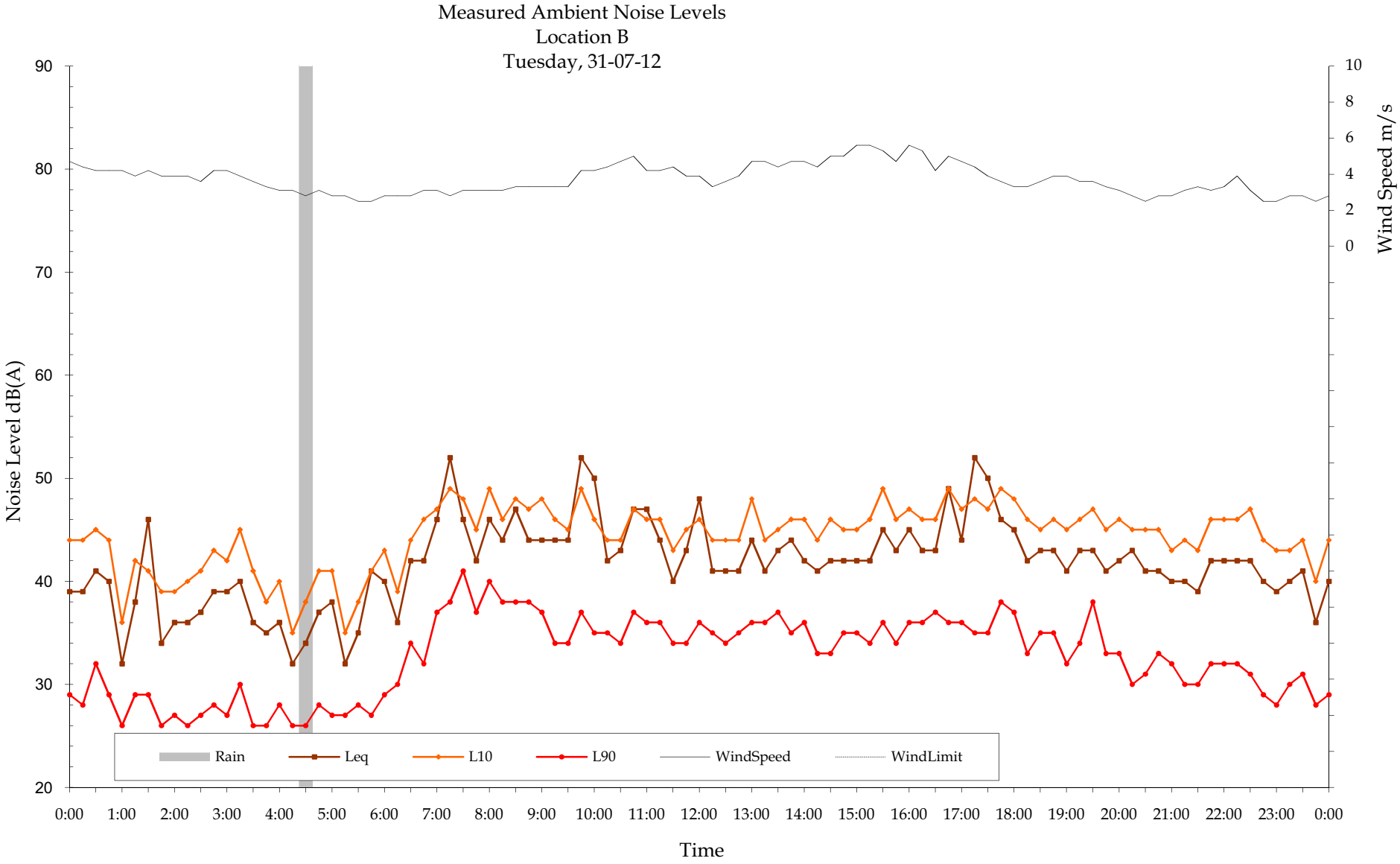
Rain
Leq
L10
L90
WindSpeed
WindLimit


Measured Ambient Noise Levels
Location B
Tuesday, 31-07-12
Noise Level dB(A)
Wind Speed m/s
Time
90
80
70
60
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40
30
20
10
8
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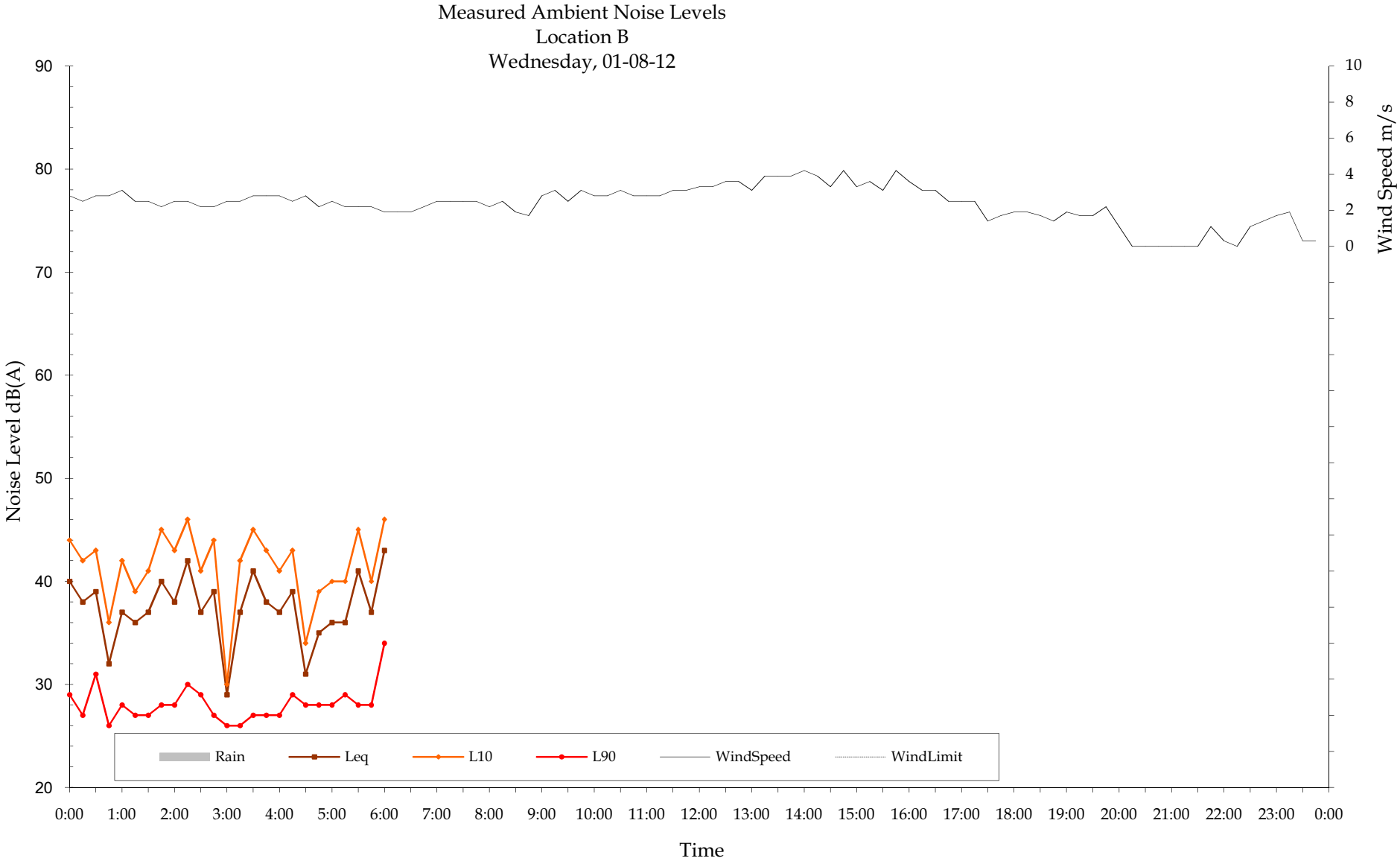
Rain
Leq
L10
L90
WindSpeed
WindLimit


Measured Ambient Noise Levels
Location B
Wednesday, 01-08-12
Noise Level dB(A)
Wind Speed m/s
Time
90
80
70
60
50
40
30
20
10
8
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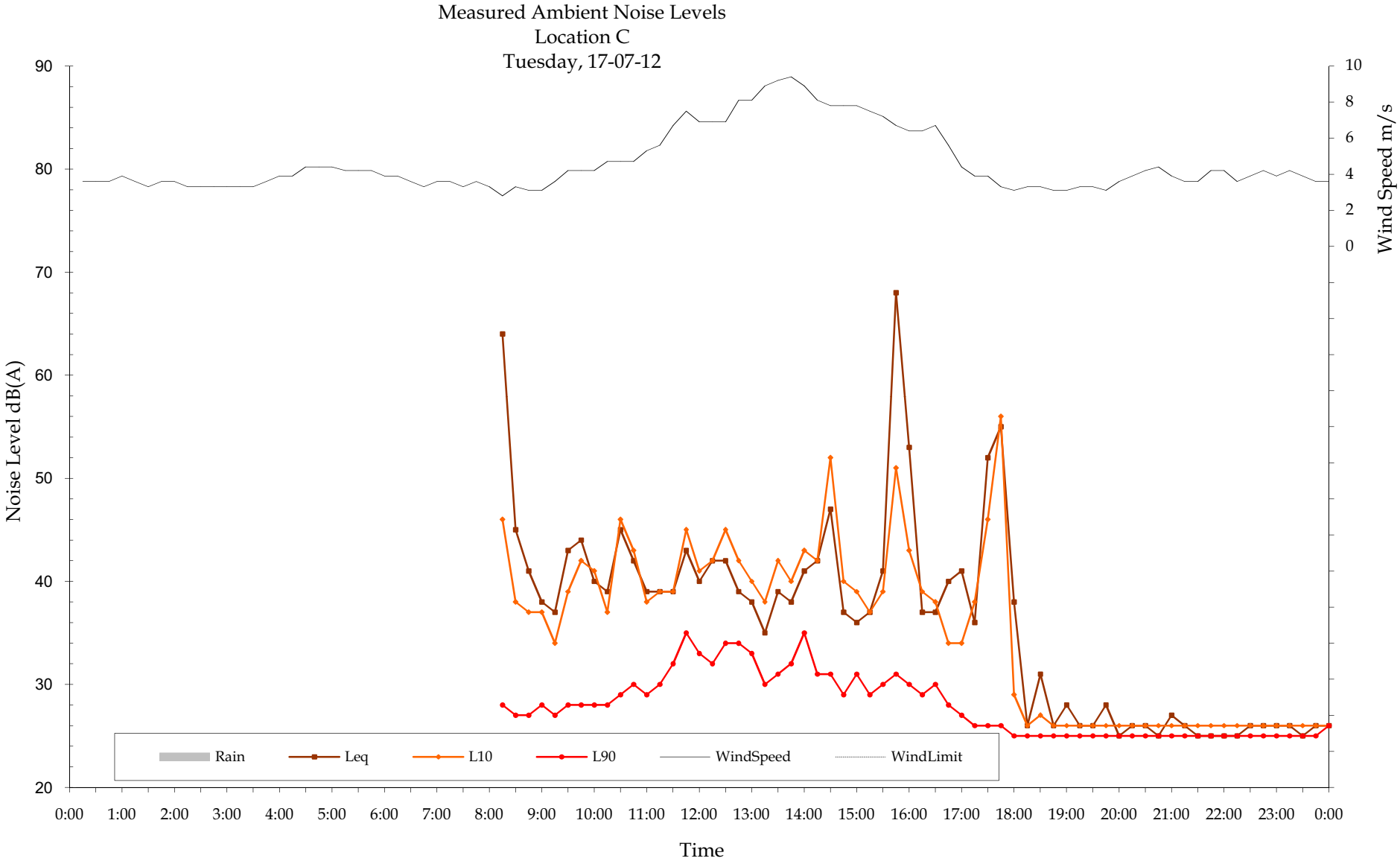
Rain
Leq
L10
L90
WindSpeed
WindLimit


Measured Ambient Noise Levels
Location C
Tuesday, 17-07-12
Noise Level dB(A)
Wind Speed m/s
Time
90
80
70
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40
30
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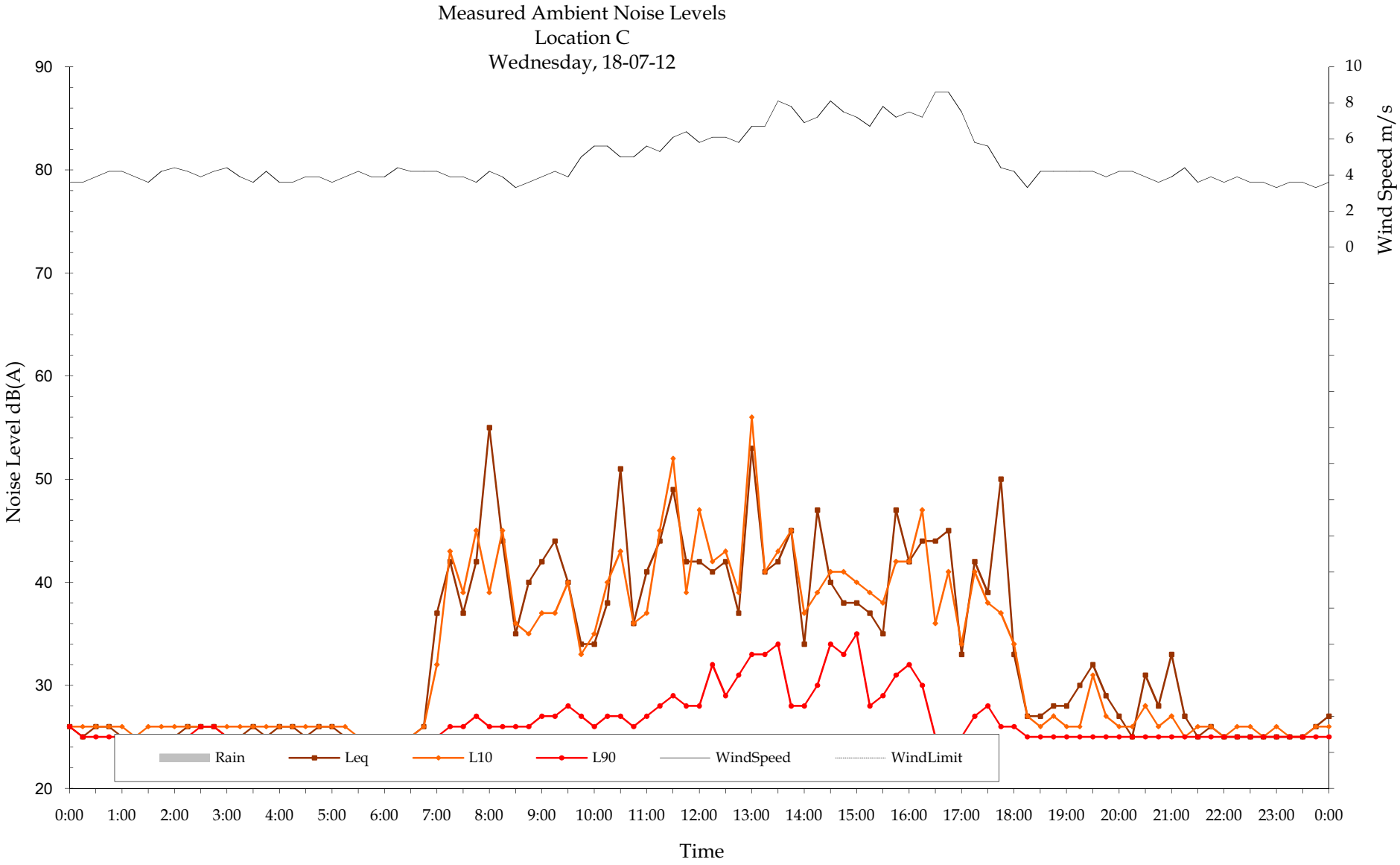
20:00
21:00
22:00
23:00
0:00
Rain
Leq
L10
L90
WindSpeed
WindLimit


Measured Ambient Noise Levels
Location C
Wednesday, 18-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
80
70
60
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40
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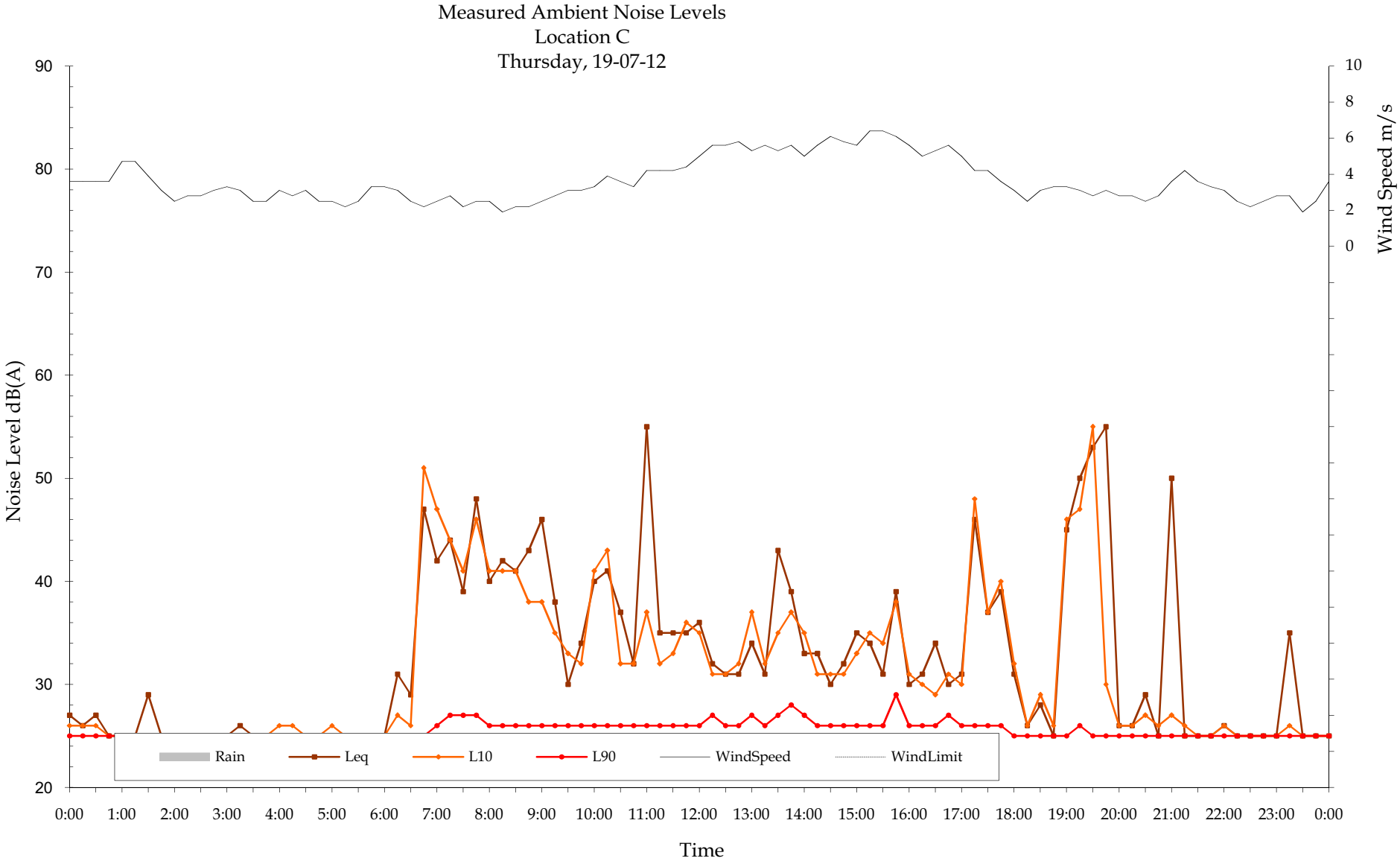
Measured Ambient Noise Levels
Location C
Thursday, 19-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
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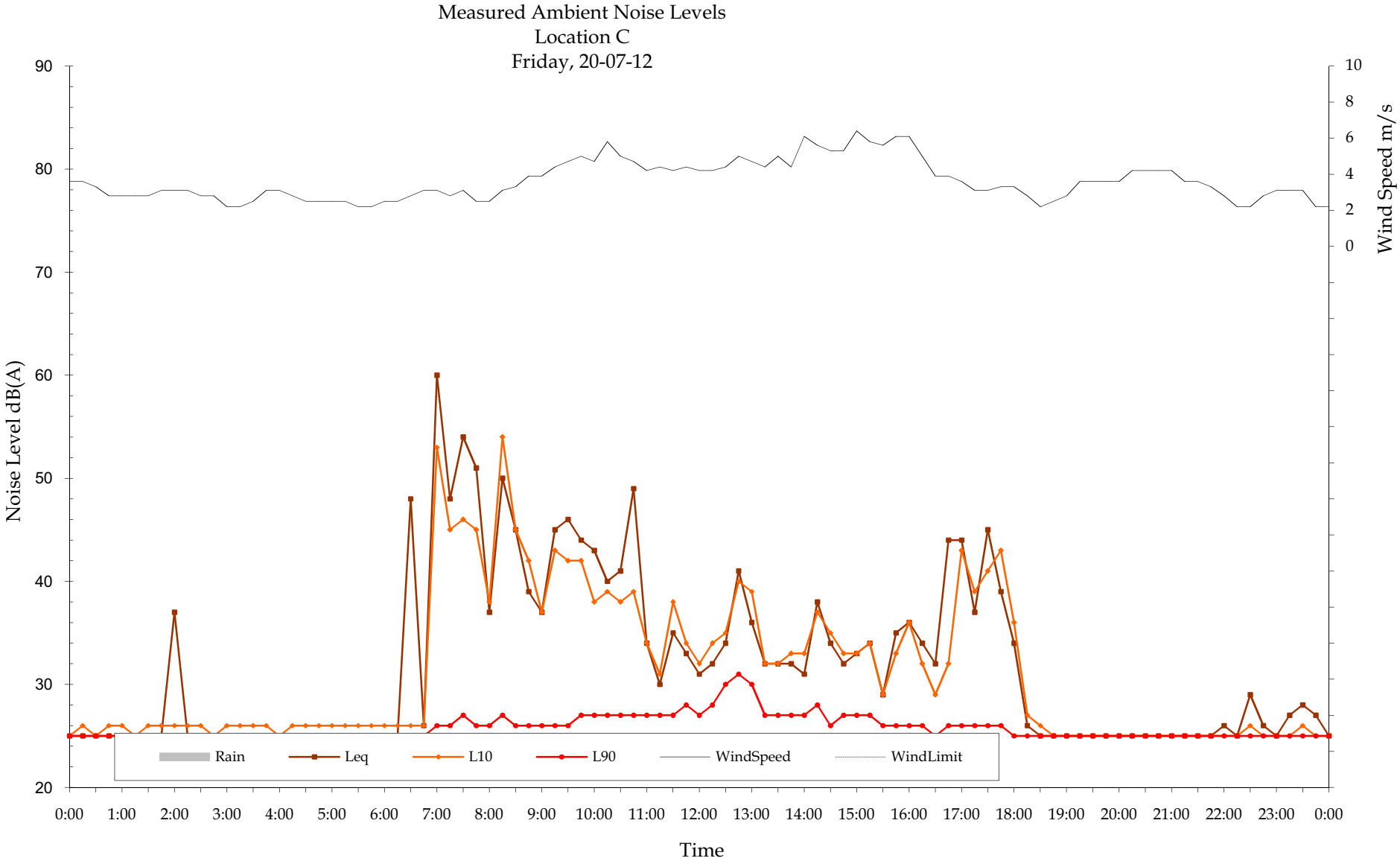
Measured Ambient Noise Levels
Location C
Friday, 20-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
80
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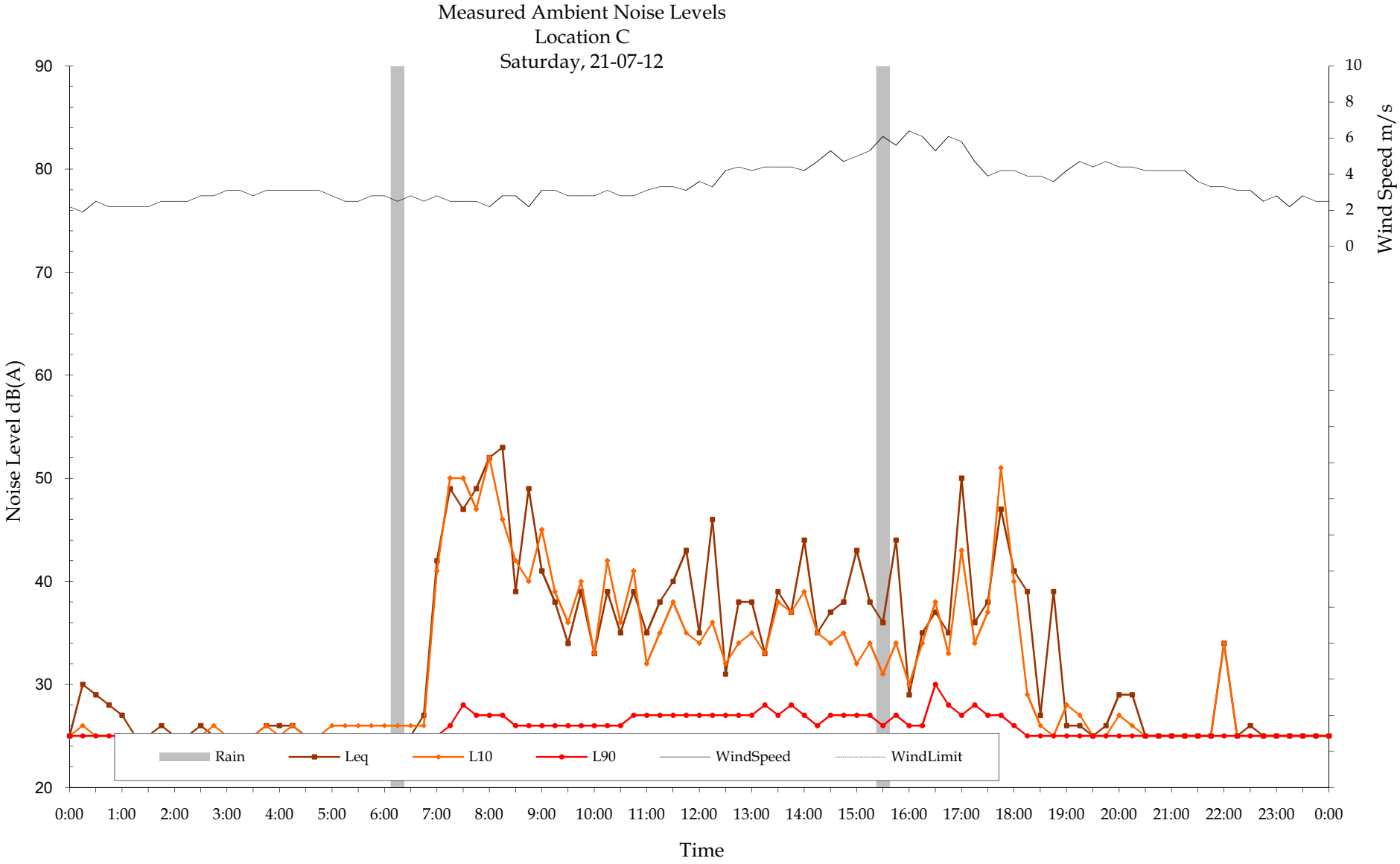
Measured Ambient Noise Levels
Location C
Saturday, 21-07-12
Noise Level dB(A)
Wind Speed m/s
Time
90
80
70
60
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40
30
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Rain
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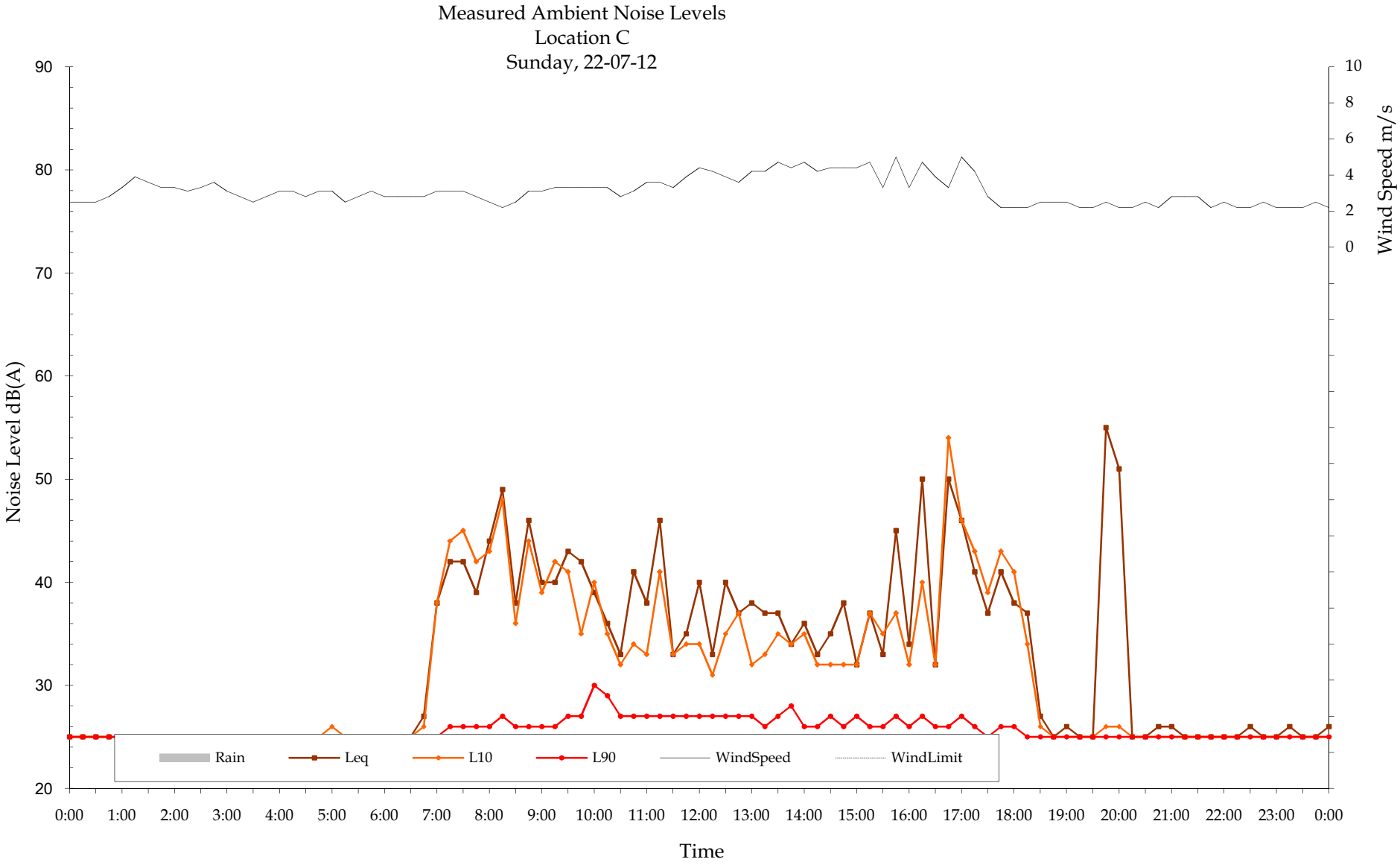
L10
L90
WindSpeed
WindLimit


Measured Ambient Noise Levels
Location C
Sunday, 22-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
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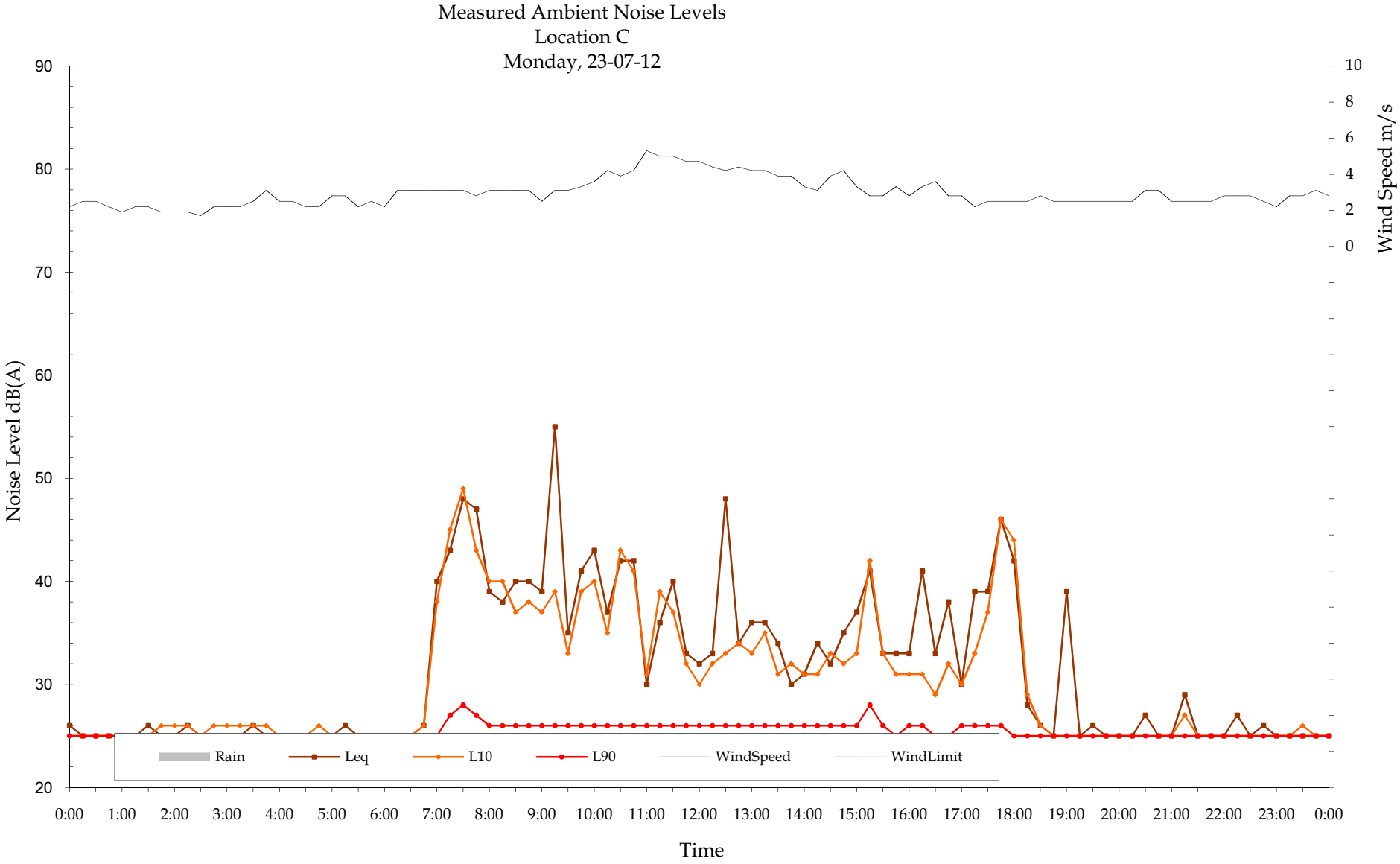
Measured Ambient Noise Levels
Location C
Monday, 23-07-12
Noise Level dB(A)
Wind Speed m/s
Time
90
80
70
60
50
40
30
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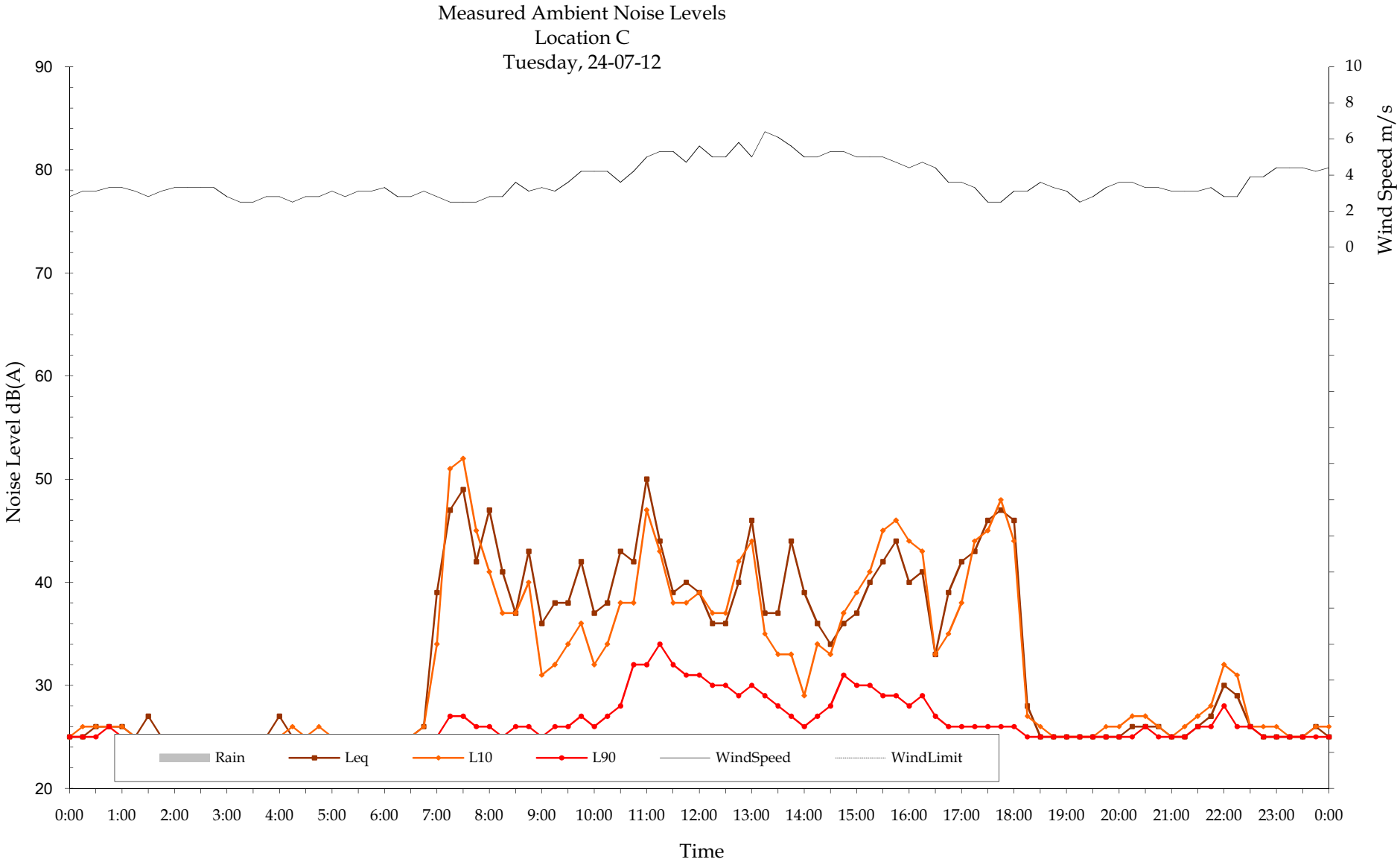
Rain
Leq
L10
L90
WindSpeed
WindLimit


Measured Ambient Noise Levels
Location C
Tuesday, 24-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
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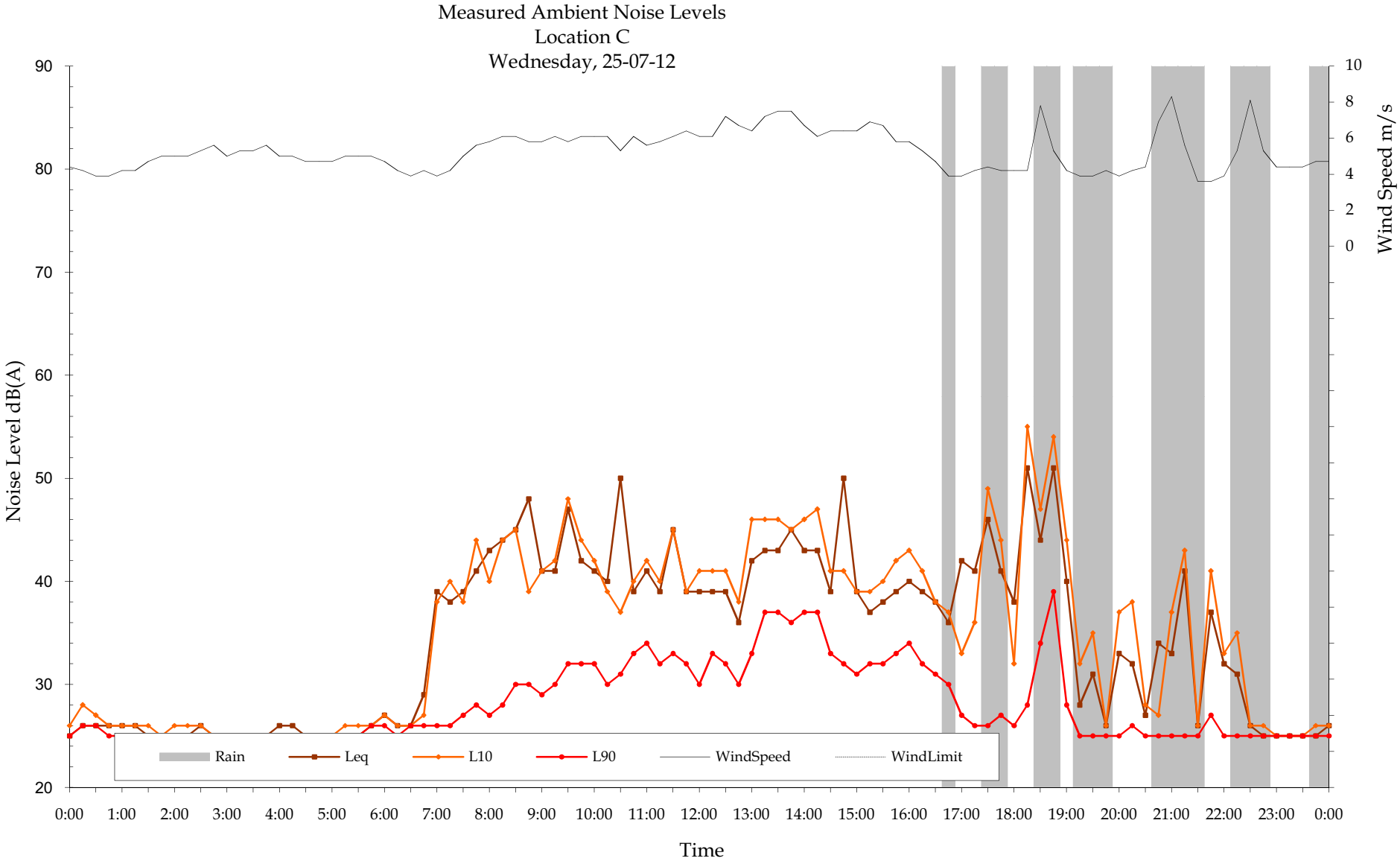
Measured Ambient Noise Levels
Location C
Wednesday, 25-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
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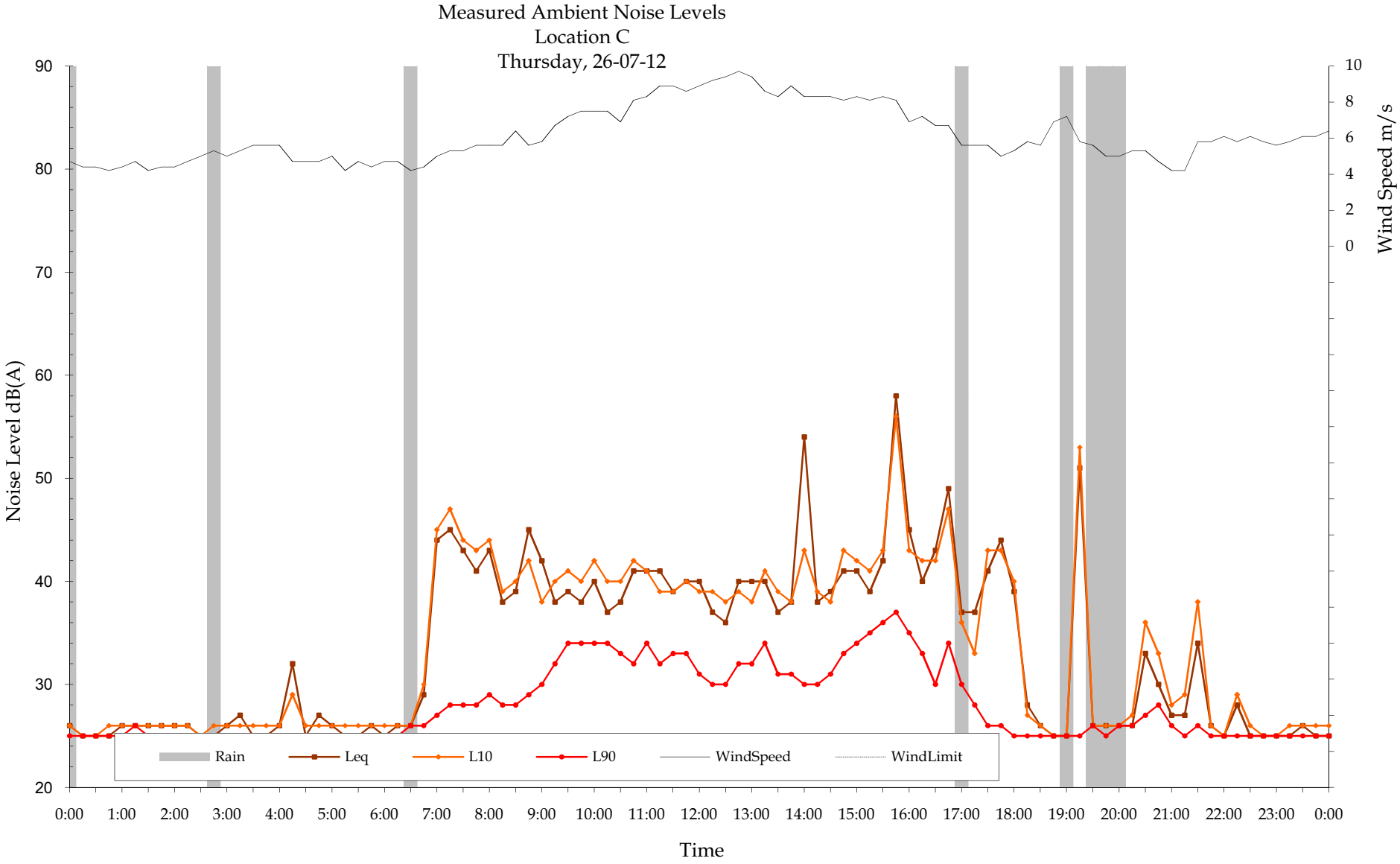
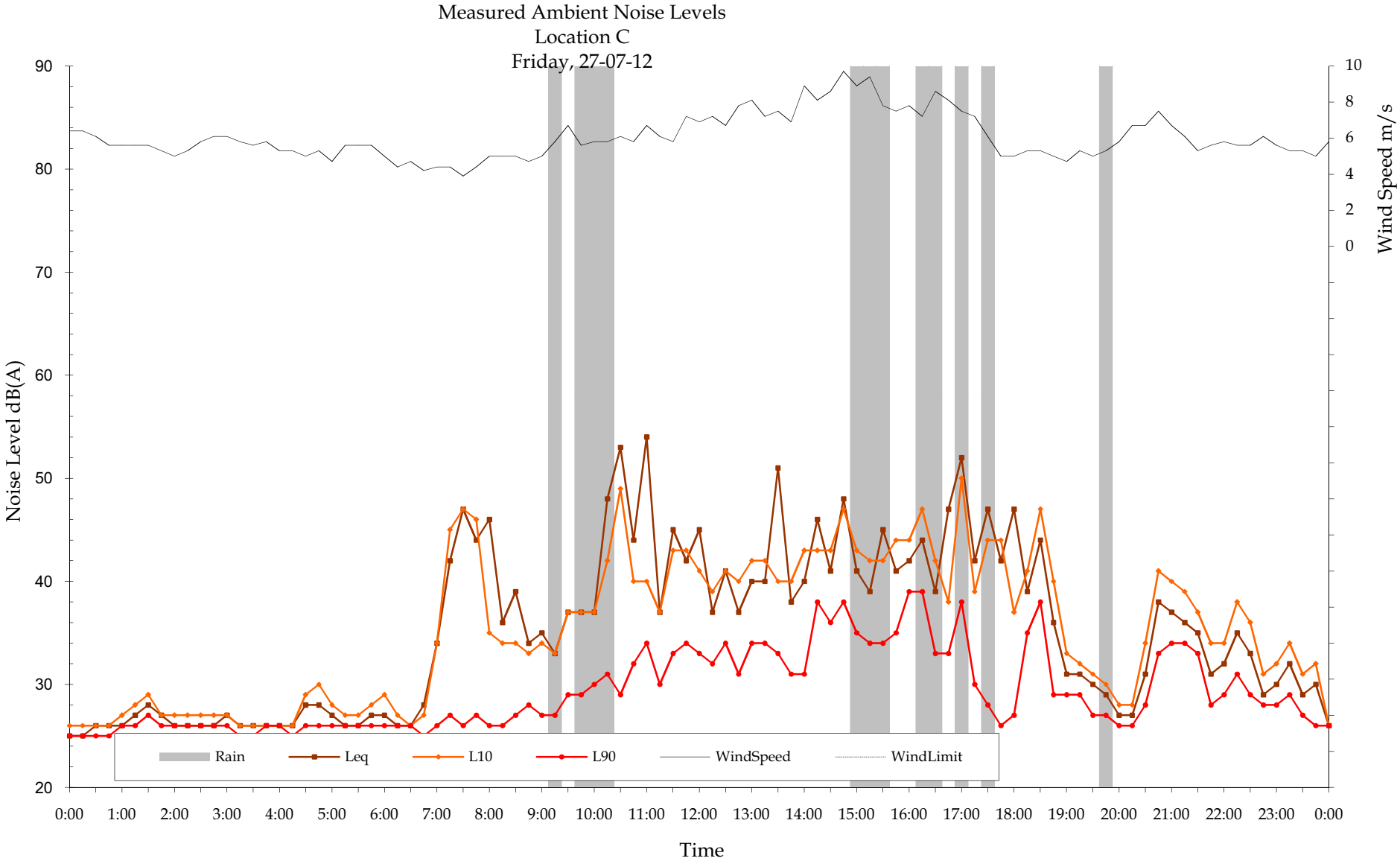
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00


Measured Ambient Noise Levels
Location C
Thursday, 26-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
80
70
60
50
40
30
20
10
8
6
4
2
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00


Measured Ambient Noise Levels
Location C
Friday, 27-07-12
Noise Level dB(A)
Wind Speed m/s
Time
Rain
Leq
L10
L90
WindSpeed
WindLimit
90
80
70
60
50
40
30
20
10
8
6
4
2
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
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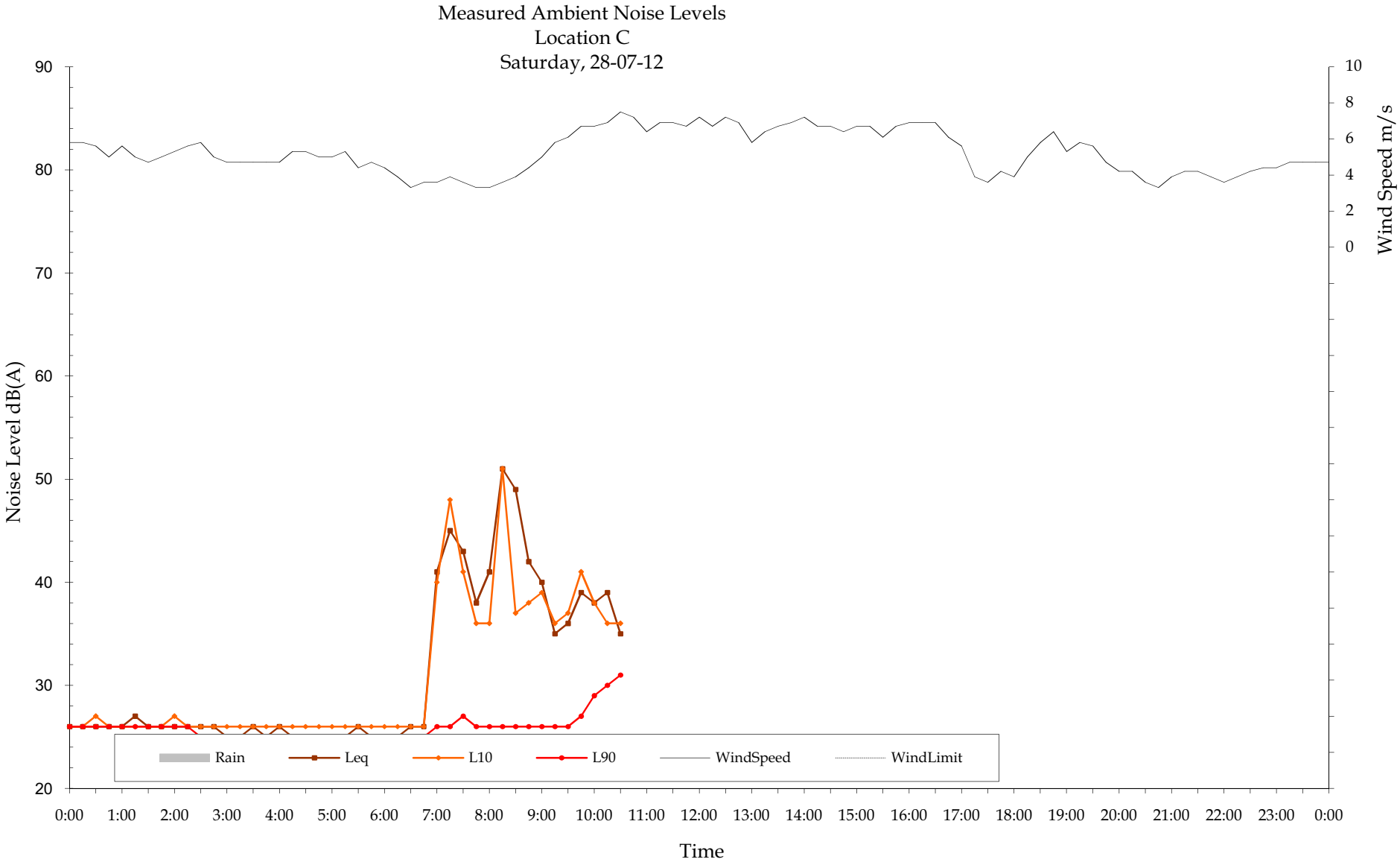
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00


Measured Ambient Noise Levels
Location C
Saturday, 28-07-12
Noise Level dB(A)
Wind Speed m/s
Time
90
80
70
60
50
40
30
20
10
8
6
4
2
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Rain
Leq
L10
L90
WindSpeed
WindLimit

Appendix B

INP wind data analysis

Table B.1 Daytime percentage of wind speed (vector at 22.5ointervals)

Direction	Winter	Autumn	Spring	Summer
22.5°	14.3	12.9	9.3	8.5
45°	14.8	12.4	9.9	8.8
67.5°	16.7	12.4	10.8	10.5
90°	19.1	12.7	12.5	11.9
112.5°	21.2	14.1	14	13.7
135°	24.4	15.5	14.2	13.9
157.5°	25	17.5	14.7	14
180°	23.9	17.4	14.6	14
202.5°	21.1	18.6	14	13.9
225°	19.8	18.7	12.8	12.6
247.5°	19.6	16.7	11.8	11.5
270°	18.6	11.6	10.4	9.8
292.5°	17.7	9.5	8.8	8.1
315°	16.9	9.2	9	8.3
337.5°	16.8	10.3	8.5	8.2
360°	16.2	11.2	8.7	8

Notes: 1.Bold highlight denotes occurrence of 30 % and greater.

Table B.2 Evening percentage of wind speed (vector at 22.5°intervals)

Direction	Winter	Autumn	Spring	Summer
22.5°	20.9	15.9	15	11.5
45°	20.6	16.8	16.6	14.4
67.5°	22.5	21.8	20.6	20.5
90°	28.3	26	24.4	22.7
112.5°	**34.8**	**34.8**	29.8	24.2
135°	**45.6**	**38.9**	**33.8**	26.4
157.5°	**48.4**	**40**	**36.8**	**30.5**
180°	**45.5**	**39.2**	**36.5**	**31.3**
202.5°	**42.9**	**35.9**	**34.8**	**32.4**
225°	**40.8**	**35.6**	**30.3**	29.9
247.5°	**35.4**	**34.4**	26.4	20.5
270°	**30.9**	23.9	20.9	11.4
292.5°	28.2	13.1	11.5	8.4
315°	25.4	9.2	8.1	6.7
337.5°	28.2	10.2	9.8	7.2
360°	25.5	13.3	10.1	9.2

Notes: 1.Bold highlight denotes occurrence of 30 % and greater.

Table B.3 Night percentage of wind speed (vector at 22.5°intervals)

Direction	Winter	Autumn	Spring	Summer
22.5°	23.7	17.5	15.2	14.6
45°	22.6	18.2	17.7	16.1
67.5°	22.6	21	19.6	19.3
90°	27.2	25.5	23.2	20.2
112.5°	**36.2**	**30.6**	27.5	26.2
135°	**41.9**	**31.7**	29.5	29.3
157.5°	**41**	**31**	**30.5**	29.1
180°	**38.9**	**30.5**	29.6	27.6
202.5°	**38.4**	**32.6**	28.6	25.4
225°	**36.7**	**34.2**	27.9	22.6
247.5°	**33.3**	27.5	24.5	15.8
270°	25.6	19.7	16.4	7.7
292.5°	24.5	16.6	9.7	6.2
315°	24.6	14.6	8.9	8.4
337.5°	25.3	13.2	10.3	10
360°	24.5	15.3	12.2	11.4

Notes: 1.Bold highlight denotes occurrence of 30 % and greater.

Appendix C

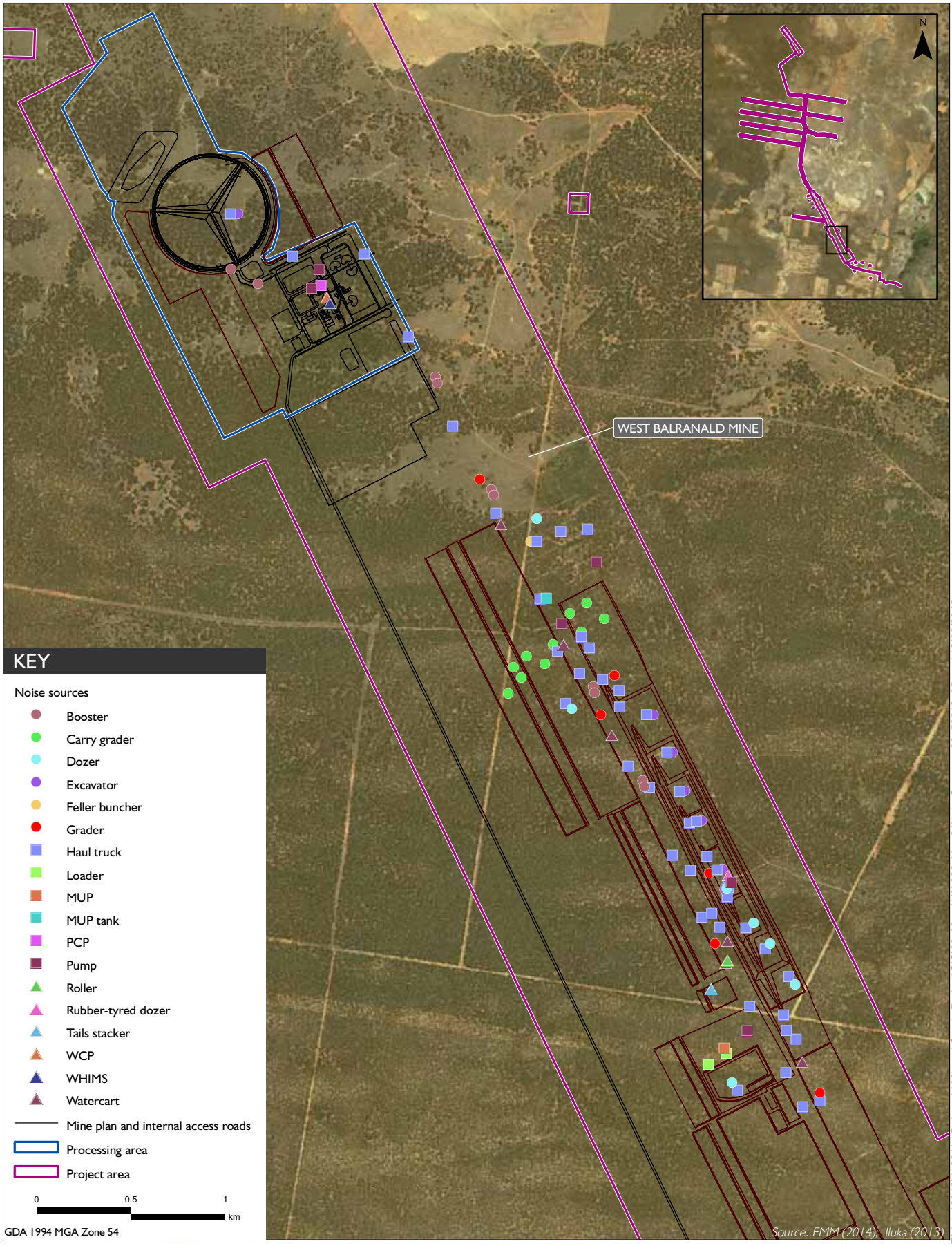
Plant and equipment sound power levels, dB(A)

Table C.1 Plant and equipment sound power levels

Item	Octave band centre frequency, dB								Overall, dB	Overall, dB(A)
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz		
Feller Buncher	120	115	121	115	113	106	99	94	128	118
Dozer	107	121	114	113	110	108	98	90	123	115
Carry Grader	111	118	114	112	111	109	102	102	122	116
R996 Excavator	119	114	120	114	112	105	98	93	127	117
CAT789/793 Haul Truck	111	116	119	114	112	109	103	97	122	117
24M Grader	109	116	112	110	109	107	100	100	120	114
CAT785C Water Cart	111	112	114	111	110	108	101	95	120	115
Roller	107	102	104	99	94	89	81	73	110	101
Rubber-tyred Dozer	110	124	117	116	113	111	101	93	126	118
CAT992/998 Loader	115	119	117	116	112	109	103	98	124	118
Pre-Concentrator Plant	131	123	111	104	103	95	89	85	132	111
Wet Concentrator Plant	131	123	111	104	103	95	89	85	132	111
WHIMS	131	123	111	104	103	95	89	85	132	111
MU10	122	117	105	98	97	89	83	73	123	105
MUP	122	117	105	98	97	89	83	73	123	105
Booster	112	107	95	88	87	79	73	63	113	95
Pump	112	107	95	88	87	79	73	63	113	95
Road train	117	106	101	97	97	93	88	84	118	102
Tails stacker	112	107	95	88	87	79	73	63	113	95
Screen Unit	122	117	105	98	97	89	83	73	123	105

Appendix D

Modelled plant and equipment locations



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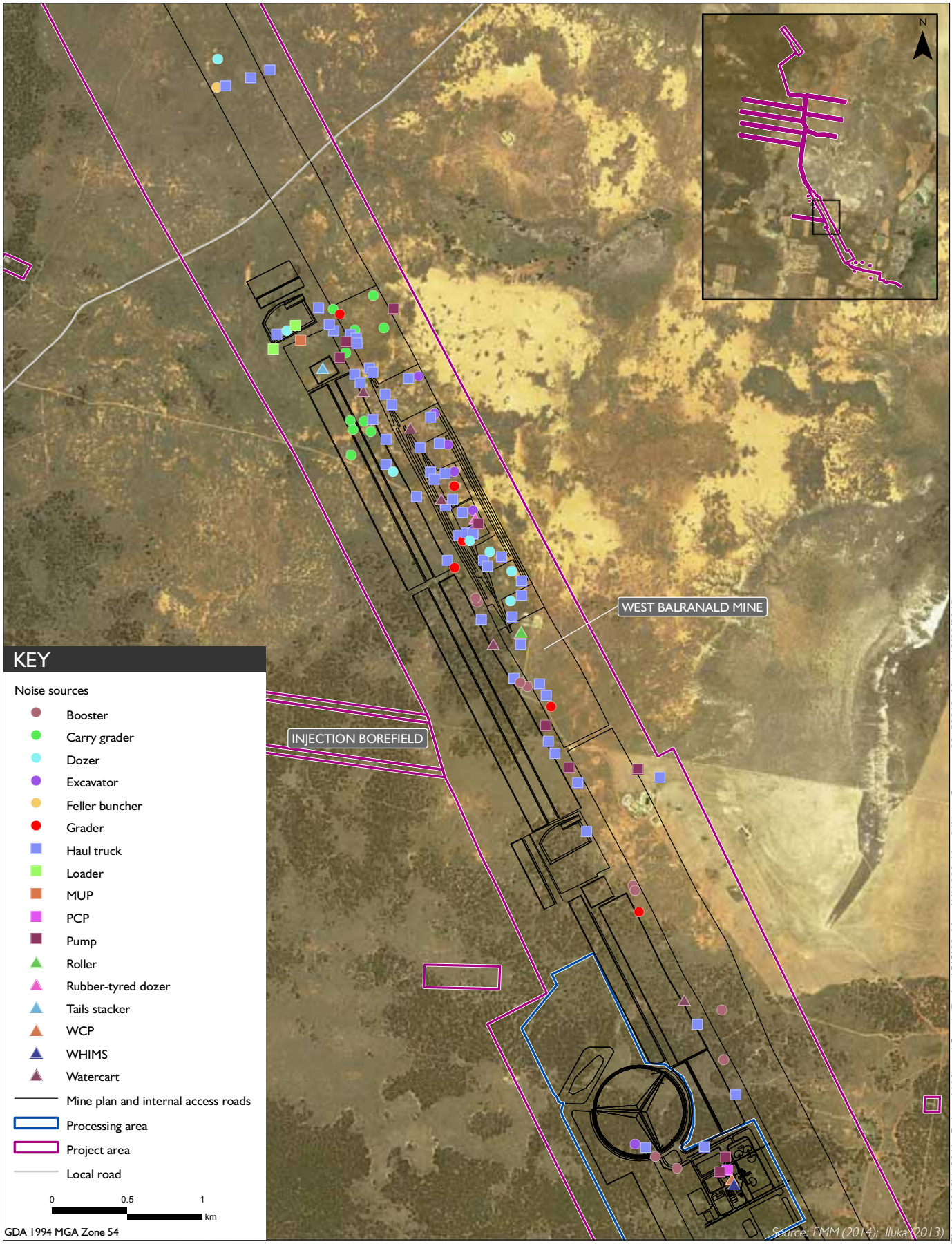
Modelled noise source locations - Year 1 - West Balranald

Balranald Mineral Sands Project
Noise Impact Assessment
Figure D1



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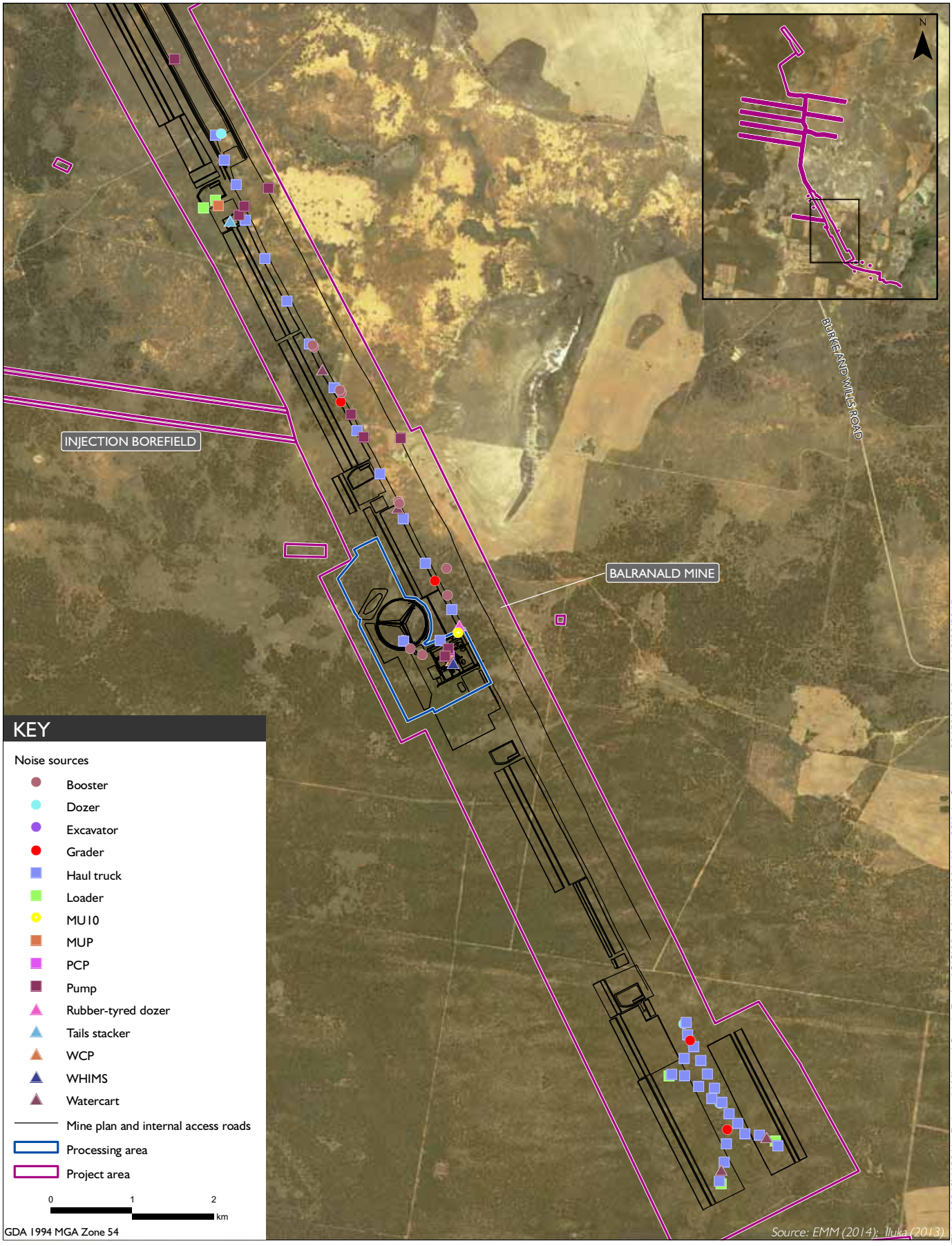
Modelled noise source locations - Year 4 - West Balranald

Balranald Mineral Sands Project

Noise Impact Assessment

Figure D2



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EMM

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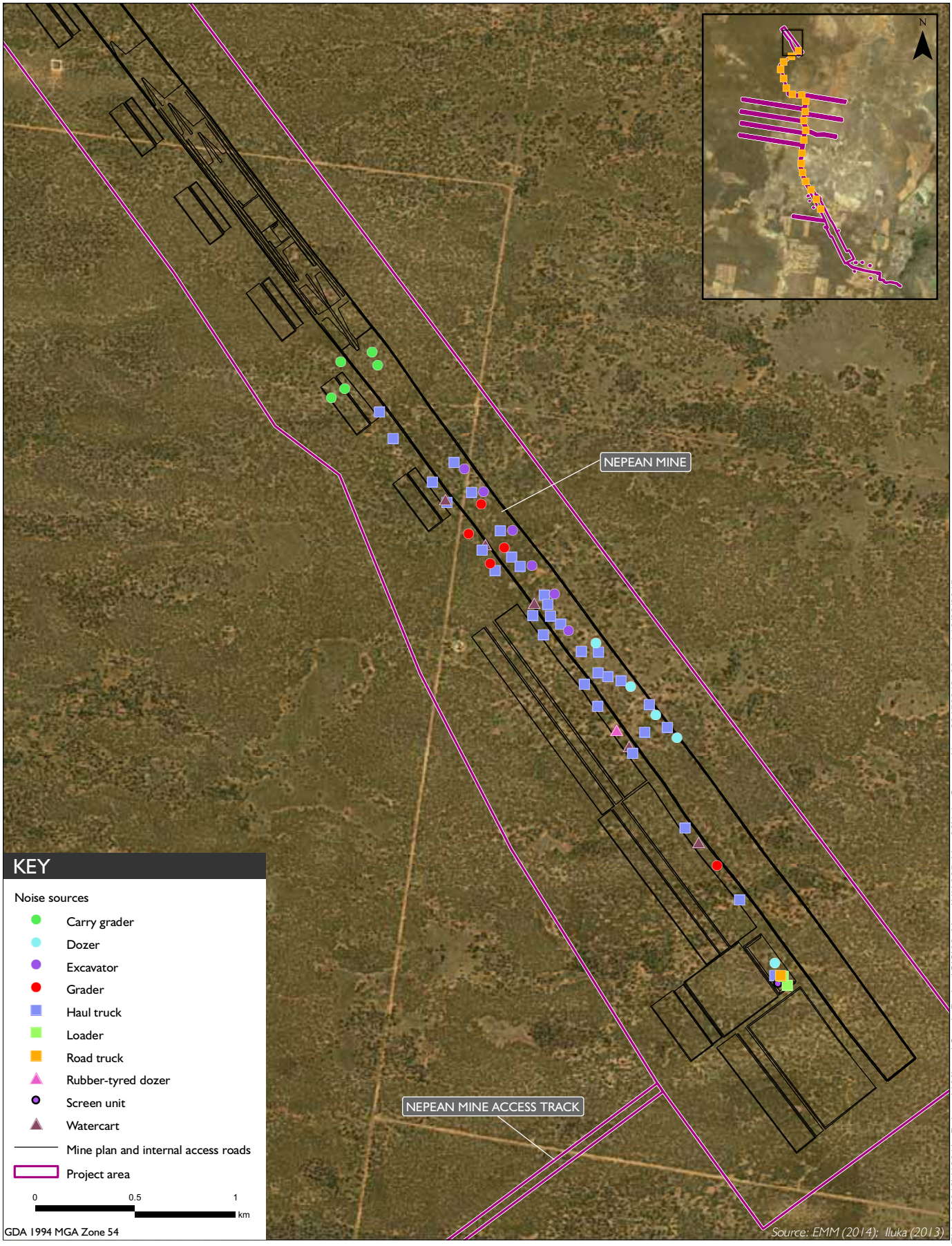
Modelled noise source locations - Year 8 - West Balranald

Balranald Mineral Sands Project
Noise Impact Assessment
Figure D3



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Modelled noise source locations - Year 8 - Nepean

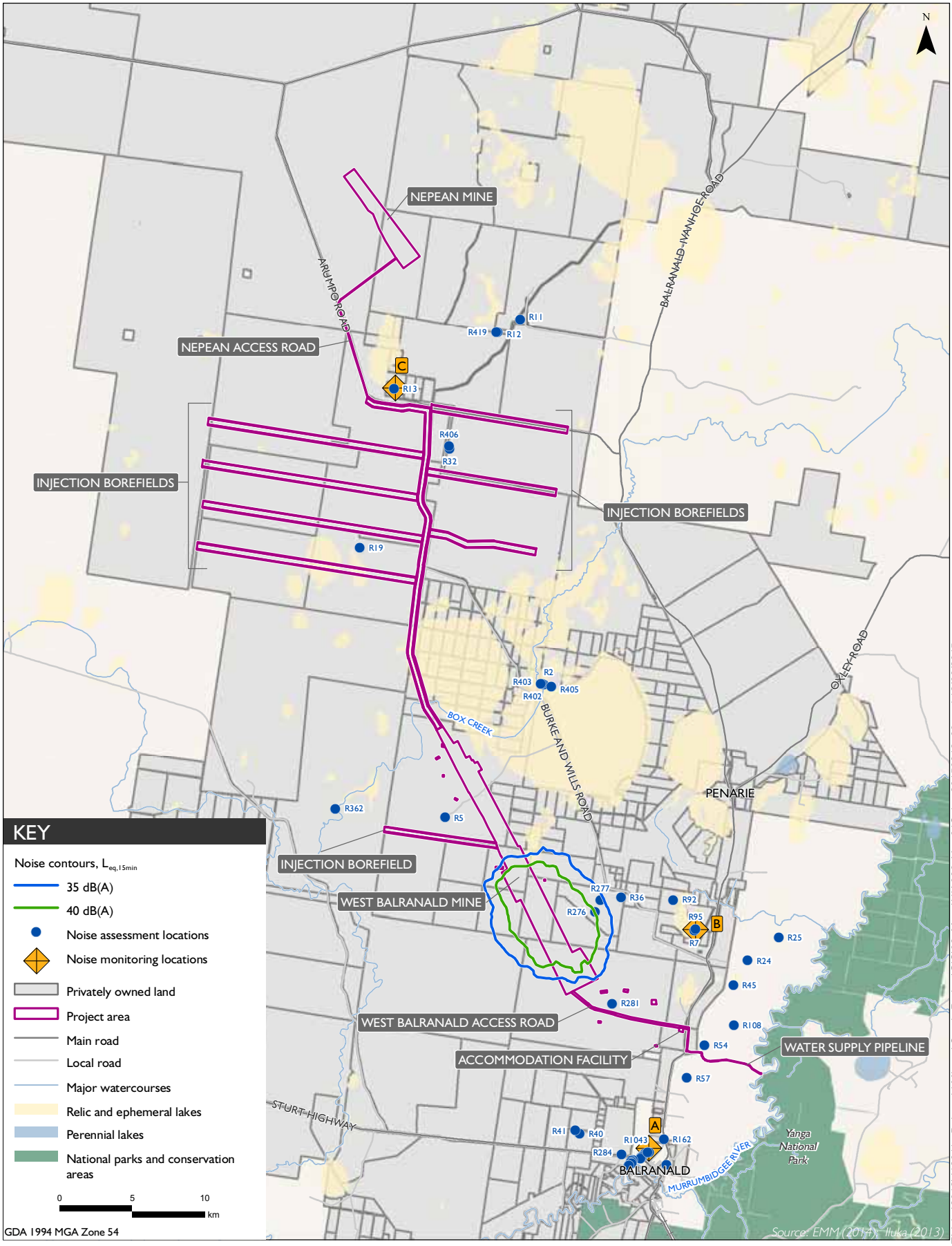
Balranald Mineral Sands Project

Noise Impact Assessment

Figure D4

Appendix E

Noise contours, $L_{eq,15min}$ dB(A)



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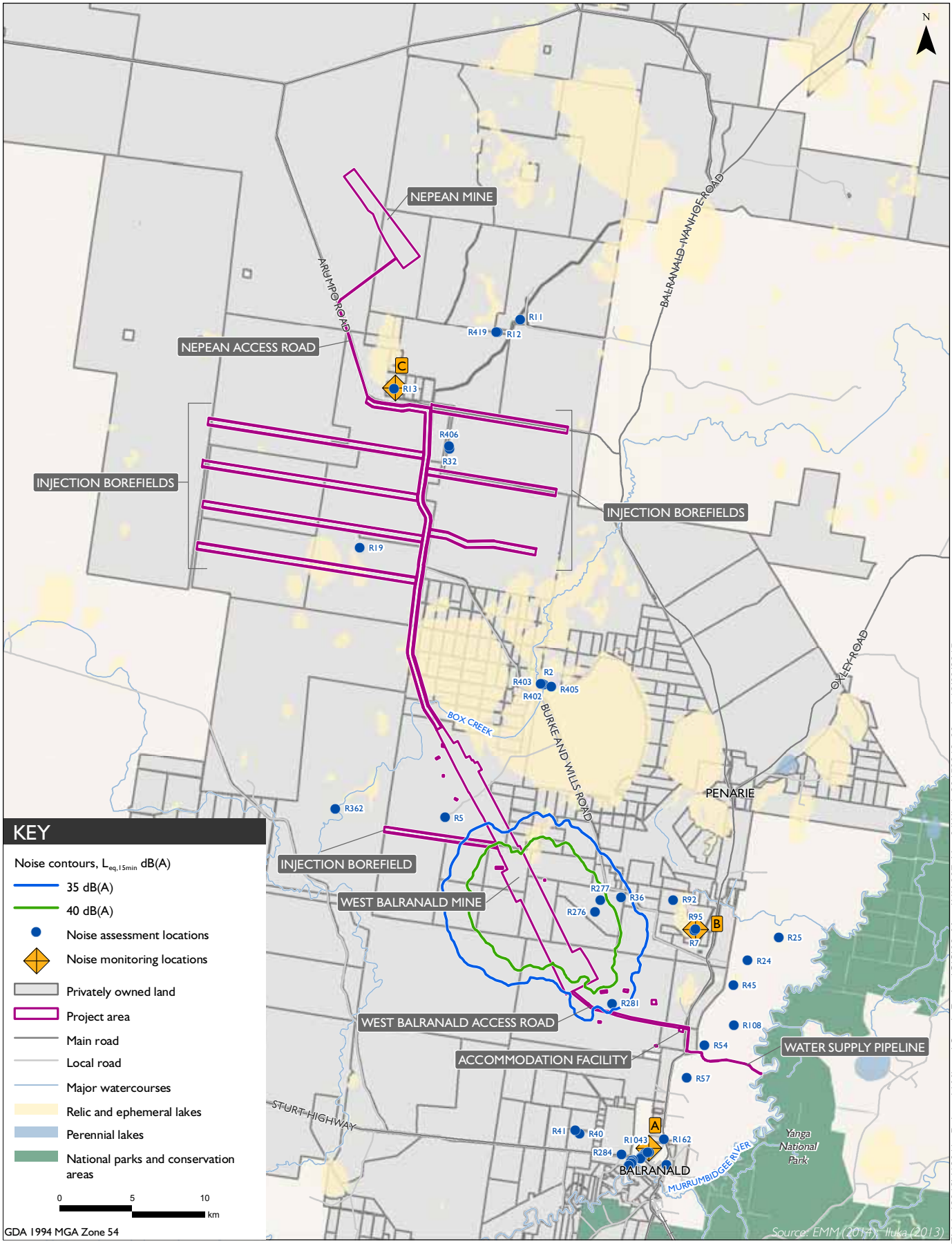
Year 1 operational noise levels - calm, $L_{eq(15\text{-}min)}$dB(A)

Balranald Mineral Sands Project

Noise Impact Assessment

Figure E1

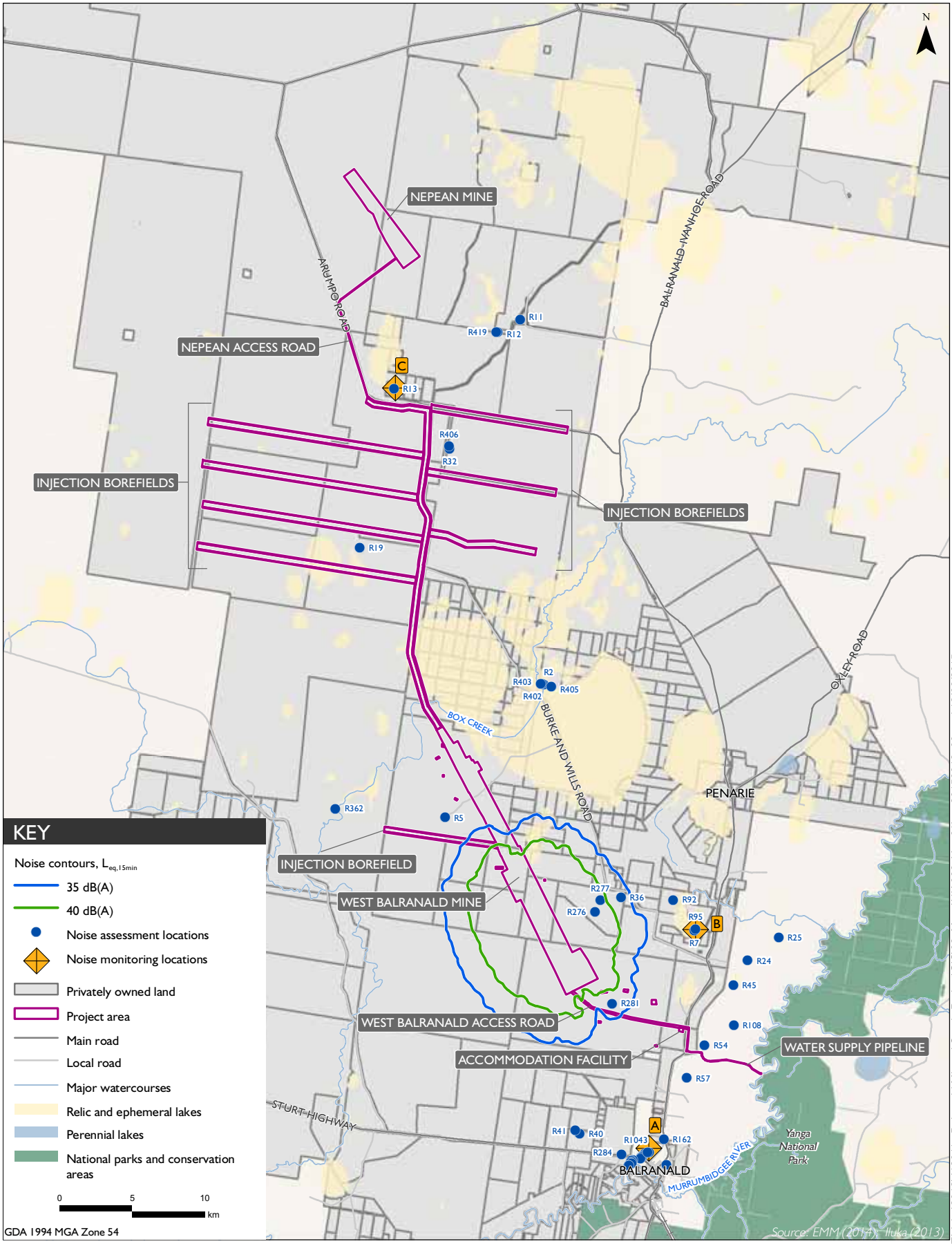


Year 1 operational noise levels - prevailing winds, $L_{eq(15\text{-}min)}$dB(A)

Balranald Mineral Sands Project

Noise Impact Assessment

Figure E2

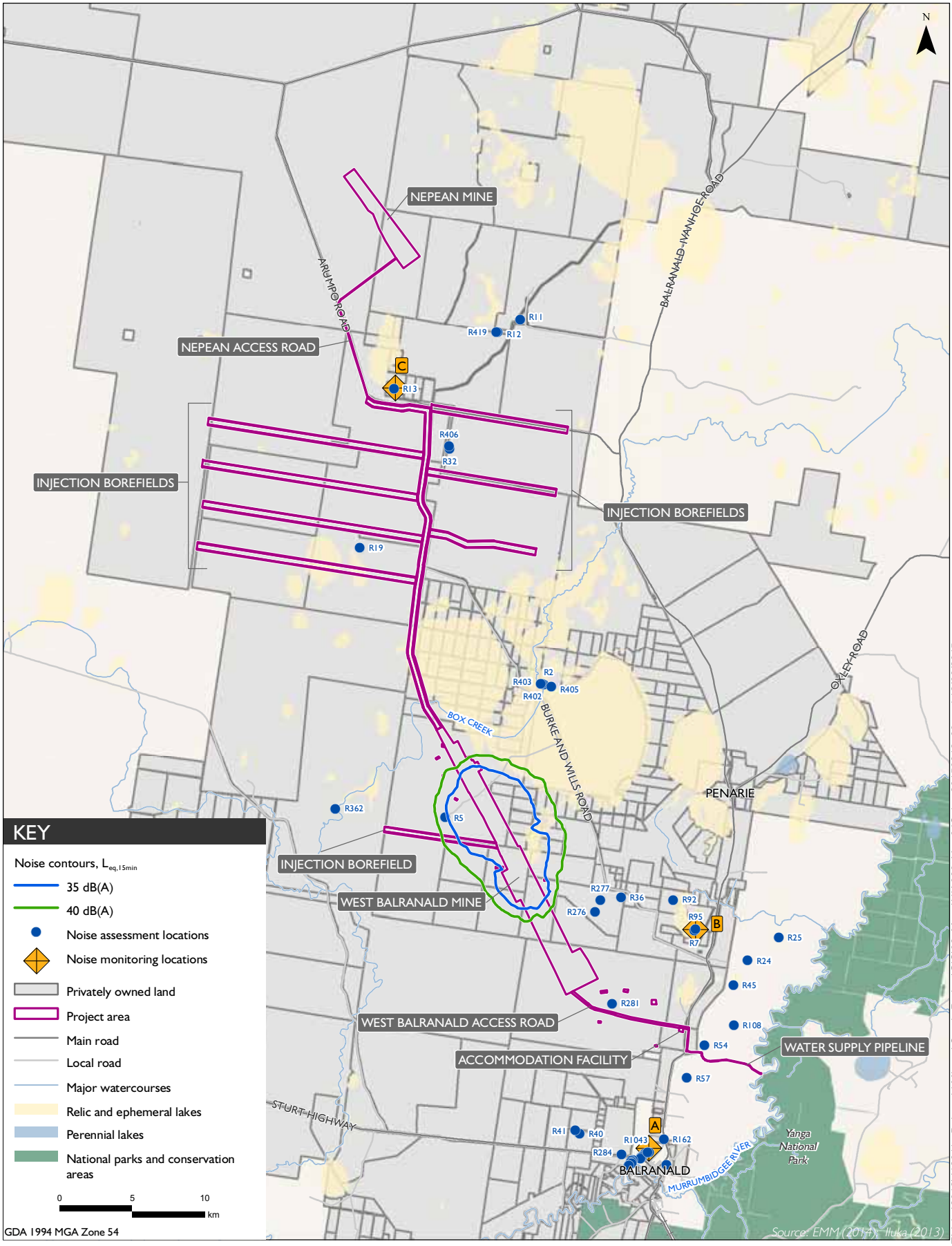


Year 1 operational noise levels - temperature inversion, $L_{eq(15\text{-}min)}$dB(A)

Balranald Mineral Sands Project

Noise Impact Assessment

Figure E3



EMM

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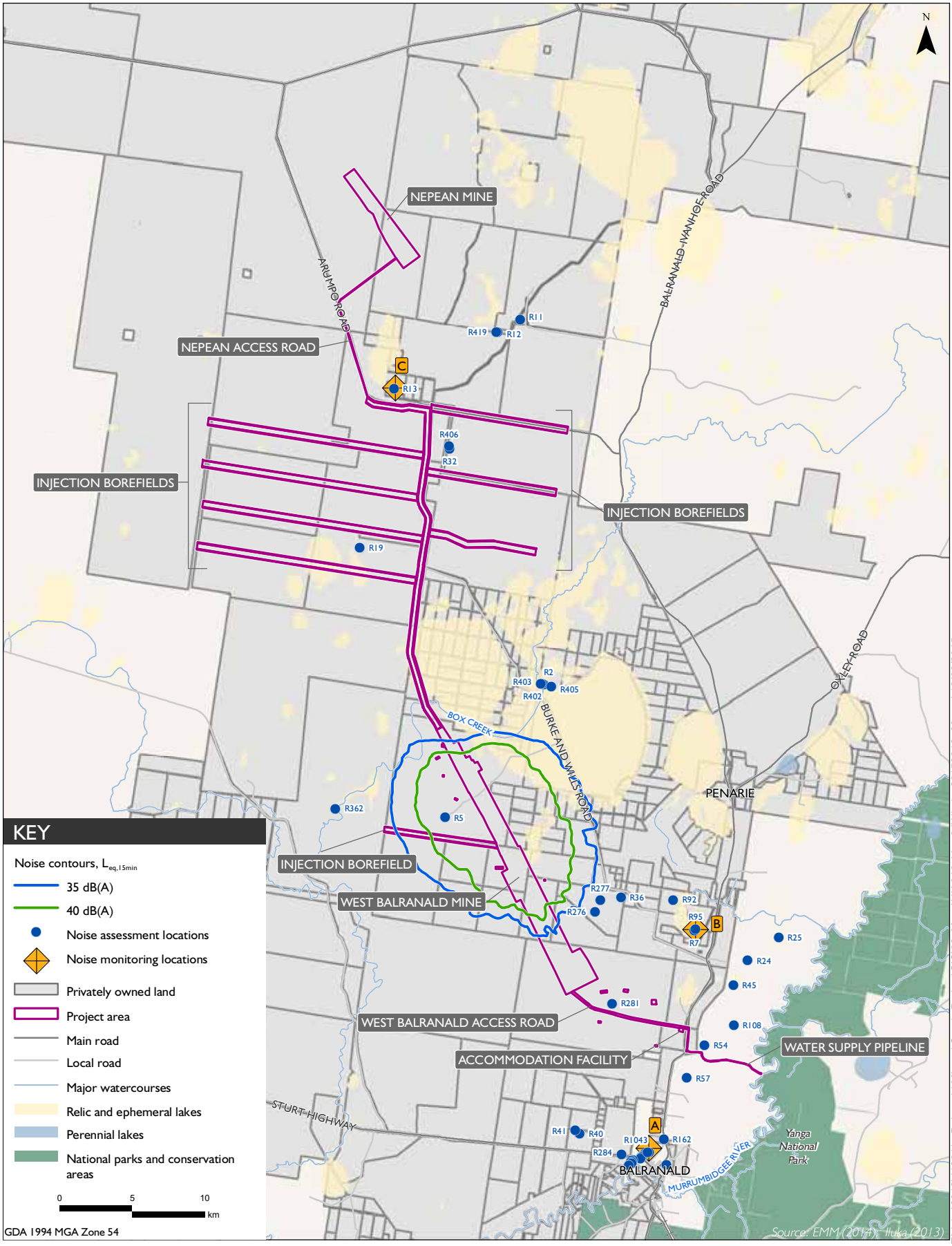
Year 4 operational noise levels - calm, $L_{eq(15\text{-}min)}$dB(A)

Balranald Mineral Sands Project

Noise Impact Assessment

Figure E4



EMM

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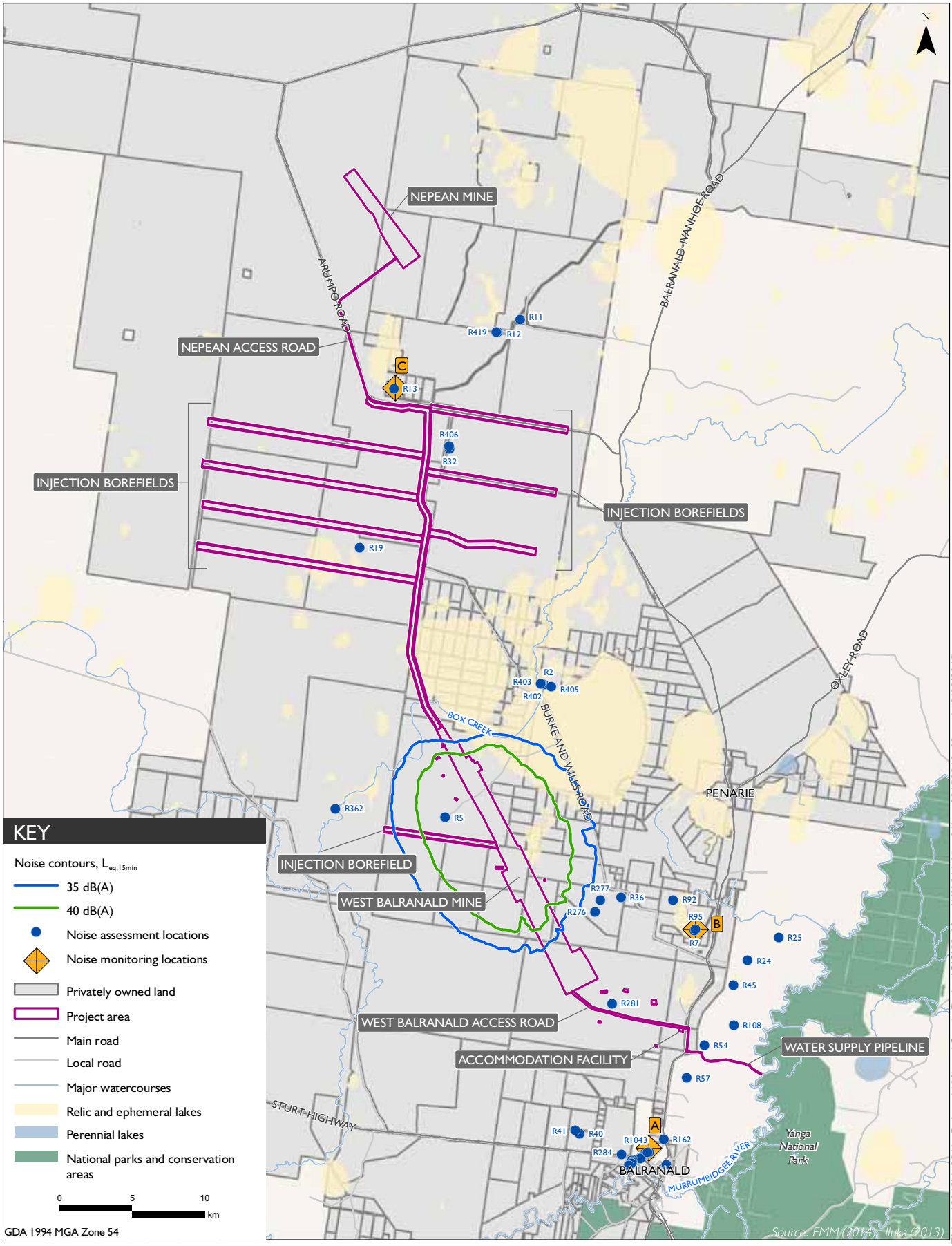
Year 4 operational noise levels - prevailing winds, $L_{eq(15\text{-}min)}$dB(A)

Balranald Mineral Sands Project

Noise Impact Assessment

Figure E5

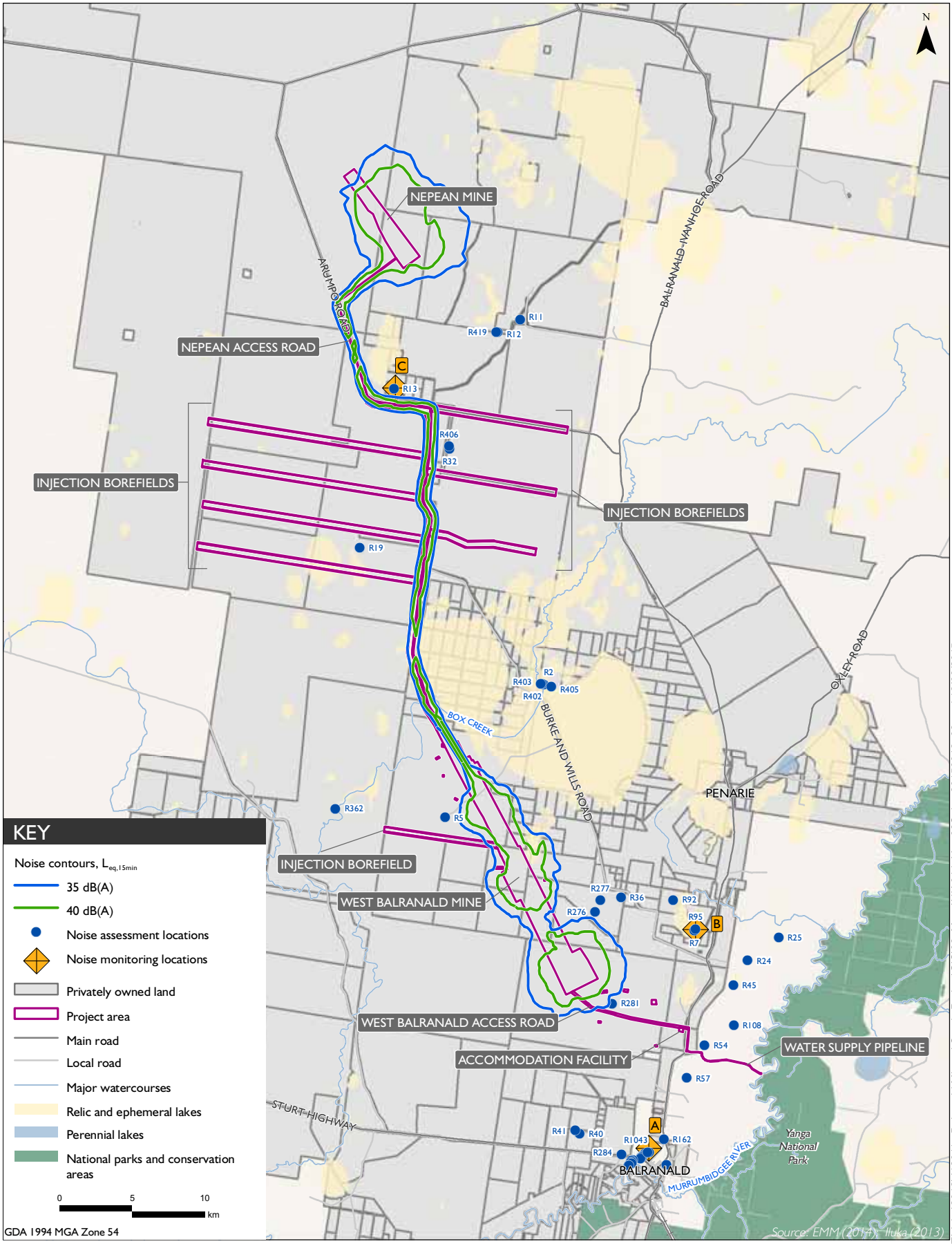


Year 4 operational noise levels - temperature inversion, $L_{eq(15\text{-}min)}$dB(A)

Balranald Mineral Sands Project

Noise Impact Assessment

Figure E6



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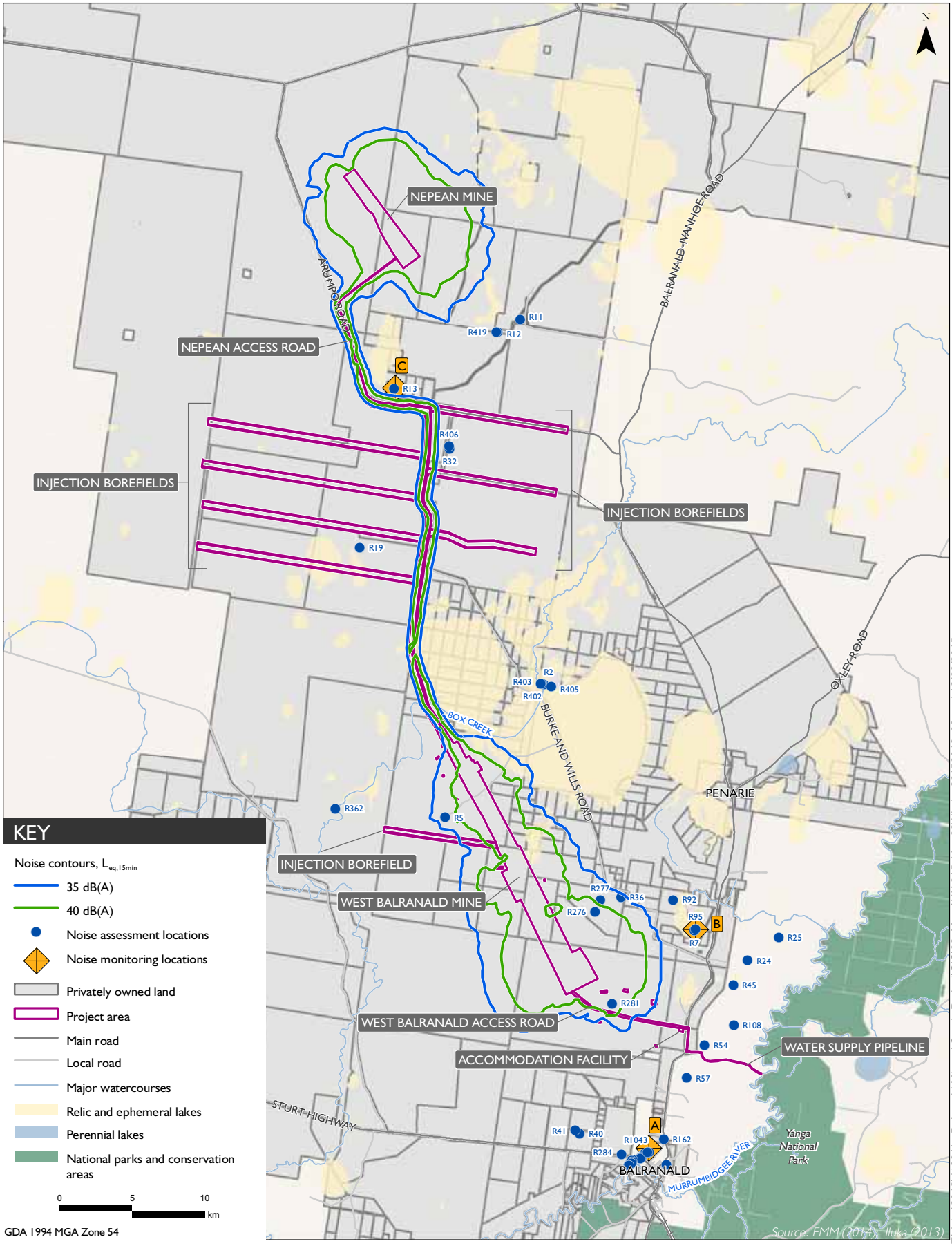
Year 8 operational noise levels - calm, $L_{eq(15\text{-}min)}$dB(A)

Balranald Mineral Sands Project

Noise Impact Assessment

Figure E7



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Year 8 operational noise levels - prevailing winds, $L_{eq(15\text{-}min)}$dB(A)

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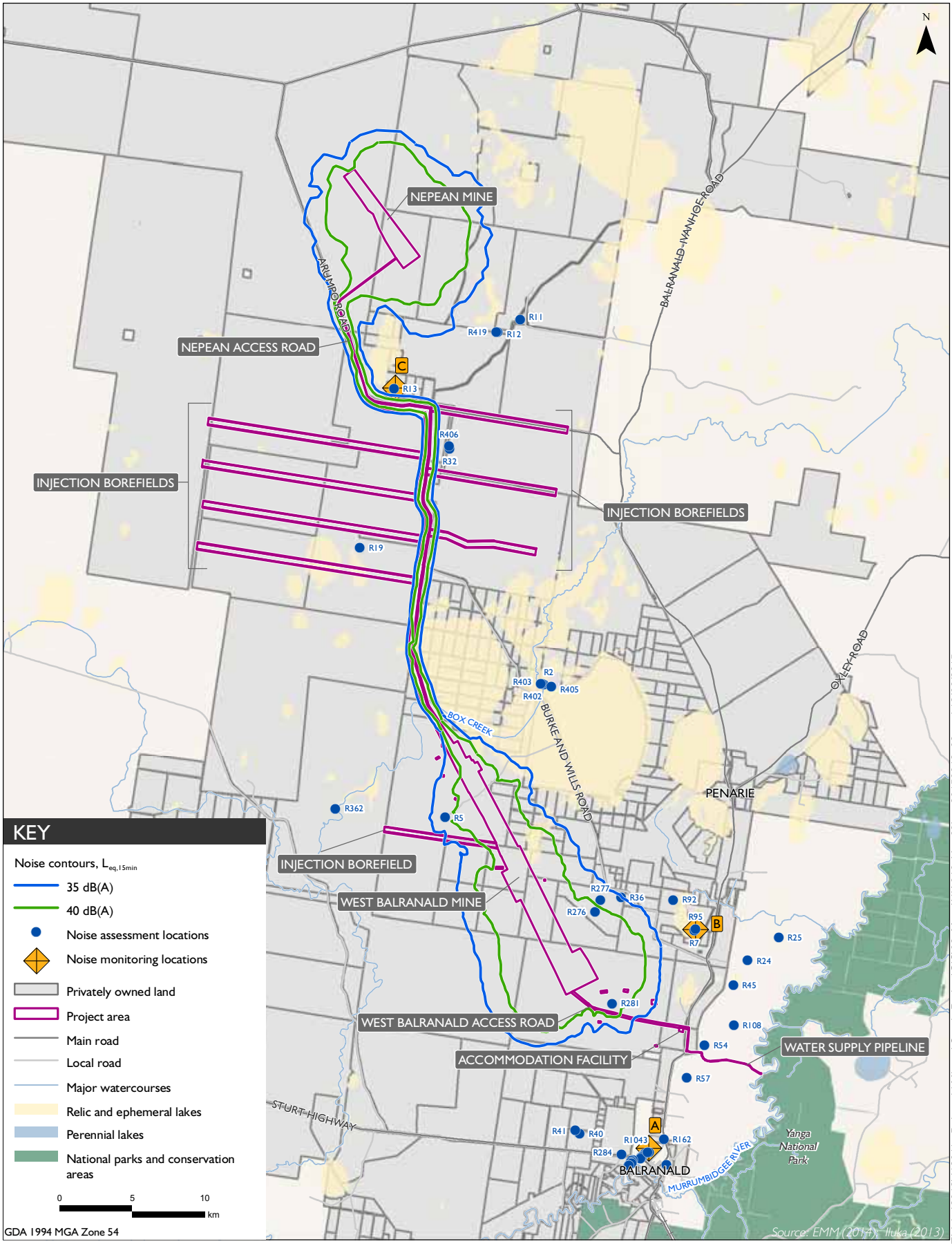
Noise Impact Assessment

Figure E8

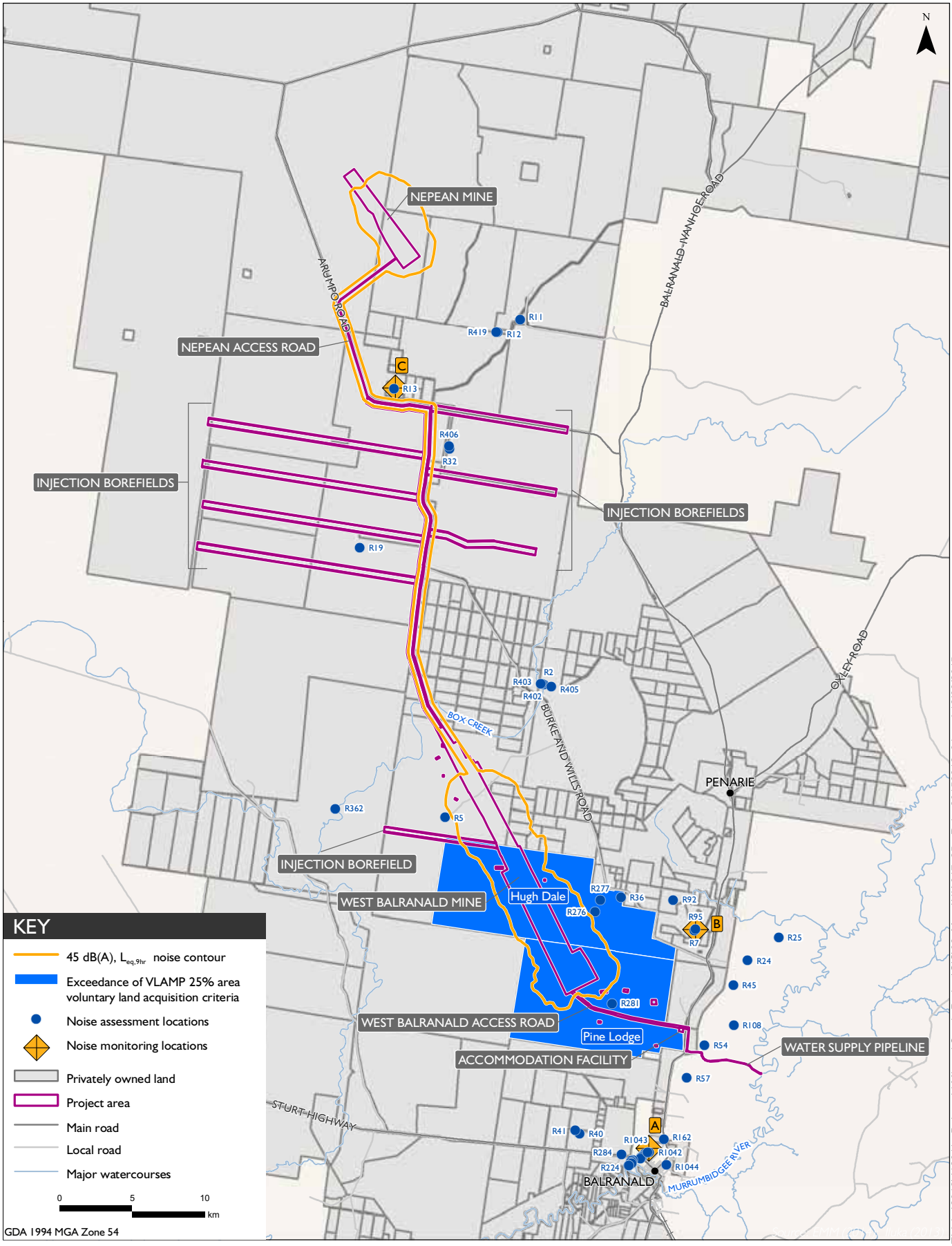


Year 8 operational noise levels - temperature inversion, $L_{eq(15\text{-}min)}$dB(A)

Balranald Mineral Sands Project

Noise Impact Assessment

Figure E9



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Privately owned land assessment - Worst case noise levels, all years, all assessed meteorological conditions, $L_{eq(9\text{-}hr)}$ dB(A)

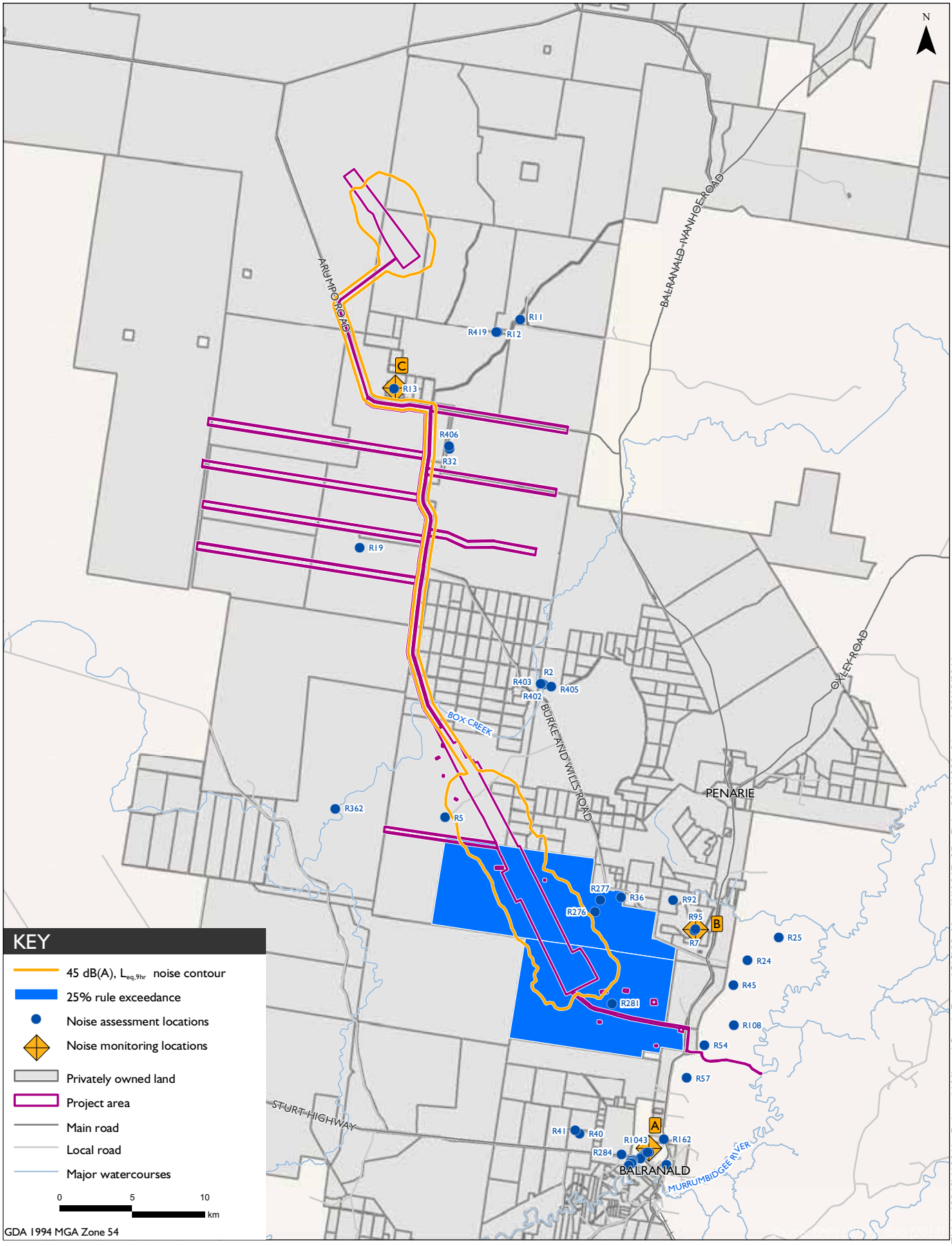
Balranald Mineral Sands Project

Noise Impact Assessment

Figure E10

Appendix F

Assessment of noise on privately owned land parcels



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Privately owned land assessment - Worst case noise levels, all years, all assessed meteorological conditions, $L_{eq(9\text{-}hr)}$ dB(A)

Balranald Mineral Sands Project

Noise Impact Assessment

Figure E10

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