Hexham Train Support Facility

Noise Impact Assessment

Report Number 30-1858-R2

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Noise Impact Assessment

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EXECUTIVE SUMMARY

SLR Consulting Australia Pty Ltd (SLR Consulting) has been commissioned by Aurizon Operation Limited (the Proponent) to conduct a Noise Impact Assessment (NIA) for the proposed Hexham Train Support Facility at Hexham, NSW. This report presents the results and findings of the noise assessment including consideration of construction, road traffic and operational noise of the proposed facility.

EXISTING ACOUSTICAL ENVIRONMENT

An ambient noise monitoring program was conducted by SLR Consulting. Ambient noise levels were monitored at four separate locations, considered to be representative of the nearest potentially affected receivers to the site. The objective of this survey was to measure $L_{A90(15\ minute)}$ and $L_{Aeq(15minute)}$ noise levels at the nearest potentially affected residential locations during the day, evening and night-time periods to enable the determination of the intrusiveness and amenity criteria for the proposed development in accordance with the NSW Industrial Noise Policy (INP).

OPERATIONAL NOISE PREDICTIONS

A computer model was used to predict noise emissions from the proposed TSF. The model used SoundPLAN software, developed by Braunstein and Berndt Gmbh in Germany. The modelling software is widely used and has been proven to be applicable to local conditions. Noise levels were predicted for the general operational scenario summarised in **Section 7.2**.

Operational noise levels from the proposed TSF are predicted to meet the project specific noise criteria at all receiver locations under prevailing weather conditions (calm) during day, evening and night periods.

Since the operational scenario modelled is likely to represent an acoustically worst-case scenario, actual operational noise levels from the proposed TSF are likely to be less than those predicted.

SLEEP DISTURBANCE ASSESSMENT

Predicted maximum noise levels from operation of the proposed TSF, particularly in relation to impact noise from the shunting of trains, during the night-time period are predicted to meet the recommended sleep disturbance noise goal at all residences.

CONSTRUCTION NOISE ASSESSMENT

The results of construction noise predictions for the proposed development show the worst case impact of all construction phases at each nearest residential receivers for the daytime period. The predictions indicate that the construction associated with the development would comply with construction noise goals at all residential receivers.

Where rail related construction work has to be carried out in close proximity to an operational rail network the need for work to be undertaken outside the standard hours often arises. In many cases, work that needs to be carried out safely in close proximity to the live rail network can only be undertaken during periods of scheduled trackwork (i.e. track possessions) which are typically scheduled during periods of lower rail usage (i.e. overnight, weekends and holiday periods).

Additionally, at the interfaces between other transport (eg. road) and utility (eg. water, sewer, telecommunications) infrastructure, construction during the standard hours may not be possible due to the need to avoid unacceptable impacts on traffic or water, power or communications services.

Where out of hours construction is required approval will be sought from the relevant authorities and the impact assessed on a case by case basis. This report considers these events.

ROAD TRAFFIC NOISE ASSESSMENT

The additional traffic movements proposed by the construction and operation of the TSF would result in an insignificant change in traffic flow on the New England Highway given the existing traffic volume. Predicted additional daily traffic vehicles for the construction and operation of the proposed TSF will result in a negligible change to the existing road traffic noise level generated from the New England Highway and therefore unlikely to exceed RNP criteria.

VIBRATION ASSESSMENT

Due to the separation distance to residential and commercial premises, the level of vibration caused by construction and operational activities at the Hexham site is predicted to be below the level of human perception at any of the nearest premises and therefore below the criteria for "minimal risk of cosmetic damage" at surrounding residential and commercial premises.

CUMULATIVE ASSESSMENT

A cumulative assessment has been carried out for the TSF and proposed Hexham Relief Road project.

The dominant influence on the cumulative noise levels at receiver locations is the operation of the Hexham Relief Roads. The influence of the Aurizon TSF operations is predicted not to result in an increase of cumulative noise levels above that of the proposed Hexham Relief Roads Project alone except at receiver R5. A marginal increase of 1dBA is predicted at this location above that of Hexham Relief project which would not noticeable by most people.

The major potential for cumulative noise impact is during the construction phase of the TSF and proposed Hexham Relief Roads project. The potential cumulative construction works are below the 'highly noise affect' management noise level at all times. However, predicted noise levels at assessment location R8 are predicted to be above the noise affected management levels during demolition and clearing and during rail construction if both the Hexham Relief road project and TSF were to occur simultaneously.

Since the church services at location R8 are predominantly on Sundays, and outside the proposed construction time periods, there will be no impact from simultaneous construction. However, if church services are required during construction time periods (7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturdays), it is recommended that Aurizon liaise with the church officials and coordinate the Aurizon and ARTC construction activities to avoid simultaneous construction during these time periods wherever possible.

CONCLUSION

SLR Consulting has assessed the overall noise and vibration impacts of the proposed TSF in relation to the relevant criteria. The proposed development is considered to be appropriate for the location and, with appropriate mitigation in place, is predicted to comply and maintain noise and vibration impacts within acceptable limits at surrounding residential and commercial receivers.

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1 INTRODUCTION

SLR Consulting Pty Ltd (SLR Consulting) has been commissioned by Aurizon (the Proponent) to conduct a Noise Impact Assessment (NIA) for the proposed Train Support Facility (TSF) at Hexham.

Broadly, the objectives of the assessment were to identify the potential noise and vibration impacts from operational and construction activities associated with the proposed development. Advice with regard to effective mitigation strategies has been provided where necessary.

The NIA has been prepared with reference to Australian Standard AS 1055:1997 *Description and Measurement of Environmental Noise* Parts 1, 2 and 3 and in accordance with the Environmental Protection Authority (EPA) NSW Industrial Noise Policy (INP), the Interim Construction Noise Guideline (ICNG) and the NSW Road Noise Policy (RNP). Where issues relating to noise are not addressed in the INP, such as sleep disturbance, reference has been made to the NSW Environmental Noise Control Manual (ENCM).

Vibration impacts have been assessed with reference to the EPA *Environmental Noise Management – Assessing Vibration: a technical guide*, DIN 4150 Part 3:1999 *Structural Vibration: effects of vibration on structures* and BS *6472-1:2008 guide to evaluation of human exposure to vibration in buildings - Vibration sources other than blasting, 2008.*

The Scope for the noise impact assessment has been designed to address the Director General's Requirements (DGR's) with regard to the assessment of noise emissions. A summary of the DGR's and relevant comments is provided in **Table 1** together with the relevant section of the NIA addressing the particular DGR/comment.

Table 1 Director General's Requirements and Government Agency Comments

Requirement	Relevant Section of NIA Report
Director-General's Requirements	
Noise and Vibration – Including but not limited to: - Noise and vibration from all activities and sources, and impacts on receivers: taking into account of the NSW Industrial Noise Policy (DEC).	Refer to entire NIA

1.1 Acoustic Terminology

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

2 PROJECT DESCRIPTION

2.1 Project Overview

Aurizon currently hauls coal from the Hunter Valley to the Port of Newcastle. They have a secured and forecast growth that will increase train sets from 10 at the present time to 38 trains by 2019. This will drive demand for additional train service capacity. Substantial amounts of rollingstock have been purchased to cope with the growth. Correspondingly the new rollingstock require new provisioning and maintenance facilities. It is of critical importance that new maintenance and provisioning facilities are brought on line in parallel with the delivery of new rollingstock. The proposed Train Support Facility at Hexham will provide Aurizon with the appropriate facilities. Approval is sought for the Hexham Train Support Facility.

The facility will provide a train support facility where:

- The operation of Aurizon trains can be managed;
- Aurizon trains can undergo statutory and routine maintenance inspections;
- Locomotives and wagons can be attached/detached from/to Aurizon trains;
- Locomotives can be provisioned;
- Locomotives and wagons can be serviced;
- Locomotives and wagons can be parked; and
- Spare parts can be held for locomotives and wagons.

2.2 Project Location

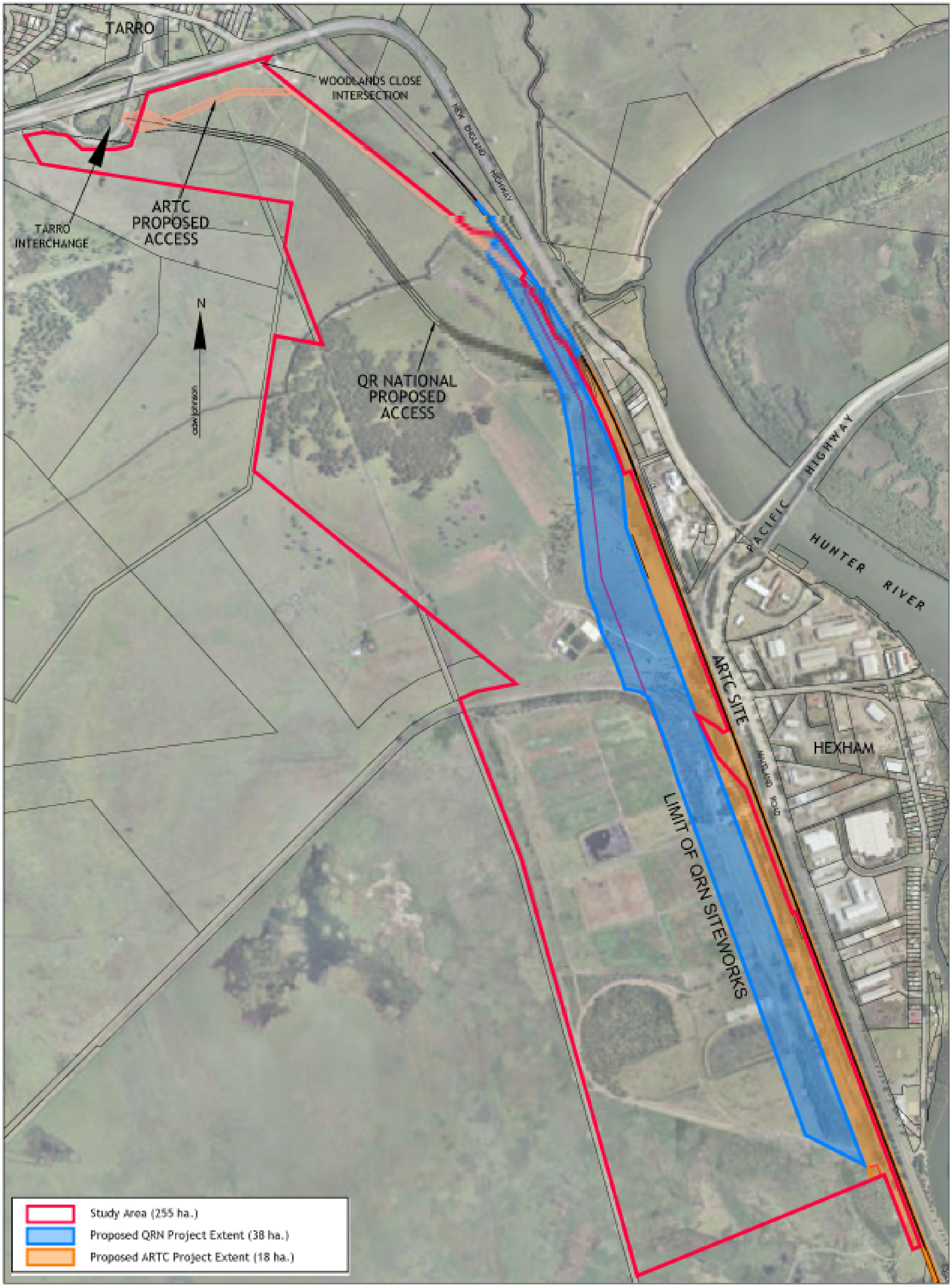
The proposed development site is located parallel to the Pacific Highway at Hexham, NSW. The Hexham study area covers approximately 255ha with the TSF project contained within a 38ha parcel of land within the study area.

In parallel with application for the TSF the Australian Rail Track Corporation (ARTC) has lodged an application for a Relief Roads project (5 rail tracks) on a 18ha site located between the TSF site and the Great Northern Railway. **Figure 1** provides a plan of the project sites at Hexham.

The site is surrounded by pastoral and wetland areas to the west. Immediately adjoining to the east is the main Northern Rail Line and Pacific Highway and then further to the east is the Hexham industrial area with some housing and then the Hunter River.

It is relevant to note that **Figure 1** does not show the full extent of earthworks. Construction planning has identified that works would also take place to the north of the footprint shown in **Figure 1** for the joint construction compound (with ARTC) as well as to the west of the project footprint at the southern end in relation to conditioning of soil for reuse and the treatment and storage of Acid Sulphate Soils. The construction footprint is provided in the Preferred Project report prepared by JBA and these additional construction areas have been taken into account in the Noise Impact Assessment.

Figure 1 Aurizon and ARTC Project Areas



2.3 Project Details and Timing

Taking into account of the changes made to the design of the Hexham TSF, the project for which approval is now being sought includes the following:

- Construction of new connections to the Great Northern Railway;
- Construction of seven new train lines (tracks) parallel to the existing Mainline to provide for provisioning, inspections, servicing and maintenance of Aurizon trains, as well as a Shunt Neck at the northern part of the facility providing in total 10.5km of railway track.
- A Provisioning Building generally as described in Section 6.4.2 of the EAR to provide provisioning, inspections and unscheduled rollingstock maintenance on a 24 hour, 7 days per week basis. Provisioning includes replenishing locomotives with fuel, sand, water, oil and other consumables as well as general cleaning and cab preparation.
- A Combined Maintenance Building located generally where the Wagon Maintenance Building was originally proposed in the EAR. The Combined Wagon Maintenance Building would generally be operated between 06:00 and 22:00 hours weekdays – however, with hours of operation driven by demand this could increase to a 7 day per week operation when and if required and approval is being sought for operations 7 day per week maintenance operations.
- The Combined Maintenance Building would include the TSF's main administration centre.
- A Service Vehicle Garage, car park, truck unloading and wheel set storage area located within the internal road turning loop, adjacent to the Combined Maintenance Building and Administration Centre. Car parking will be provided for up to 50 cars and light vehicles in the main car park, with a five space carpark also located near to the provisioning building for occasional parking of vehicles.
- A bulk fuel storage area with capacity for up to 630,000L of diesel fuel in 90,000 litre above ground, self-bunded fuel storage tanks. Bulk storage of sand would be located adjacent to the fuel storage area.
- At the completion of construction the facility will have a maximum of 30 personnel on-site over a 24-hour period.
- Construction of an intersection and a new access road from the Tarro Interchange.
- Construction of internal access roads comprising of sealed single carriage way road
- The protection or diversion of existing utilities, and where appropriate connection of the site to utilities.
- Beneficial reuse of up to 30,000 tonnes of geotechnical and environmentally suitable borrow materials sourced from on-site excavations / earthworks for construction.
- Permanent stockpiling of up to approximately 50,000m^3 of excess treated Acid Sulfate Soils and up to 100,000 m3 of treated acid generating materials.
- Installation of a package Waste Water Treatment Plant with on-site effluent irrigation to be located within the internal road turning loop, adjacent to the Combined Maintenance Building and Administration Centre.

The project is planned to be constructed continuously over approximately 18 months. It is planned to commence provisioning of locomotives once the Provisioning Building and associated rail infrastructure has been constructed and commissioned. Provisioning would be carried out whilst construction of the maintenance facilities and associated railway track infrastructure is being constructed.

Operational Details

For the operational management of Aurizon trains running on the Hunter rail corridor, the facility is expected to be open 24 hours per day, 7 days per week.

Servicing of locomotives and wagons will be undertaken predominantly during the hours of 0600 to 2200 hours 7 days, but will also be undertaken to a lesser extent at other times the facility is open to meet the needs of the 24 hour Aurizon train operation. Servicing can be planned (i.e. preventative) and unplanned (due to failures). During night time hours the facility will be lit for security reasons.

Car movements can be expected from on-site worker's cars with dedicated employee carparks adjacent the main buildings. Site workers will be predominantly maintenance staff.

Fuel will be delivered by B-double tankers, delivery is expected to occur during daylight hours. There will also be infrequent road delivery of spare parts, sand and other consumables expected to occur during daylight hours Monday to Friday. Most deliveries will be pallet based, but sand will be in semi-trailer based tankers.

The total employment for the proposed TSF is estimated to be 30 people.

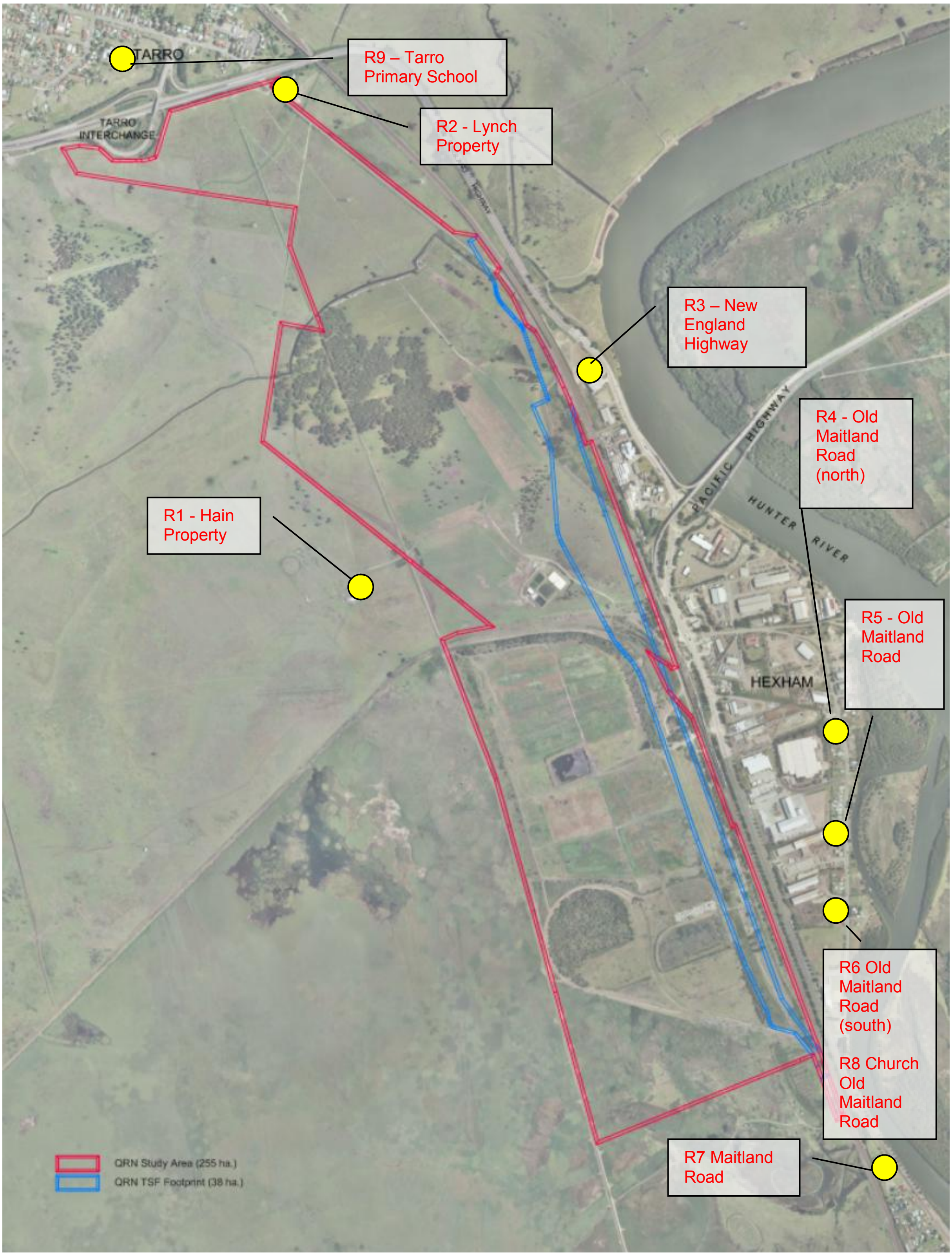
2.4 Sensitive Receivers

The nearest sensitive residential receivers potentially affected by the proposed development are listed in **Table 2** (refer to **Figure 2)**.

Table 2 Nearest Affected Residential Receivers

Residence No.	Description
R1	Hain Property west of site
R2	Lynch property north of site
R3	New England Highway east of site
R4	Old Maitland Road (North) east of site
R5	Old Maitland Road east of site
R6	Old Maitland Road (South) east of site
R7	Maitland Road south-east of site
R8	Church old Maitland Road
R9	Tarro Primary School

Figure 2 Site Locality and Sensitive Receivers



3 NOISE MANAGEMENT

Selecting an appropriate noise management strategy for the proposed rail servicing project involves the following steps:

- Determining the noise reduction required (if required) to achieve the project-specific noise levels.
- Identifying the specific characteristics of the industry and the site that would indicate a preference for specified measures.
- Examining the mitigation strategies chosen by similar industries on similar sites with similar requirements for noise reduction; and considering that strategy's appropriateness for the subject development.
- Considering the range of noise-control measures available.
- Considering community preferences for particular strategies. This is especially important when the community has particular sensitivities to noise.

The preference ranking (from most preferred to least preferred) for noise mitigation strategies is as follows:

- **Land-use controls** - a long-term strategy preferable to other measures when such strategic decisions are possible in planning land use, as it separates noise-producing industries from sensitive areas and avoids more expensive short-term measures.
- **Control at the source** - Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA). These strategies serve to reduce the noise output of the source so that the surrounding environment is protected against noise.
- **Control in transmission** - the next best strategy to controlling noise at the source—it serves to reduce the noise level at the receiver but not necessarily the environment surrounding the source.
- **Receiver controls** - the least-preferred option, as it protects only the internal environment of the receiver and not the external noise environment.

The proponent will take into account the cost-effectiveness of strategies in determining how much noise reduction is affordable. A proponent's choice of a particular strategy is likely to have unique features due to the economics of the industry and site specific technical considerations.

The above steps and the range of measures described in this section can be used as a guide in assessing the strength of the proponent's mitigation proposals. Where a proposed mitigation strategy will not achieve the desired noise reduction and leaves a remaining noise impact, the problem needs to be solved by negotiation.

4 IMPACT ASSESSMENT PROCEDURES

4.1 General Objectives

Responsibility for the control of noise emission in New South Wales is vested in Local Government and the EPA. The INP was released in January 2000 and provides a framework and process for deriving noise criteria for consents and licences that will enable the EPA to regulate premises that are scheduled under the Protection of the Environment Operations Act, 1997.

The specific policy 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.
- To carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the Act.

The INP provides two forms of noise criteria with the aim of achieving environmental noise objectives; one to account for intrusive noise which involves setting a noise goal relative to the existing acoustic environment and the other to protect the amenity of a particular land use.

4.2 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 five (5) decibels above the measured background level (L_{A90}).

4.3 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 is measured. 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. For high-traffic areas there is a separate amenity criterion.

An extract from the INP that relates to the amenity criteria is given in **Table 3** and **Table 4**.

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Table 3 Amenity Criteria - Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq(Period)}$ Noise Level (dBA)	
			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
School classrooms - internal	All	Noisiest 1 hour period when in use	35	40
Hospital wards - internal - external	All	Noisiest 1 hour period	 35 50	 40 55
Place of worship - internal	All	When in use	40	45
Area specifically reserved for passive recreation (eg National Park)	All	When in use	50	55
Active recreation area (eg school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Note: Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am, On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Table 4 Modification to Acceptable Noise Level (ANL)* to Account for Existing Levels of Industrial Noise

Total Existing L_{Aeq} noise level from Industrial Noise Sources	Maximum L_{Aeq} Noise Level for Noise from New Sources Alone, dBA
≥ Acceptable noise level plus 2 dBA	If existing noise level is *likely to decrease* in future acceptable noise level minus 10 dBA If existing noise level is *unlikely to decrease* in future existing noise level minus 10 dBA
Acceptable noise level plus 1 dBA	Acceptable noise level minus 8 dBA
Acceptable noise level	Acceptable noise level minus 8 dBA
Acceptable noise level minus 1 dBA	Acceptable noise level minus 6 dBA
Acceptable noise level minus 2 dBA	Acceptable noise level minus 4 dBA
Acceptable noise level minus 3 dBA	Acceptable noise level minus 3 dBA
Acceptable noise level minus 4 dBA	Acceptable noise level minus 2 dBA
Acceptable noise level minus 5 dBA	Acceptable noise level minus 2 dBA
Acceptable noise level minus 6 dBA	Acceptable noise level minus 1 dBA
< Acceptable noise level minus 6 dBA	Acceptable noise level

* ANL = recommended acceptable L_{Aeq} noise level for the specific receiver, area and time of day from **Table 3**

4.4 INP Project Specific Criteria

The INP Project Specific Noise levels are the more stringent of either the amenity or intrusive criteria. The INP states that these criteria have been selected to protect at least 90% of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90% of the time. Provided the criteria in the INP are achieved, it is unlikely that most people would consider the resultant noise levels excessive.

In those cases where the INP project specific assessment criteria are not achieved, it does not automatically follow that all people exposed to the noise would find the noise unacceptable. In subjective terms, exceedances of the INP project specific assessment criteria can be generally described as follows:

- Negligible noise level increase <1 dBA (Not noticeable by all people)
- Marginal noise level increase 1 dBA to 2 dBA (Not noticeable by most people)
- Moderate noise level increase 3 dBA to 5 dBA (Not noticeable by some people but may be noticeable by others)
- Appreciable noise level increase >5 dBA (Noticeable by most people)

In view of the foregoing, **Table 5** presents the methodology for assessing noise levels which may exceed the INP project specific noise assessment criteria.

Table 5 Noise Impact Assessment Methodology

Assessment Criteria	Project Specific Criteria	Noise Management Zone	Noise Affectation Zone
Intrusive	Rating background level plus 5 dBA	≤ 5 dBA above project specific criteria	> 5 dBA above project specific criteria
Amenity	INP based on existing industrial level	≤ 5 dBA above project specific criteria	> 5 dBA above project specific criteria

For the purposes of assessing the potential noise impacts the project specific, management and affectation criteria are further defined as follows:

4.4.1 Project Specific Criteria

Most people in the broader community would generally consider exposure to noise levels at or below the project specific noise criteria acceptable.

4.4.2 Noise Management Zone

Depending on the degree of exceedance of the project specific criteria (1 dBA to 5 dBA) noise impacts could range from negligible to moderate. It is recommended that management procedures be implemented, when noise exceedences between 1 dBA and 5 dBA are predicted, including:

- Prompt response to any community issues of concern.
- Noise monitoring on site and within the community.
- Refinement of onsite noise mitigation measures and plant operating procedures where practical.
- Consideration of acoustical mitigation at receivers.
- Consideration of negotiated agreements with property holders.

4.4.3 Noise Affectation Zone

Exposure to noise levels exceeding the project-specific criteria by more than 5 dB(A) may be considered unacceptable by some property holders and the INP recommends that the proponent explore the following:

- Discussions with relevant property holders to assess concerns and provide solutions.
- Implementation of acoustical mitigation at receivers.
- Negotiated agreements with property holders, where required.

4.5 Assessing Sleep Disturbance

The EPA's current approach to assessing potential sleep disturbance is to apply an initial screening criterion of background plus 15 dBA (as described in the Application Notes to the INP), and to undertake further detailed analysis if the screening criterion cannot be achieved. The sleep disturbance screening criterion applies outside bedroom windows during the night-time period.

Where the screening criterion cannot be met, the additional analysis should consider the number of potential sleep disturbance events during the night, the level of exceedance and noise from other events. It may also be appropriate to consider other guidelines including the EPA's RNP which contains additional guidance relating to the potential sleep disturbance impacts.

A review of research on sleep disturbance in the RNP indicates that in some circumstances, higher noise levels may occur without significant sleep disturbance. Based on studies into sleep disturbance, the RNP concludes that:

- *Maximum internal noise levels below 50 dBA to 55 dBA are unlikely to cause awakening reactions.*
- *One or two noise events per night, with maximum internal noise levels of 65 dBA to 70 dBA, are not likely to affect health and wellbeing significantly.*

It is generally accepted that a dwelling of standard construction, with the windows open, provides a 10 dBA reduction to external noise levels. It follows that the first conclusion above suggests that short term external noises of 60 dBA to 65 dBA are unlikely to cause awakening reactions. The second conclusion suggests that one or two noise events per night with maximum external noise levels of 75 dBA to 80 dBA are not likely to affect health and wellbeing significantly.

4.6 Construction Noise

The EPA has prepared a new interim guideline covering construction noise. The ICNG sets out noise criteria applicable to construction site noise for the purpose of defining intrusive noise impacts. **Table 6** and **Table 7** sets out the noise management levels and how they are to be applied. The approach is intended to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

Table 6 Construction Noise Management Residential Receivers

Time of Day	Management Level $L_{Aeq,(15mins)}$ *	How to apply
Recommended standard hours : Monday to Friday 7:00am to 6:00pm Saturday 8:00am to 6:00pm No work on Sundays or public holidays	Noise affected RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15mins)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. • 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 dBA	The highly affected noise level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dBA	• 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 dBA above the noise affected level, the proponent should negotiate with the community.

Table 7 Noise at sensitive land uses (other than residences)

Land use	Management level, LAeq(15minute) (applies when properties are being used)
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreation areas (characterized by sporting activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
Passive recreation areas (characterized by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)
Community centres	Depends on the intended use of the centre. Refer to the recommended 'maximum' internal levels in AS2107 for specific uses.

Furthermore, the ICNG provides external noise level limits for industrial and commercial premises and are as follows:

- Industrial premises: external $L_{Aeq\ (15\ minute)}$ 75dB(A)
- Offices, retail outlets: external $L_{Aeq\ (15\ minute)}$ 70dB(A)

Based upon this document, the project specific construction noise goals outlined in **Table 6** and **Table 7** will apply during construction activities at the nearest potentially affected residential locations.

4.7 Traffic Noise

The EPA released the "*NSW Road Noise Policy*" (RNP) in March 2011. The policy sets out noise criteria applicable to particular types of projects, road category and land use for the purpose of defining traffic noise impacts. Relevant road traffic noise criteria are identified in **Section 6.4** of this report.

4.8 Vibration

4.8.1 Human Response

The EPA released *Assessing Vibration: a technical guideline* (the Guideline) in February 2006. The Guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. The Guideline is based on British Standard BS 6472- 2008 *Evaluation of human exposure to vibration in buildings (1-80Hz)*.

4.8.2 Building Response

British Standard 7385: Part 2-1993 "*Evaluation and measurement for vibration in buildings Part 2*" provides criteria against which the likelihood of building damage from ground vibration can be assessed.

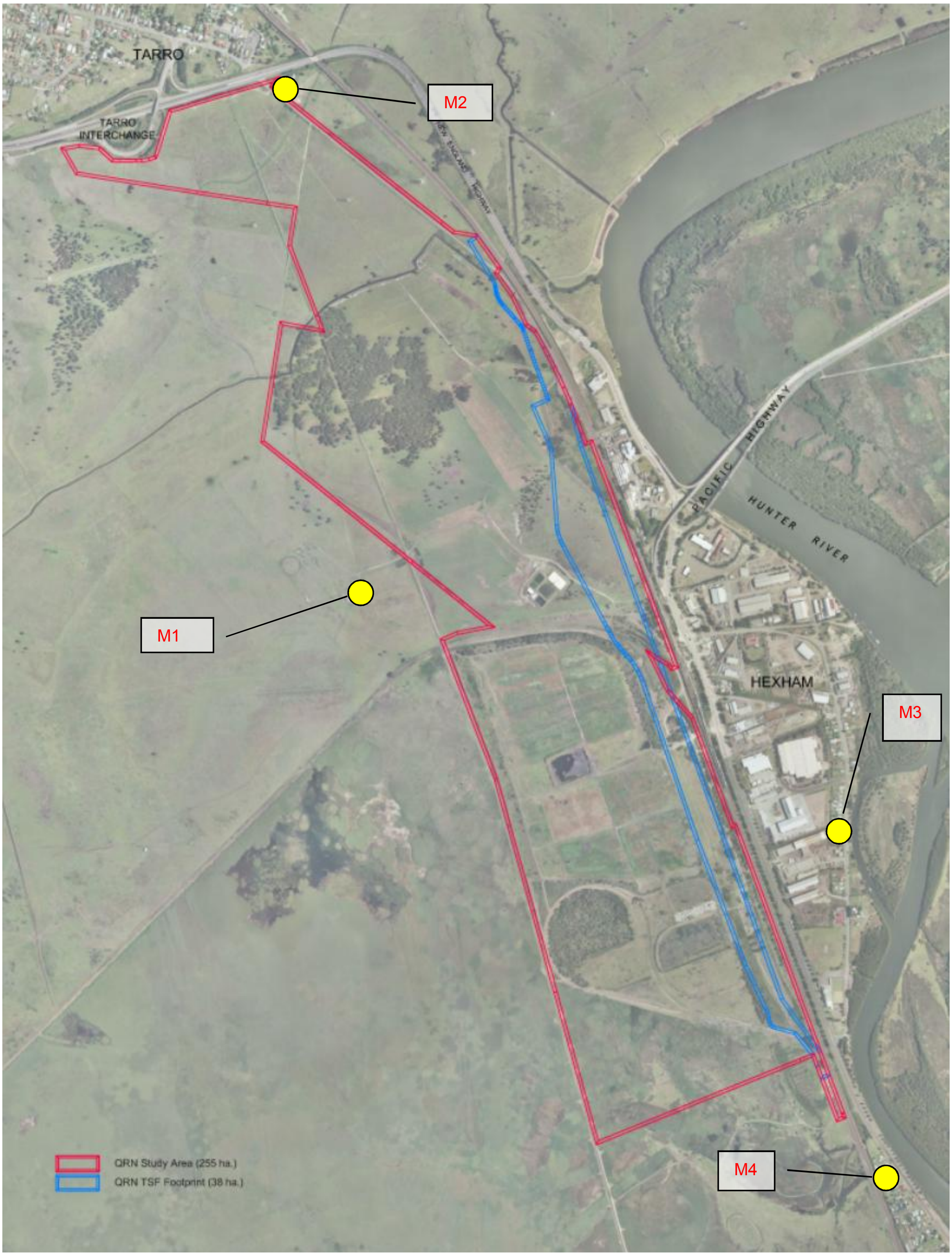
5 EXISTING ACOUSTICAL AND METEOROLOGICAL ENVIRONMENT

5.1 General Methodology

Ambient noise surveys were conducted to characterise and quantify the acoustical environment in the area surrounding the proposed development. Noise surveys were conducted by SLR Consulting in March 2008 at four (4) of the nearest potentially affected residential receivers (M1 to M4). The location of the monitoring and assessment sites are shown on a location map contained in **Figure 3**. A combination of operator attended noise monitoring and unattended continuous noise monitoring was conducted at residential receivers M1, M2 and M3. Operator attended noise surveys were conducted at residential receiver M4.

All acoustic instrumentation employed throughout the monitoring programme has been designed to comply with the requirements of AS IEC 61672 (parts 1 and 2) 2004 "Electroacoustics - Sound Level Meters" and carries current NATA or manufacturer calibration certificates. Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dBA.

Figure 3 Noise Monitoring Locations



5.1.1 Continuous Unattended Noise Surveys

Environmental noise loggers were deployed at residential locations M1, M2 and M3 from 17 March 2008 to 27 March 2008. The noise loggers were programmed to record statistical noise level indices continuously in 15 minute intervals, including L_{Amax}, L_{A1}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and L_{Aeq}. Precautions were taken to minimise influences from extraneous noise sources and reflections from adjacent buildings.

Weather data for the survey period was obtained from the nearest Bureau of Meteorology station located at Newcastle. Noise data corresponding to periods of rainfall and/or wind speeds in excess of 5 m/s (approximately 9 knots) were discarded in accordance with INP data exclusion methodology. A summary of the results of the background surveys is given in **Table 8**. Results are displayed graphically in **Appendix B** for details.

Noise levels at all locations were influenced by traffic on the Pacific and New England Highways and rail movements on the Main Northern Rail Line. Due to the influence of traffic noise at all residential locations they have been classified as having an urban acoustic character.

Table 8 Background Noise Levels in Area Surrounding TSF Development

Location	Description	Measured Background L_{A90} Noise Level	Adopted Rating Background Level	Estimated Existing Industrial L_{Aeq} Contribution
M1 Hain Property	Daytime	41 dBA	41 dBA	< 44 dBA
	Evening	46 dBA	41 dBA	< 39 dBA
	Night	47 dBA	41 dBA	< 34 dBA
M2 Lynch Property	Daytime	56 dBA	56 dBA	< 54 dBA
	Evening	53 dBA	53 dBA	< 44 dBA
	Night	47 dBA	47 dBA	< 39 dBA
M3 Old Maitland Road	Daytime	40 dBA	40 dBA	< 54 dBA
	Evening	40 dBA	40 dBA	< 44 dBA
	Night	39 dBA	39 dBA	< 39 dBA

The results of long-term unattended background noise monitoring indicates that the calculated Rating Background Level (RBL, defined in the INP) for the evening and night-time period is higher than the RBL for the day time period at monitoring location M1. These situations can often arise due to increased noise from, for example, insects or frogs during the evening in the warmer months or due to temperature inversion conditions during winter.

The RBL is used in determining relevant noise criteria for an industrial development. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than five decibels above the measured background level (L_{A90}).

In determining project-specific noise criteria the INP Application Notes state that the community's expectation also needs to be considered. The community generally expects greater control of noise during the more sensitive evening and night-time periods than the less sensitive daytime period. Therefore, in determining project-specific noise criteria for a particular development, it is generally recommended that the intrusive noise criteria for evening be set at no greater than the intrusive noise criteria for daytime. The intrusive noise criteria for night-time should be no greater than the intrusive noise level for day or evening.

In this case, given that the lowest measured RBL between the day, evening and night- time period was during the day at monitoring location M1, the day RBL would be utilised in determining relevant project specific noise criteria for the evening and night-time time period at this location.

5.1.2 Operator Attended Noise Surveys

Operator attended noise surveys were conducted at residential locations M1, M2, M3 and M4 to characterise and quantify the main contributions to ambient noise at these locations. A summary of the operator attended measurements is contained within **Table 9**.

Table 9 Operator Attended Noise Survey Results

Location	Date/ Start time/ Weather	Primary Noise Descriptor (dBA re 20 µPa)					Description of Noise Emission, Typical Maximum Levels L_{Amax} (dBA) and Estimated Existing LAeq Contribution
		L_{Amax}	L_{A1}	L_{A10}	L_{A90}	L_{Aeq}	
M1 Hain Property	17/3/2008 15:25 Day W=2 to 4 m/s NE Temp=25°C	69	61	55	49	53	Wind in trees to 50 Distant traffic 45 to 47 Train passby to 50 Birds 52 to 60 Aircraft 55 to 60
M2 Lynch Property	17/3/2008 07:50 Day W= calm Temp=20°C	78	70	66	58	64	Traffic noise dominant 65 Train passby to 63
M3 Old Maitland Road	17/3/2008 14:17 Day W=2 to 3 m/s NE Temp=25°C	69	66	55	47	54	Truck in industry site to 54 Industrial noise 45 to 46 Distant traffic 47
M4 Maitland Road	17/3/2008 14:44 Day W=2 to 3 m/s NE Temp=24°C	79	74	69	55	65	Traffic noise dominant 73 Some wind in trees Some cicadas

5.2 Effects of Meteorology on Noise Levels

Wind

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the source of the noise. As the strength of the wind increases the noise produced by the wind will obscure noise from most industrial and transport sources.

Wind effects need to be considered when wind is a feature of the area under consideration. Where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30% of the time in any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

Weather data was obtained, for a period of 12 months, from a Bureau of Meteorology weather station located at Newcastle. This location is approximately 7 km north east of the subject site. A summary of the most frequently occurring winds is contained within **Table 10**, **Table 11** and **Table 12**.

Table 10 Seasonal Frequency of Occurrence of Wind Speed Intervals - Daytime

Period	Calm	Wind Direction	0.5 - 2 m/s	2 - 3 m/s	0.5 - 3 m/s
Summer	4.8%	NE±45°	0.9%	2.0%	2.9%
Autumn	0.8%	NNW±45°	0.7%	2.6%	3.3%
Winter	0.1%	NNW±45°	0.7%	1.9%	2.6%
Spring	2.4%	N±45°	0.6%	1.2%	1.8%

Table 11 Seasonal Frequency of Occurrence of Wind Speed Intervals - Evening

Period	Calm	Wind Direction	0.5 - 2 m/s	2 - 3 m/s	0.5 - 3 m/s
Summer	5.0%	SSE±45°	1.1%	1.1%	2.2%
Autumn	2.4%	N±45°	0.7%	4.2%	4.9%
Winter	0.8%	WNW±45°	1.1%	2.6%	3.7%
Spring	1.4%	NNE±45°	0.0%	2.1%	2.1%

Table 12 Seasonal Frequency of Occurrence of Wind Speed Intervals - Night

Period	Calm	Wind Direction	0.5 - 2 m/s	2 - 3 m/s	0.5 - 3 m/s
Summer	7.8%	NE±45°	1.4%	5.6%	7.0%
Autumn	3.0%	NW±45°	1.7%	12.0%	13.6%
Winter	0.1%	WNW±45°	1.7%	4.6%	6.3%
Spring	2.3%	NNW±45°	1.0%	6.3%	7.3%

Seasonal wind records indicate prevailing winds of 0.5 m/s to 3 m/s are not a feature of the area since the frequency of occurrence of such winds is below the 30% threshold.

5.3 Temperature Inversion

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30% of the total night-time during winter, or about two nights per week.

Weather data from Newcastle weather station did not contain sufficient data to determine the frequency of occurrence of temperature inversions in the area. Meteorological data, was analysed by SLR Consulting using TAPM (SLR Consulting Air Quality Assessment 30-1858R1) to determine atmospheric stability class at the site. This information was used to determine the percentage occurrences of temperature inversions during winter nights. The analysis indicates that stabilities of F class and above occur for less than 30% of the time during winter. This means that temperature inversion is not a feature of the area as the occurrence of inversion does not exceed the 30% threshold. Hence, the occurrence of temperature inversion during the night-time period has not been considered as part of this noise assessment.

6 PROJECT SPECIFIC NOISE CRITERIA

6.1 Operational Noise Design Criteria

The noise emission design criteria for the proposed TSF have been established with reference to the INP outlined in **Section** 4 of this report.

The amenity criteria have been set from **Table 3**, with adjustments to account for existing industrial noise contributions from **Table 4** as necessary.

The acoustical environment typifies an urban environment; "*an area with an acoustical environment that: is dominated by 'urban hum' or industrial source noise, has through traffic with characteristically heavy and continuous traffic flows during peak periods, is near commercial districts or industrial district"* (INP). Therefore, the residences in the general area have been assessed as "urban" receiver types.

In accordance with the INP, the project specific noise levels reflect the most stringent noise level requirements from the noise levels derived from both the intrusive and amenity criteria. Applying the most stringent requirement as the project specific noise levels ensures that both intrusive noise is limited and amenity is protected

The intrusive and amenity noise assessment criteria based on the INP for the nearest potentially affected residential locations are presented in **Table 13.**

The resulting operational project specific noise criteria for residences and sensitive receiver locations (see **Figure 2**) are based on L_{A90} and L_{Aeq} noise levels measured at Locations M1 to M3 (see **Figure 3**). The noise environment at Location M1 is most likely to be representative of the noise environments at Residence R1, the noise environment at Location M2 is most likely to be representative of the noise environments at Residences R2, R3 and R9, and the noise environment at Location M3 will most likely be assumed to be representative of the noise environments at Residences R4, R5, R6 and R8. Furthermore, the operator attended noise monitoring at location M4 was compared to the long term noise monitoring results at location M2 are were found to be comparable. Therefore, the noise environment at Location M2 is most likely to be representative of the noise environments at Residences R7.

Table 13 Train Support Facility Project Specific Noise Levels

Location	Locality	Period	Intrusiveness Criteria $L_{Aeq(15minute)}$	Amenity Criteria $L_{Aeq(Period)}$	Project Specific Noise Level (PSNL)
R1	Hain Property	Day	46 dBA	60 dBA	46 dBA
		Evening	46 dBA	50 dBA	46 dBA
		Night	46 dBA	45 dBA	45 dBA
R2	Lynch property	Day	61 dBA	60 dBA	60 dBA
		Evening	58 dBA	50 dBA	50 dBA
		Night	52 dBA	45 dBA	45 dBA
R3	New England Highway	Day	61 dBA	60 dBA	60 dBA
		Evening	58 dBA	50 dBA	50 dBA
		Night	52 dBA	45 dBA	45 dBA
R4	Old Maitland Road (north)	Day	45 dBA	60 dBA	45 dBA
		Evening	45 dBA	50 dBA	45 dBA
		Night	44 dBA	45 dBA	44 dBA
R5	Old Maitland Road	Day	45 dBA	60 dBA	45 dBA
		Evening	45 dBA	50 dBA	45 dBA
		Night	44 dBA	45 dBA	44 dBA
R6	Old Maitland Road (south)	Day	45 dBA	60 dBA	45 dBA
		Evening	45 dBA	50 dBA	45 dBA
		Night	44 dBA	45 dBA	44 dBA
R7	Maitland Road	Day	61 dBA	60 dBA	60 dBA
		Evening	58 dBA	50 dBA	50 dBA
		Night	52 dBA	45 dBA	45 dBA
R8	Church Old Maitland Road	Day	45 dBA	Internal when in use 40 dBA	Internal when in use 40 dBA
		Evening	45 dBA		
		Night	44 dBA		
R9	Tarro Primary School	Day	61 dBA	Internal Classroom Noisiest 1-hour period when in use 35 dBA	Internal Classroom 35 dBA
		Evening	58 dBA	N/A	N/A
		Night	52 dBA	N/A	N/A

Note : For Monday to Saturday, Daytime 7.00 am - 6.00pm; Evening 6.00pm - 10.00pm; Night-time 10.00pm 7.00am. On Sundays and Public Holidays, Daytime 8.00am - 6.00pm; Evening 6.00pm - 10.0 pm; Night-time 10.0 pm - 8.00am.

The INP states that these criteria have been selected to protect at least 90% of the population, living in the vicinity of industrial noise sources, from the adverse effects of noise for at least 90% of the time. Provided the criteria in the INP are achieved, it is unlikely that most people would consider the resultant noise levels excessive.

6.2 Sleep Disturbance Noise Goals

The relevant sleep disturbance noise goals for each residential area are provided in **Table 14**.

The resulting sleep disturbance project specific noise criteria for residential receiver locations (see **Figure 2**) are based on the night-time adopted rating background noise levels measured at Locations M1 to M3 (see **Figure 3**) and results presented in **Table 8** plus 15 dBA (as described in the Application Notes to the INP). The noise environment at Location M1 is most likely to be representative of the noise environments at Residence R1, the noise environment at Location M2 is most likely to be representative of the noise environments at Residences R2 and R3, and the noise environment at Location M3 will most likely be assumed to be representative of the noise environments at Residences R4, R5 and R6. Furthermore, the operator attended noise monitoring at location M4 was compared to the long term noise monitoring results at location M2 are were found to be comparable. Therefore, the noise environment at Location M2 is most likely to be representative of the noise environments at Residences R7.

Table 14 Sleep Disturbance Noise Goals

Location	Locality	Period	Sleep Disturbance Criteria $L_{1(1minute)}$
R1	Hain Property	Night	56 dBA
R2	Lynch property		62 dBA
R3	New England Highway		62 dBA
R4	Old Maitland Road (North)		54 dBA
R5	Old Maitland Road		54 dBA
R6	Old Maitland Road (south)		54 dBA
R7	Maitland Road		62 dBA
R8	Church Old Maitland Road		N/A
R9	Tarro Primary School		N/A

6.3 Construction Noise Goals

The construction noise goals for the project are presented in **Table 15** for the nearest potentially affected residential locations.

Table 15 Construction Noise Goals

Location	Period	Management Level $L_{Aeq(15minute)}$ (dBA)	
		Noise Affected	**Highly Noise Affected**
R1	Day	51 dBA	75 dBA
R2		66 dBA	
R3		66 dBA	
R4		50 dBA	
R5		50 dBA	
R6		50 dBA	
R7		66 dBA	
R8		Internal noise level 45 dBA	N/A
R9			

Note: Construction may only occur between the hours of 7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturdays. No construction work is to take place on Sundays or Public Holidays.

Where rail related construction work has to be carried out in close proximity to an operational rail network the need for work to be undertaken outside the standard hours often arises. In many cases, work that needs to be carried out safely in close proximity to the live rail network can only be undertaken during periods of scheduled trackwork (i.e. track possessions) which are typically scheduled during periods of lower rail usage (i.e. overnight, weekends and holiday periods).

Additionally, at the interfaces between other transport (eg. road) and utility (eg. water, sewer, telecommunications) infrastructure, construction during the standard hours may not be possible due to the need to avoid unacceptable impacts on traffic or water, power or communications services.

6.4 Traffic Noise Goals

Access to the site will be off the New England Highway via a newly constructed private roadway from the Tarro interchange. The RNP provides the following comments with regard to the assessment of private haul roads:

C4 Private haul roads

Noise from vehicles travelling on private roads associated with an industrial activity, such as a mine or quarry, is to be assessed as an industrial noise source under the NSW Industrial Noise Policy (Environment Protection Authority 2000). Further guidance on this approach is provided in the ‘Application Notes’ to the policy.

Furthermore, the RNP sets out assessment criteria for residences to be applied to particular types of projects, road category and land use.

Table 16 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of Project/land use	Assessment Criteria – dB(A)	
		Day (7am – 10pm)	**Night (10pm – 7pm)**
Freeway/arterial/Sub-arterial roads	Existing residences affected by additional traffic on existing freeway/arterial/sub-arterial roads generated by land use development	LAeq, (15 hour) 60 (external)	LAeq, (9 hour) 55 (external)

6.5 Vibration Goals

6.5.1 Human Response

The EPA released *Assessing Vibration: a technical guideline* (the Guideline) in February 2006. The Guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. The Guideline is based on British Standard BS 6472- 2008 *Evaluation of human exposure to vibration in buildings (1-80Hz)*. The criteria presented in the Guideline are non-mandatory. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, the operator would need to negotiate directly with the affected community.

The construction and rail activity expected to occur at the Hexham site is most likely to cause intermittent vibration at the nearest potentially affected facades. Section 2.4 of the Guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms acceleration over the frequency range 1 Hz to 80 H. To calculate VDV the following formula is used:

$$VDV = \left[\int_0^T a^4(t)dt \right]^{0.25}$$

where VDV is the vibration dose value in $m/s^{1.75}$, *a(t)* is the frequency-weighted acceleration in m/s^2 and *T* is the total period of the day (in seconds) during which vibration may occur.

The acceptable VDV are reproduced here in **Table 17**.

Table 17 Acceptable Vibration Dose Values for Intermittent Vibration

Location	Daytime		Night-time	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Residences	0.20 $m/s^{1.75}$	0.40 $m/s^{1.75}$	0.13 $m/s^{1.75}$	0.26 $m/s^{1.75}$

Note: Daytime is 7.00 am to 10.00 pm.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The Guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

Appendix A of the Guideline provides a methodology for estimating VDV as an initial screening method. Appendix B2 of the Guideline describes an alternative calculation of vibration dose using root-mean-squared (rms) velocity instead of rms acceleration.

6.5.2 Building Response

British Standard 7385: Part 2-1993 "*Evaluation and measurement for vibration in buildings Part 2*" provides criteria against which the likelihood of building damage from ground vibration can be assessed.

Sources of vibration which are considered in the standard include blasting (carried out during mineral extractions or construction excavation), demolition, piling, ground treatments (compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The standard states that the guide values relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values may need to be reduced by up to 50%. Since the nearest buildings could potentially experience resonance effects, a conservative level of continuous "minimal risk of cosmetic damage" criterion has been adopted here and is shown in **Table 18**.

Table 18 Transient Vibration Guide Values – Minimal Risk of Cosmetic Damage

Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	**15 Hz and Above**
Reinforced or framed structures - Industrial and heavy commercial buildings	25 mm/s at 4 Hz and above	
Unreinforced or light framed structures - Residential or light commercial type buildings	7.5 mm/s at 4 Hz increasing to 10 mm/s at 15 Hz	10 mm/s at 15 Hz increasing to 25 mm/s at 40 Hz and above

Note: Values referred to are at the base of the building being considered.

7 OPERATIONAL NOISE MODELLING

7.1 Operational Noise Modelling Parameters

The Conservation of Clean Air and Water Europe (CONCAWE) prediction methodology was utilised within SoundPLAN 3D modelling software (Version 7.1), developed by Braunstein and Berndt Gmbh in Germany, to predict noise emissions from operation of the TSF. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. The model used this map, together with noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

Topographic contours and operational layouts were supplied by Aurizon for the purpose of modelling noise from the proposed development.

Predictions of noise were carried out under prevailing atmospheric conditions (calm). Atmospheric parameters under which noise predictions were made are given in **Table 19**.

Table 19 Meteorological Parameters for Noise Predictions

	Temperature	Humidity	Wind Speed	Wind Direction (degrees from north)	Temperature Gradient
Calm (All periods)	20°C	65%	Calm	N/A	N/A

The operational noise levels modelled are presented in **Table 20**. Sound power levels of relevant plant and equipment have been obtained from SLR Consulting database of similar equipment and the octave band spectral data are contained within **Appendix C**.

A summary of the predicted maximum noise levels at the most affected locations are contained within **Table 21**.

Table 20 Operational Sound Power Levels

Plant and Equipment	Sound Power Level dBA
Provisioning Facility	
4 x Locomotives (notch setting 1)	112 dBA
Wagons	94 dBA
Compressor	93 dBA
Forklift	102 dBA
Hand tools	101 dBA
Loco Maintenance Shed, Wash Bay and Wagon Shop	
4 x Locomotives (notch setting 1)	112 dBA
1 x Stationary Locomotive Notch setting 8	119 dBA
Locomotive wash	96 dBA
Compressor	93 dBA
Forklift	102 dBA
Hand tools	101 dBA
Wagon Placement tractor	104 dBA
Train Shunting[1]	125 dBA
Onsite Vehicles	
Truck Drive off	102 dBA

Notes: 1. Train shunting includes bunching, braking and wheel squeals

Other assumptions made in modelling the proposed operation include the following:

- All acoustically significant plant and equipment operates simultaneously.
- Mobile noise sources such as trains and wagons were modelled to account for their movement along the appropriate tracks.

7.2 Operational Scenario - Noise Model Summary

The operational scenario modelled during each period is summarised in **Table 21**. A tick (✓) indicates that the equipment is in operation during the relevant period. Where there is a number in brackets following a tick, this represents the number of pieces of the equipment that has been considered in the noise model during the relevant period. It should be noted that the operational scenario modelled is likely to represent an acoustically worst-case scenario.

Table 21 Operational Scenario Considered in Noise Model

Plant and Equipment	Day	Evening	Night
Provisioning Facility			
Loco and Wagons	✓(1)	✓(1)	✓(1)
Compressor	✓(1)	✓(1)	✓(1)
Forklift	✓(1)	✓(1)	✓(1)
Hand Tools as required	✓	✓	✓
Locomotive Maintenance Shed, Wash Bay and Wagon Shop			
Locomotive wash	✓(1)	✓(1)	✓(1)
Loco	✓(1)	✓(1)	✓(1)
Compressor	✓(1)	✓(1)	✓(1)
Forklift	✓(1)	✓(1)	✓(1)
Hand Tools as required	✓	✓	✓
Wagon Placement tractor	✓(1)	✓(1)	✓(1)
Train shunting	✓(1)	✓(1)	✓(1)

The TSF will provide a low key centre, with staff numbers of 30 on site associated with work at the facility. In addition, there will be up to 3 to 4 B-doubles required to access the site per day associated with fuel delivery. There will be other delivery vehicles e.g. sand, with the expected maximum volume of traffic amounting to 20 inbound and 20 outbound movements per day.

An estimation of potential traffic flows has been provided by Better Transport Futures Traffic Impact Assessment. Potential future traffic movements are contained in **Table 22**.

Table 22 Traffic Flows Associated with the Proposed Operational Phase of the TSF

Demand	Number per day	Inbound per day	Outbound per day	Total per day
Staff	30	30	30	60
Fuel	3	3	3	6
Delivery Vehicles	20	20	20	40
Total	53	53	53	106

7.3 Operational Noise Modelling Results and Discussion

Noise emission levels were predicted from the proposed TSF for the typical operational scenario described in **Table 21**. Noise from all sources that contribute to the total noise from the site have been examined to identify characteristics that may cause greater annoyance (for example tonality, impulsiveness etc). The appropriate modifying factors, as outlined in the INP, have been applied where these characteristics are considered to be present. A summary of the predicted operational noise levels from the proposed TSF are contained within **Table 23**. Noise contours for the operation were also produced and are contained in **Appendix D**.

Table 23 Predicted Noise Levels TSF

Location	Period	Predicted Noise Level $L_{Aeq(15minute)}$ Calm	Project Specific Noise Criteria $L_{Aeq(15minute)}$
R1 Hain Property	Day	35 dBA	46 dBA
	Evening	35 dBA	46 dBA
	Night	35 dBA	45 dBA
R2 Lynch Property	Day	<35 dBA	60 dBA
	Evening	<35 dBA	50 dBA
	Night	<35 dBA	45 dBA
R3 New England Highway	Day	45 dBA	60 dBA
	Evening	45 dBA	50 dBA
	Night	45 dBA	45 dBA
R4 Old Maitland Road (North)	Day	44 dBA	45 dBA
	Evening	44 dBA	45 dBA
	Night	44 dBA	44 dBA
R5 Old Maitland Road	Day	43 dBA	45 dBA
	Evening	43 dBA	45 dBA
	Night	43 dBA	44 dBA
R6 Old Maitland Road (South)	Day	42 dBA	45 dBA
	Evening	42 dBA	45 dBA
	Night	42 dBA	44 dBA
R7 Maitland Road	Day	<35 dBA	60 dBA
	Evening	<35 dBA	50 dBA
	Night	<35 dBA	45 dBA
R8 Church Old Maitland Road	Day	42[1] dBA	Internal when in use 40 dBA
	Evening	42[1] dBA	
	Night	42[1] dBA	
R9 Tarro Primary School	Day	<35[1] dBA	Internal Classroom 35 dBA
	Evening	<35[1] dBA	N/A
	Night	<35[1] dBA	N/A

Note: 1. These are external noise levels. As a conservative estimate, the difference between external to internal noise levels with a dwelling comprising of standard construction and windows open for adequate ventilation is 10 dB. As a result, the internal noise level for receiver R8 and R9 are <35dBA. These internal noise levels comply with the internal operational noise criteria presented in **Table 13**.

Operational noise levels from the proposed TSF are predicted to meet the project specific noise criteria at all receiver locations under prevailing weather conditions (calm) during day, evening and night periods.

Since the operational scenario modelled is likely to represent an acoustically worst-case scenario, actual operational noise levels from the proposed TSF are likely to be less than those predicted.

7.3.1 Operational Road Traffic Noise

The additional traffic movements proposed by the operation of the TSF would result in an insignificant change in traffic flow on the New England Highway given the existing traffic volumes. It is predicted that the additional daily traffic of up to 106 vehicles for the operation of the proposed TSF will result in a negligible change to the existing road traffic noise level generated from the New England Highway and therefore are predicted to meet the requirements of the RNP.

7.4 Sleep Disturbance Analysis

In assessing sleep disturbance, typical L_{Amax} noise levels of plant and equipment to be operated at the subject site, during the night, were used as input to the noise model and predictions were undertaken at the nearest potentially affected residential locations. The maximum noise level modelled is associated with impact noise from a shunting train and are presented in **Table 24**. Sound power levels of relevant plant and equipment have been obtained from SLR Consulting database and the octave band spectral data are contained within **Appendix C**. The use of the L_{Amax} noise level provides a worst-case prediction since the $L_{A1(1minute)}$ noise level of a noise event is likely to be less than the L_{Amax}.

A summary of the predicted maximum noise levels at the most affected locations are contained within **Table 25**.

Table 24 LAmax Sound Power Levels

Plant and Equipment	Sound Power Level dBA
Train shunting[1]	125

Notes: 1. Train shunting includes bunching, braking and wheel squeals

Table 25 Predicted Maximum Noise Levels at Night

Location	Locality	Period	Predicted Sleep Disturbance Noise Level	Sleep Disturbance Criteria $L_{1(1minute)}$
R1	Hain Property	Night	<45 dBA	56 dBA
R2	Lynch property	Night	<45 dBA	62 dBA
R3	New England Highway	Night	61 dBA	62 dBA
R4	Old Maitland Road (North)	Night	46 dBA	54 dBA
R5	Old Maitland Road	Night	51 dBA	54 dBA
R6	Old Maitland Road (south)	Night	54 dBA	54 dBA
R7	Maitland Road	Night	49 dBA	62 dBA
R8	Church Old Maitland Road	Night	N/A	N/A
R9	Tarro Primary School	Night	N/A	N/A

The predicted Sleep disturbance noise levels presented in **Table 25** comply with the sleep disturbance criteria at all assessment location.

7.5 Construction Noise

Construction at the site will consist of various phases including the following:

- Construction of road from Tarro interchange.
- Demolition clearing and drainage.
- Rail works.
- Building works.

A list of plant and equipment that has been assumed for the construction of the proposed TSF is summarised in **Table 26**. Sound power levels of construction equipment were obtained from a SLR Consulting database.

Furthermore, the transport route to and from the site will be via the New England Highway and a newly constructed roadway from the Tarro interchange. During the initial few months of construction, there will be in the order of 20 to 30 vehicles per day, whilst at its peak there could be in the order of 190 vehicles or so entering the site. Allowing for existing movements, this would indicate some 377 vehicles per day two-way associated with the construction works on site.

The results of construction noise predictions for the proposed TSF are contained within **Table 27** and show the worst case impact of all construction phases at each nearest residential receivers for the daytime period only. Noise predictions, summarised in **Table 27**, indicate that the construction of the TSF would comply with construction noise goals for the daytime period at all assessment locations. However, a marginal 2 dBA exceedance of the 'noise affected' management noise level is predicted at location R6 during Rail works but is well below the 'highly noise affect' management noise level. The exceedance is caused by the operation of the tamping machine.

Table 26 Construction Plant and Equipment

Plant and Equipment	Sound Power Level (L_{Aeq})
Road Construction	
Trucks as required	102 dBA
Excavator Loading	104 dBA
Dozer D9 or equivalent	111 dBA
Grader 12G or equivalent	111dBA
Compactor	110 dBA
Backhoe	104 dBA
Concrete Batching Plant	109 dBA
Frontend loader	111dBA
Trucks unloading into hopper	115 dBA
Cement bulk tanker unloading	109 dBA
Conveyor Drive	97 dBA
Crusher	115 dBA
General Construction Demolition Clearing and Drainage	
Trucks as required	102 dBA
Excavator Loading	104 dBA
Dozer D8 or equivalent	111 dBA
Excavator with hammer	112 dBA
Concrete transit mixer (deliveries)	112 dBA
Backhoe	103 dBA

Plant and Equipment	**Sound Power Level (L_{Aeq})**
Front End Loader	106 dBA
Concrete Batching Plant	109 dBA
Frontend loader	111dBA
Trucks unloading into hopper	115 dBA
Cement bulk tanker unloading	109 dBA
Conveyor Drive	97 dBA
Crusher	115 dBA
Rail Works	
Tamping Machine	117 dBA
Front end loader (30t Crane)	107 dBA
Roller	111 dBA
Truck as required	102 dBA
Grader	111 dBA
Concrete Batching Plant	109 dBA
Frontend loader	111dBA
Trucks unloading into hopper	115 dBA
Cement bulk tanker unloading	109 dBA
Conveyor Drive	97 dBA
Crusher	115 dBA
Building Works	
Trucks as required	102 dBA
Concrete transit mixer (deliveries)	112 dBA
Backhoe	104 dBA
Crane	101 dBA
Pile driving	127 dBA
Concrete Batching Plant	109 dBA
Frontend loader	111dBA
Trucks unloading into hopper	115 dBA
Cement bulk tanker unloading	109 dBA
Conveyor Drive	97 dBA
Crusher	115 dBA

Table 27 Construction Noise Predictions

Location	Activity	Weather Conditions	Predicted Noise Level $L_{Aeq(15minute)}$	Management Level $L_{Aeq(15minute)}$ (dBA)	
				Noise Affected	Highly Noise Affected
Road Construction					
R1 - Hain Property		Calm	41 dBA	51 dBA	75 dBA
R2 - Lynch Property			51 dBA	66 dBA	
R3 - New England Highway			57 dBA	66 dBA	
R4 - Old Maitland Road (North)			45 dBA	50 dBA	
R5 - Old Maitland Road			43 dBA	50 dBA	
R6 - Old Maitland Road (South)			49 dBA	50 dBA	
R7 - Maitland Road			41 dBA	66 dBA	
R8 - Church Old Maitland Road			49 dBA[1]	45 dBA internal	N/A
R9 - Tarro Primary School			54dBA[1]	45 dBA internal	N/A
Demolition Clearing and Drainage					
R1 - Hain Property		Calm	49 dBA	51 dBA	75 dBA
R2 - Lynch Property			39 dBA	66 dBA	
R3 - New England Highway			53 dBA	66 dBA	
R4 - Old Maitland Road (North)			46 dBA	50 dBA	
R5 - Old Maitland Road			44 dBA	50 dBA	
R6 - Old Maitland Road (South)			51 dBA	50 dBA	
R7 - Maitland Road			41 dBA	66 dBA	
R8 - Church Old Maitland Road			51 dBA[1]	45 dBA internal	N/A
R9 - Tarro Primary School			35 dBA[1]	45 dBA internal	N/A
Rail Works					
R1 - Hain Property		Calm	44 dBA	51 dBA	75 dBA
R2 - Lynch Property			39 dBA	66 dBA	
R3 - New England Highway			61 dBA	66 dBA	
R4 - Old Maitland Road (North)			49 dBA	50 dBA	
R5 - Old Maitland Road			47 dBA	50 dBA	
R6 - Old Maitland Road (South)			**52 dBA**	50 dBA	
R7 - Maitland Road			40 dBA	66 dBA	
R8 - Church Old Maitland Road			52 dBA[1]	45 dBA internal	N/A
R9 - Tarro Primary School			36 dBA[1]	45 dBA internal	N/A
Building Works					

R1 - Hain Property	Calm	43 dBA	51 dBA	75 dBA
R2 - Lynch Property		35 dBA	66 dBA	
R3 - New England Highway		56 dBA	66 dBA	
R4 - Old Maitland Road (North)		48 dBA	50 dBA	
R5 - Old Maitland Road		45 dBA	50 dBA	
R6 - Old Maitland Road (South)		41 dBA	50 dBA	
R7 - Maitland Road		<35 dBA	66 dBA	
R8 - Church Old Maitland Road		41 dBA[1]	45 dBA internal	N/A
R9 - Tarro Primary School		<35 dBA[1]	45 dBA internal	N/A

Note: Construction may only occur between the hours of 7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturdays. No construction work is to take place on Sundays or Public Holidays

1. These are external noise levels. As a conservative estimate, the difference between external to internal noise levels with a dwelling comprising of standard construction and windows open for adequate ventilation is 10 dB. As a result, the internal noise level for receiver R8 and R9 is 39 dBA and 44 dBA during road construction respectively, 41 dBA and <35 dBA during demolition works respectively, 42 dBA and <35 dBA during rail works respectively and <35 dBA during building works at both receiver R8 and R9. These internal noise levels comply with the internal construction noise criteria 45 dBA.

Where construction is required outside of normal construction hours, approval shall be sought from the relevant authorities. The need for and impacts of this construction shall be assessed on a case by case basis.

Although noise levels are predicted to be below the relevant guidelines at the closest residential receivers during construction the following measures should be considered to reduce the construction noise impact:

- Site noisy equipment behind structures that act as barriers or at the greatest distance from the noise-sensitive area or orient the equipment so that noise emissions are directed away from any sensitive areas.
- Keep equipment well maintained.
- Employ “quiet” practices when operating equipment (eg positioning and unloading of trucks in appropriate areas).
- A Construction Noise Management Plan should be prepared and implemented prior to commencement of construction works at the site. This should include the following:
  - Construction noise goals.
  - Recommendations regarding specific physical and managerial measures for controlling noise, noise and vibration monitoring programs and reporting procedures.
  - Measures for dealing with exceedances and mechanisms to provide ongoing community liaison.

With regard to potentially offensive noise events associated with construction activities AS 2436-1981 “*Guide to noise control on construction, maintenance and demolition sites”* provides the following:

If noisy operations must be carried out, then a responsible person should maintain liaison between the neighbouring community and the contractor. This person should inform the public at what time to expect noisy operations and also inform the contractor of any special needs of the public. Consultation and cooperation between the contractor and his neighbours and the removal of uncertainty and rumour can help to reduce the adverse reaction to noise.

7.5.1 Construction Road Traffic Noise

The additional traffic movements proposed by the construction of the TSF would result in an insignificant change in traffic flow on the New England Highway given the existing traffic volume. It is predicted that the additional daily traffic of up to 340 vehicles for the construction of the proposed TSF will result in a negligible change to the existing road traffic noise level generated from the New England Highway and therefore are predicted to meet the requirements of the RNP.

7.6 Vibration

7.6.1 Construction Vibration

The major vibration generating activities at the Hexham site will occur during the site preparation, access road construction and track construction. The only potential for vibration impact to occur is during the access road construction where construction activities will come within 215 m of residence R3 (Lynch Property). Measurements conducted by SLR Consulting indicate that the vibration level from a large vibratory roller/compactor would be <0.1 mm/s (peak particle velocity) at a distance of 215 m. This level of vibration would be below the level of human perception.

Due to the separation distance to this and other residential and commercial premises, the level of vibration caused by construction activities at the Hexham site is predicted to be below the level of human perception at any of the nearest premises and therefore below the criteria for “minimal risk of cosmetic damage” at surrounding residential and commercial premises.

7.6.2 Operational Vibration Levels

The major potential for vibration during the operation of the TSF would be from trains entering and leaving the site.

The level of vibration from a slow moving train and wagons was measured by SLR Consulting at another location in NSW and is suitable for comparison in this instance. The vibration level (peak particle velocity) was 0.3 mm/s at a distance of 26 m from the rail line. The closest residential receiver to the TSF rail movements would be approximately 138 m at R6 (New England Highway properties). At this distance the level of vibration of trains on the site would be below the level of human perception.

Due to the separation distance to this and other residential and commercial premises, the level of vibration caused by operational activities at the Hexham site is predicted to be below the level of human perception at any of the nearest premises and therefore below the criteria for “minimal risk of cosmetic damage” at surrounding residential and commercial premises.

8 AUSTRALIAN RAIL TRACK CORPORATION RELIEF ROADS PROJECT

The Australian Rail Track Corporation (ARTC) proposes to develop Hexham Relief Roads and associated infrastructure at Hexham in the NSW Hunter Valley (the Proposed Project). The Proposed Project is located at Hexham, approximately 176 kilometres north of Sydney by rail. Key components of the Proposed Project comprise:

- Five Up Relief Roads (train lines) to the west of the existing Up Main, Down Main and Up Coal including:
  - The removal of the existing Down Coal (located to the west of the Up Coal);
  - The construction of five new train lines (tracks) for the Relief Roads;
  - The construction of a new Down Coal to the west and outside of the proposed Relief Roads;

- Each Relief Road is to accommodate trains generally comprising two or three locomotives and up to 91 wagons (1,543m long) requiring a minimum standing room of 1,670m; and
- New turnouts, return curves and associated track changes.

- Installation of new signal infrastructure for the five Relief Roads including signal location cases, huts and gantries.
- Earth and civil works of approximately 265,000 cubic metres, including cut to fill, track formation, drainage and minor structures.
- Ancillary infrastructure including vehicle access tracks, temporary construction compounds and stockpile sites.
- Land acquisition and the upgrading of existing rail infrastructure and public utilities as required.
- Access road from Tarro Interchange to Woodlands Close

9 ASSESSMENT OF CUMULATIVE IMPACTS

9.1 Cumulative Operational Noise

The Aurizon TSF project has been assessed in accordance with the INP; in Section 1.3 of the INP the guideline states *the policy is focused on the noise emitted from industrial sites* and *examples of noise sources that are NOT dealt with by the policy are; transportation corridors (roadways, railways and air corridors)*.

The proposed Hexham Relief Roads project has been assessed to the Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects (IGANRIP); Section 1.4 of the IGANRIP states the guidelines does not apply to *projects involving maintenance facilities for rolling stock which should be assessed in accordance with the NSW Industrial Noise Policy (EPA 2000)*, or to *development where railway systems activities are not being undertaken*.

Therefore a cumulative operational assessment is not warranted in this instance. The INP and IGANRIP provide separate assessment methodology and are mutually exclusive.

Not withstanding the above, **Table 28**, **Table 29** and **Table 30** provide the day time, night time and maximum predicted cumulative noise levels assuming the predicted impacts from the TSF project are indicative of continuous operation during a 24 hour period.

It is relevant to note that predicted noise levels from the Parsons Brinckerhoff report '*Hexham Relief Roads – Noise and Vibration assessment*' dated 9 May 2012 have been referenced.

Table 28 Potential Cumulative Day Time Operational Noise impacts

Residential Receiver	Predicted Day Time Rail Noise LAeq, 15hr dBA		
	Hexham Relief Roads	**Aurizon TSF**	**Cumulative Both Projects**
R1 - Hain Property	49	35	49
R2 - Lynch Property	54	<35	54
R5 - Old Maitland Road	51	43	52
R6 - Old Maitland Road (South)	56	42	56
R7 - Maitland Road	61	<35	61
R8 – Church Old Maitland Road	57	42	57

Table 29 Potential Cumulative Night Time Operational Noise impacts

Residential Receiver	Predicted Night Time Rail Noise LAeq, 9hr dBA		
	Hexham Relief Roads	**Aurizon TSF**	**Cumulative Both Projects**
R1 - Hain Property	48	35	48
R2 - Lynch Property	54	<35	54
R5 - Old Maitland Road	50	43	51
R6 - Old Maitland Road (South)	55	42	55
R7 - Maitland Road	60	<35	60
R8 – Church Old Maitland Road	56	42	56

Table 30 Potential Cumulative Maximum Operational Noise impacts

Residential Receiver	Predicted Maximum Rail Noise LAmax dBA		
	Hexham Relief Roads	**Aurizon TSF**	**Cumulative Both Projects**
R1 - Hain Property	64	<45	64
R2 - Lynch Property	73	<45	73
R5 - Old Maitland Road	68	51	68
R6 - Old Maitland Road (South)	72	54	72
R7 - Maitland Road	79	49	79

Based on the predicted noise levels present in **Table 28**, **Table 29** and **Table 30** the influence of the Aurizon TSF operations is predicted not to result in an increase of cumulative noise levels above that of the proposed Hexham Relief Roads project alone except at receiver R5. A marginal increase of 1dBA is predicted at this location above that of Hexham Relief project which would not be noticeable by most people. The dominant influence on the cumulative noise levels at receiver locations is the operation of the Hexham Relief Roads. The TSF project is a negligible contributor to LAeq 15-hour and LAeq 9-hour noise levels compared to the Hexham Relief Roads project. The TSF project makes a negligible overall impact on the general ambient noise levels.

9.2 Cumulative Construction Noise

The TSF and Hexham Relief Roads project have the potential for simultaneous works to occur during construction. These projects have both been assessed using the ICNG. An assessment of the cumulative noise from concurrent construction is provided in **Table 31**.

Table 31 Cumulative Construction Noise Predictions

Location	Activity	Predicted Noise Level LAeq(15minute)		Cumulative Noise Level LAeq(15minute)	Management Level LAeq(15minute)	
					Noise Affected	Highly Noise Affected
		Hexham Relief Road	TSF			
Road Construction						
R1 - Hain Property		45 dBA	41 dBA	46 dBA	51 dBA	75 dBA
R2 - Lynch Property		**70 dBA**	51 dBA	**70 dBA**	66 dBA	75 dBA
R5 - Old Maitland Road		22 dBA	43 dBA	43 dBA	50 dBA	75 dBA
R6 - Old Maitland Road (South)		22 dBA	49 dBA	49 dBA	50 dBA	75 dBA
R7 - Maitland Road		18 dBA	41 dBA	41 dBA	66 dBA	75 dBA
R8 – Church Old Maitland Road		<10 dBA[1]	49 dBA[1]	49 dBA[1]	Internal 45 dBA	N/A
Demolition Clearing and Drainage						
R1 - Hain Property		45 dBA	49 dBA	50 dBA	51 dBA	75 dBA
R2 - Lynch Property		37 dBA	39 dBA	41 dBA	66 dBA	75 dBA
R5 - Old Maitland Road		**59 dBA**	44 dBA	**59 dBA**	50 dBA	75 dBA
R6 - Old Maitland Road (South)		**59 dBA**	51 dBA	**60 dBA**	50 dBA	75 dBA
R7 - Maitland Road		49 dBA	41 dBA	50 dBA	66 dBA	75 dBA
R8 – Church Old Maitland Road		**59 dBA[1]**	51 dBA[1]	**60dBA[1]**	Internal 45 dBA	N/A
Rail Works						
R1 - Hain Property		38 dBA	44 dBA	45 dBA	51 dBA	75 dBA
R2 - Lynch Property		30 dBA	39 dBA	40 dBA	66 dBA	75 dBA
R5 - Old Maitland Road		**54 dBA**	47 dBA	**55 dBA**	50 dBA	75 dBA
R6 - Old Maitland Road (South)		**54 dBA**	52 dBA	**56 dBA**	50 dBA	75 dBA
R7 - Maitland Road		58 dBA	40 dBA	58 dBA	66 dBA	75 dBA
R8 – Church Old Maitland Road		54 dBA[1]	52[1]dBA	**56 dBA[1]**	Internal 45 dBA	N/A
Building Works						
R1 - Hain Property		45 dBA	43 dBA	47 dBA	51 dBA	75 dBA
R2 - Lynch Property		28 dBA	35 dBA	36 dBA	66 dBA	75 dBA
R5 - Old Maitland Road		50 dBA	45 dBA	**51 dBA**	50 dBA	75 dBA
R6 - Old Maitland Road (South)		50 dBA	41 dBA	**51 dBA**	50 dBA	75 dBA
R7 - Maitland Road		49 dBA	<35 dBA	49 dBA	66 dBA	75 dBA
R8 – Church Old Maitland Road		47 dBA[1]	41 dBA[1]	48 dBA[1]	Internal 45 dBA	N/A

Note: Construction may only occur between the hours of 7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturdays. No construction work is to take place on Sundays or Public Holidays

1. These are external noise levels. As a conservative estimate, the difference between external to internal noise levels with a dwelling comprising of standard construction and windows open for adequate ventilation is 10 dB. As a result, the internal noise level for receiver R8 is 39 dBA during road construction, 50 dBA during demolition works, 46 dBA during rail works and 38 dBA during building works. These internal noise levels comply with the internal construction noise criteria 45 dBA during road construction and building works. However, exceeded noise levels of 5 dBA and 1 dBA during demolition and rail works respectively are predicted above the internal noise level criteria of 45 dBA.

Noise predictions, summarised in **Table 31**, indicate that the cumulative construction noise predictions for the TSF and Hexham Relief Road project would comply with construction noise affected noise management levels for the daytime period at all assessment locations with the exception of R2 during road construction (Hexham Relief Road project), R5 and R6 during demolition and clearing (Hexham Relief Road project), R5 and R6 during railworks (both projects) and R5 and R6 during building works (both projects). The potential cumulative construction works are below the ‘highly noise affected’ management noise level at all times.

Furthermore, the cumulative construction internal noise levels (internal) for assessment location R8 are predicted to comply with the construction noise management levels during road construction and building works. However the construction noise levels are predicted to be above the noise affect management noise levels for demolition and clearing and during rail construction if both the Hexham Relief road project and TSF were to occur simultaneously.

Since the church services at location R8 are predominantly on Sundays, and outside the proposed construction time periods, there will be no impact from simultaneous construction. However, if church services are required during construction time periods (7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturdays), it is recommended that Aurizon liaise with the church officials and coordinate the Aurizon and ARTC construction activities to avoid simultaneous construction during these time periods wherever possible.

9.3 Potential Cumulative Road Traffic Noise Impacts

As the TSF has proposed to use a private access road (which has been assessed in accordance with the INP) the impact of noise from construction and operational traffic impact is negligible and hence the potential cumulative traffic impact is also negligible.

9.4 Potential Cumulative Ground Vibration Impacts

Consistent with the Parsons Brinckerhoff report, based on the separation distance to nearest receivers, potential vibration impacts for both projects would be below the level of human perception and of minimal risk to cause cosmetic damage.

A quantitative prediction of cumulative ground vibration is not considered to be necessary to assess cumulative impacts.

10 CONCLUSION

SLR Consulting has assessed the overall noise and vibration impacts of the proposed TSF in relation to the relevant criteria. The proposed development is considered to be appropriate for the location and is predicted to comply and maintain noise and vibration impacts within acceptable limits at surrounding residential and commercial receivers.

10.1 Existing Acoustical Environment

An ambient noise monitoring program was conducted by SLR Consulting. Ambient noise levels were monitored at four separate locations, considered to be representative of the nearest potentially affected receivers to the site. The objective of this survey was to measure $L_{A90(15minute)}$ and $L_{Aeq(15minute)}$ noise levels at the nearest potentially affected residential locations during the day, evening and night-time periods to enable the determination of the intrusiveness and amenity criteria for the proposed development in accordance with the NSW Industrial Noise Policy (INP).

10.2 Operational Noise Predictions

A computer model was used to predict noise emissions from the proposed TSF. The model used SoundPLAN software, developed by Braunstein and Berndt Gmbh in Germany. The modelling software is widely used and has been proven to be applicable to local conditions. Noise levels were predicted for the general operational scenario summarised in **Section 7.2**.

Operational noise levels from the proposed TSF are predicted to meet the project specific noise criteria at all receiver locations under prevailing weather conditions (calm) during day, evening and night periods.

Since the operational scenario modelled is likely to represent an acoustically worst-case scenario, actual operational noise levels from the proposed TSF are likely to be less than those predicted.

Operational Road Traffic Assessment

The additional traffic movements proposed by the operation of the TSF would result in an insignificant change in traffic flow on the New England Highway given the existing traffic volumes. It is predicted that the additional daily traffic of up to 106 vehicles for the operation of the proposed TSF will result in a negligible change to the existing road traffic noise level generated from the New England Highway and therefore likely to meet the requirements of the RNP.

Sleep Disturbance Assessment

Predicted maximum noise levels from operation of the proposed TSF, particularly in relation to impact noise from the shunting of trains, during the night-time period are predicted to meet the recommended sleep disturbance noise goal at all residences.

10.3 Construction Noise Assessment

Noise predictions, summarised in **Table 27**, indicate that the construction of the TSF would comply with construction noise goals for the daytime period at all assessment locations. However, a marginal 2dBA exceedance of the ‘noise affected’ management noise level is predicted at location R6 during Rail works but is well below the ‘highly noise affected’ management noise level. The exceedance is caused by the operation of the tamping machine.

Where rail related construction work has to be carried out in close proximity to an operational rail network the need for work to be undertaken outside the standard hours often arises. In many cases, work that needs to be carried out safely in close proximity to the live rail network can only be undertaken during periods of scheduled trackwork (ie track possessions) which are typically scheduled during periods of lower rail usage (i.e. overnight, weekends and holiday periods).

Additionally, at the interfaces between other transport (eg. road) and utility (eg. water, sewer, telecommunications) infrastructure, construction during the standard hours may not be possible due to the need to avoid unacceptable impacts on traffic or water, power or communications services.

Where out of hours construction is required approval will be sought from the relevant authorities and the impact assessed on a case by case basis.

Construction Road Traffic Noise Assessment

The additional traffic movements proposed by the construction of the TSF would result in an insignificant change in traffic flow on the New England Highway given the existing traffic volume. It is predicted that the additional daily traffic of up to 340 vehicles for the construction of the proposed TSF will result in a negligible change to the existing road traffic noise level generated from the New England Highway and therefore likely to meet the requirements of the RNP.

10.4 Vibration Assessment

Due to the separation distance to residential and commercial premises, the level of vibration caused by construction and operational activities at the Hexham site is predicted to be below the level of human perception at any of the nearest premises and therefore below the criteria for “minimal risk of cosmetic damage” at surrounding residential and commercial premises.

10.5 Cumulative Assessment

10.5.1 Cumulative Operational Noise

The influence of the Aurizon TSF operations is predicted not to result in an increase of cumulative noise levels above that of the proposed Hexham Relief Roads Project alone except at receiver R5. A marginal increase of 1dBA is predicted at this location above that of Hexham Relief project which would not be noticeable by most people. The dominant influence on the cumulative noise levels at receiver locations is the operation of the Hexham Relief Roads. The TSF project is a negligible contributor to LAeq 15-hour and LAeq 9-hour noise levels compared to the Hexham Relief Roads project. The TSF project makes a negligible overall impact on the general ambient noise levels.

10.5.2 Cumulative Construction Noise

The major potential for cumulative noise impact is during the construction phase of the TSF and proposed Hexham Relief Roads project. The potential cumulative construction works are below the ‘highly noise affect’ management noise level at all times.

However, predicted noise levels at assessment location R8 are predicted to be above the noise affected management levels during demolition and clearing and during rail construction if both the Hexham Relief road project and Hexham Train Support Facility were to occur simultaneously.

Since the church services at location R8 are predominantly on Sundays, and outside the proposed construction time periods, there will be no impact from simultaneous construction. However, if church services are required during construction time periods (7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturdays), it is recommended that Aurizon liaise with the church officials and coordinate the Aurizon and ARTC construction activities to avoid simultaneous construction during these time periods wherever possible.

11 RECOMMENDATIONS

11.1 Operational Noise and Vibration Mitigation and Management

Operational noise levels are predicted to be below the relevant guidelines at the closest residential receivers and therefore noise mitigation is not required. However, it is recommended that the proponent monitors noise from the operational activities. The results of this monitoring determine whether compliance is being achieved, and whether noise mitigation is warranted for the site. If mitigation is found to be warranted the following general noise mitigation procedures will be adopted.

11.1.1 General Noise Mitigation Options for Industrial Sources

Additional mitigation options that would be considered if required for noise control are:

- Control noise at the source.
- Best Management Practice (BMP)
- Best Available Technology Economically Achievable (BATEA).
- Control the transmission of noise.
- Use barriers and land-use controls to attenuate noise by increasing the distance between source and receiver.

11.1.2 Controlling Noise at the Source

Best Management Practice

Best Management Practice (BMP) may be adopted for particular operational procedures that minimise noise while retaining productive efficiency.

When an appropriate mitigation strategy that incorporates expensive engineering solutions is being considered, the extent to which cheaper, non-engineering-oriented BMP can contribute to the required reduction of noise will be taken into account.

Application of BMP will include the following types of practice:

- Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise.
- Keeping equipment well maintained.
- Restricting truck speed on the site to reduce noise from the transport operation.
- Employing “quiet” practices when operating equipment (eg positioning and unloading of trucks in appropriate areas).
- Running staff-education programmes on the effects of noise and the use of quiet work practices.

Best Available Technology Economically Achievable (BATEA)

Equipment, plant and machinery that produce noise will incorporate advanced and affordable technology to minimise noise output.

Where BMP fails to achieve the required noise reduction by itself, the BATEA approach will be considered. Uses of BATEA which will be considered are:

- Using a non-acoustic warning method to warn of a vehicles reversing or if this method does not prove satisfactory for safety reasons, adjusting the reversing alarm volume on heavy equipment to make them “smarter”, by limiting acoustic range to immediate danger area.
- Using pieces of equipment with efficient muffler design.
- Using vehicles with quieter engines.
- Active noise control.

11.1.3 Controlling Noise in Transmission

Barriers

Barriers are more effective if they are near the source or the receiver. Their effectiveness is also determined by their height, the materials used (absorptive or reflective) and their density. The relationship of these design features to attenuation is well documented.

Barriers can take a number of forms - including free-standing walls, grass or earth mounds or bunds, and trenches or cuttings within which noise sources are sited. They are employed when source and receiver control is either impractical or too costly.

11.2 Construction Noise Mitigation

Although noise levels are predicted to be below the relevant guidelines at the closest residential receivers during construction the following measures should be considered to reduce the construction noise impact:

- Site noisy equipment behind structures that act as barriers or at the greatest distance from the noise-sensitive area or orient the equipment so that noise emissions are directed away from any sensitive areas.
- Keep equipment well maintained.
- Employ "quiet" practices when operating equipment (eg positioning and unloading of trucks in appropriate areas).
- A Construction Noise Management Plan should be prepared and implemented prior to commencement of construction works at the site. This should include the following:
  - Construction noise goals.
  - Recommendations regarding specific physical and managerial measures for controlling noise, noise and vibration monitoring programs and reporting procedures.
  - Measures for dealing with exceedances and mechanisms to provide ongoing community liaison.

With regard to potentially offensive noise events associated with construction activities AS 2436-1981 "*Guide to noise control on construction, maintenance and demolition sites"* provides the following:

If noisy operations must be carried out, then a responsible person should maintain liaison between the neighbouring community and the contractor. This person should inform the public at what time to expect noisy operations and also inform the contractor of any special needs of the public. Consultation and cooperation between the contractor and his neighbours and the removal of uncertainty and rumour can help to reduce the adverse reaction to noise.

12 CLOSURE

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Aurizon Operations Limited. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR Consulting.

SLR Consulting disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

1 Sound Level or Noise Level

The terms "sound" and "noise" are almost interchangeable, except that in common usage "noise" is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2E-5 Pa.

2 "A" Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an "A-weighting" filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120 110	Heavy rock concert Grinding on steel	Extremely noisy
100 90	Loud car horn at 3 m Construction site with pneumatic hammering	Very noisy
80 70	Kerbside of busy street Loud radio or television	Loud
60 50	Department store General Office	Moderate to quiet
40 30	Inside private office Inside bedroom	Quiet to very quiet
20	Unoccupied recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as "linear", and the units are expressed as dB(lin) or dB.

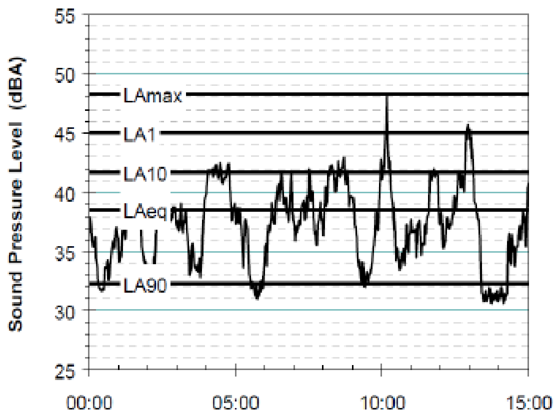
3 Sound Power Level

The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 1E-12 W.
The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

L_{Aeq} The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the "repeatable minimum" L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or "average" levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than "broad band" noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

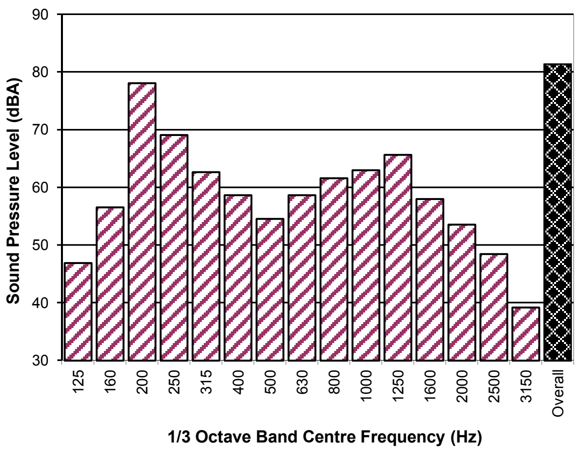
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of "peak" velocity or "rms" velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as "peak particle velocity", or PPV. The latter incorporates "root mean squared" averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/V_o), where V_o is the reference level (1E-6 mm/s). Care is required in this regard, as other reference levels are used by some organizations.

9 Human Perception of Vibration

People are able to "feel" vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

10 Over-Pressure

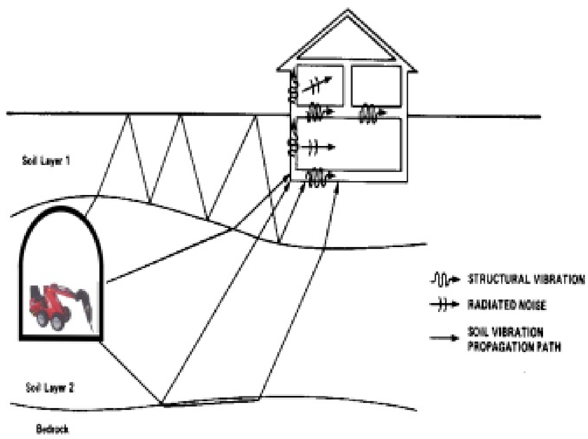
The term "over-pressure" is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Regenerated Noise

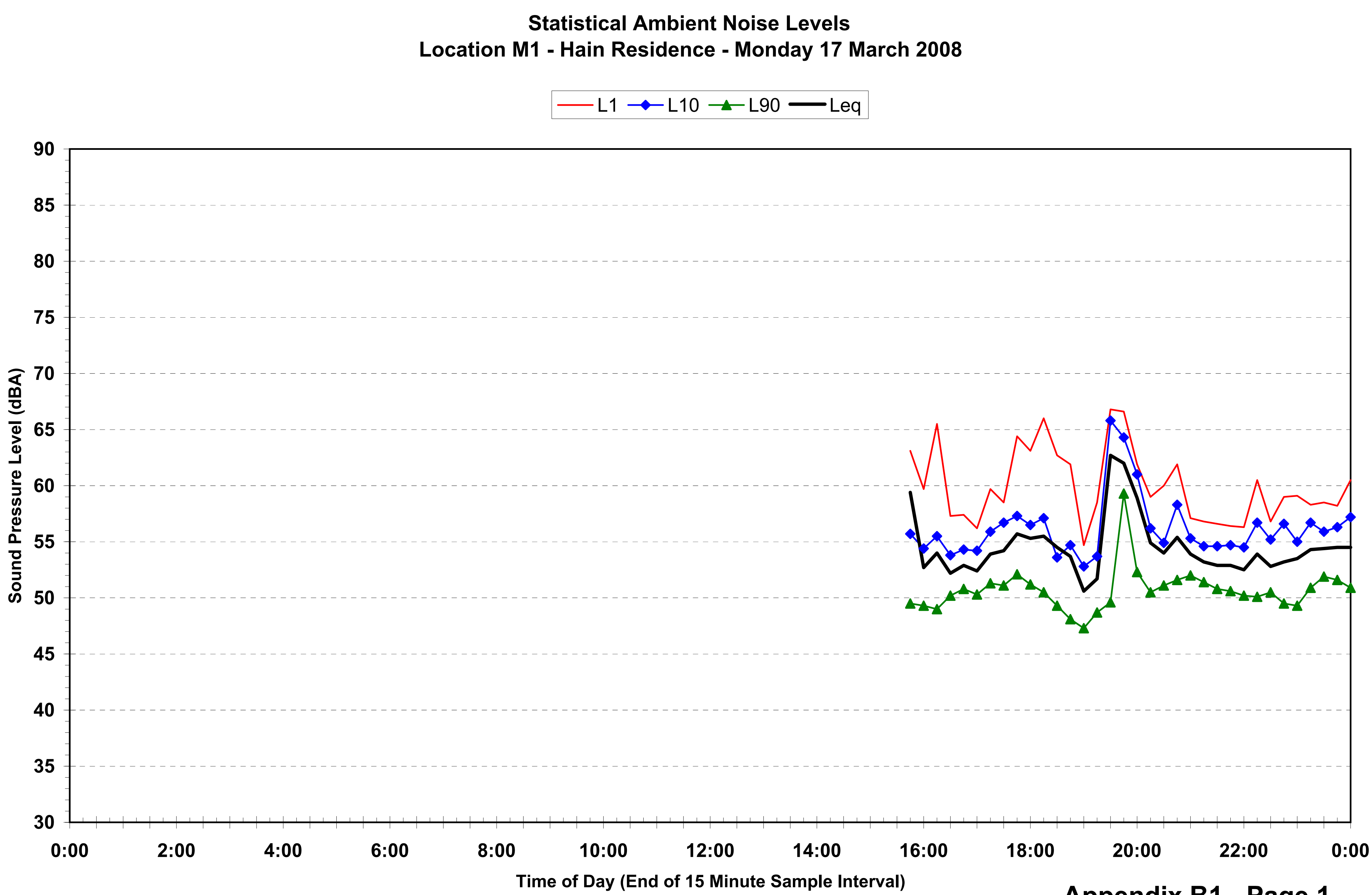
Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed "regenerated noise", "structure-borne noise", or sometimes "ground-borne noise". Regenerated noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

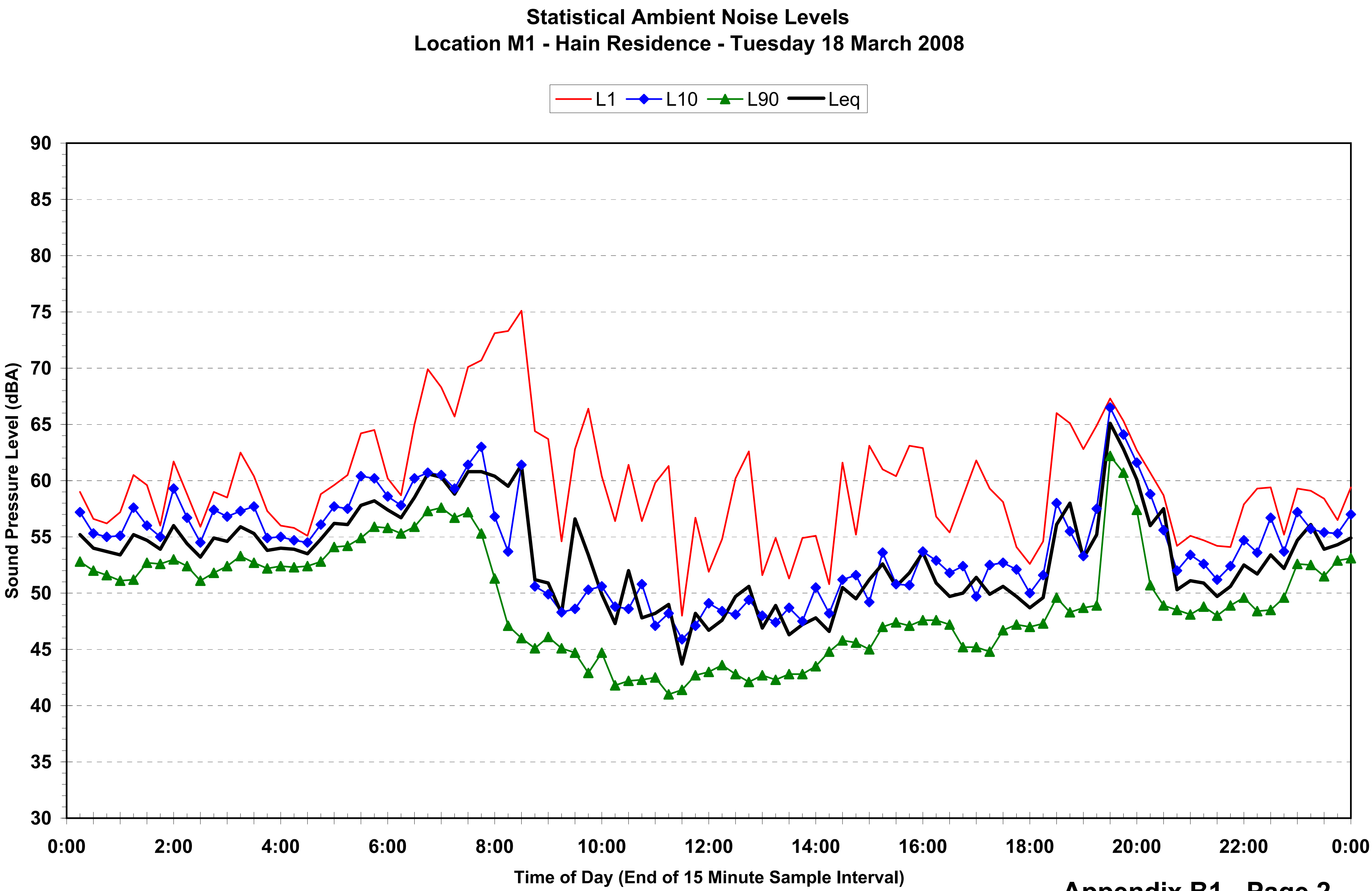
Typical sources of regenerated noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and regenerated noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term "regenerated noise" is also used to describe other types of noise that are emitted from the primary source as a different form of energy. One example would be a fan with a silencer, where the fan is the energy source and primary noise source. The silencer may effectively reduce the fan noise, but some additional noise may be created by the aerodynamic effect of the silencer in the airstream. This "secondary" noise may be referred to as regenerated noise.


Statistical Ambient Noise Levels
Location M1 - Hain Residence - Monday 17 March 2008
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)



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Statistical Noise Levels

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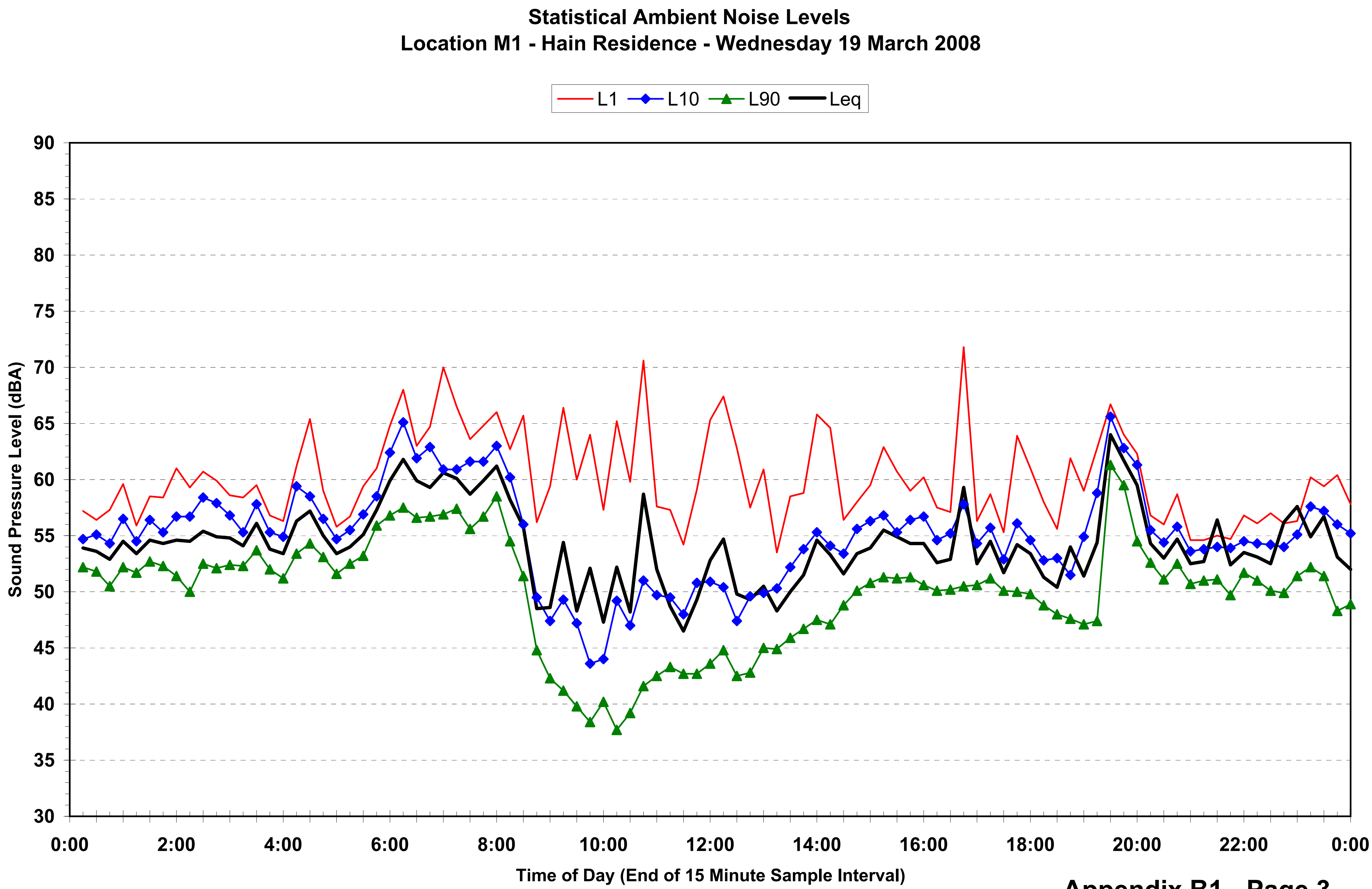

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Statistical Noise Levels

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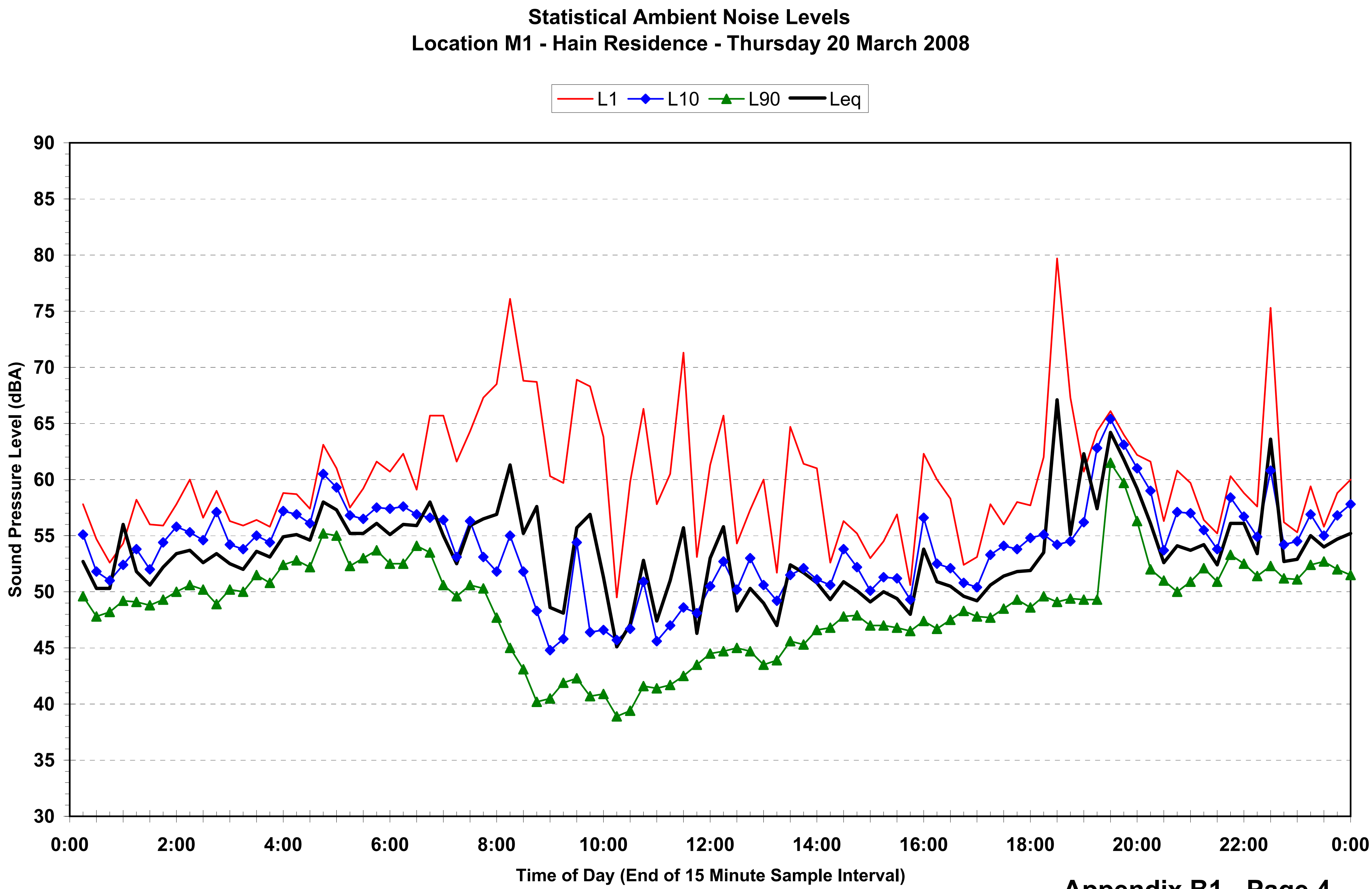

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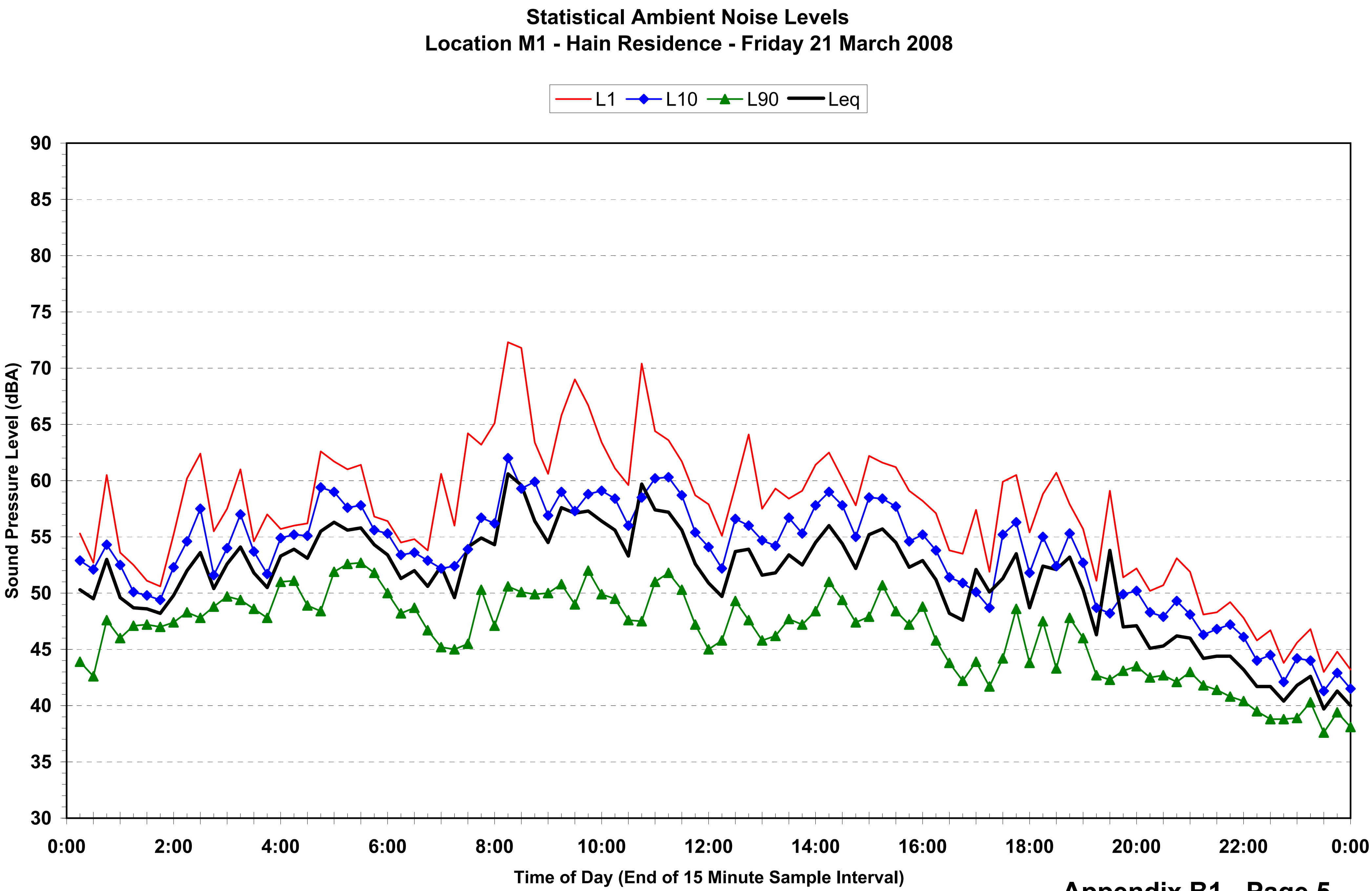
Statistical Noise Levels

SLR Consulting Report 30-1858


Statistical Ambient Noise Levels
Location M1 - Hain Residence - Friday 21 March 2008
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
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18:00
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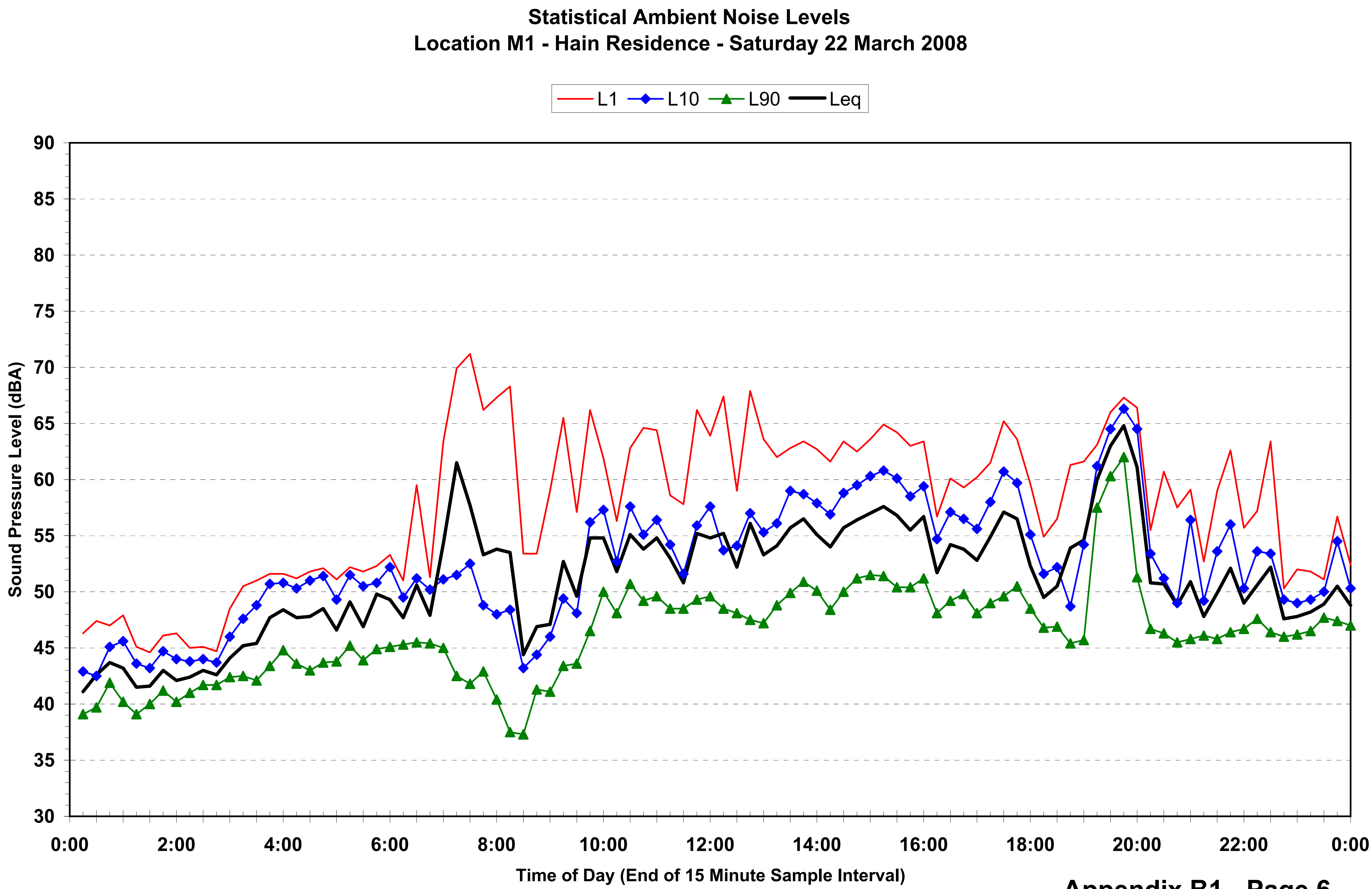
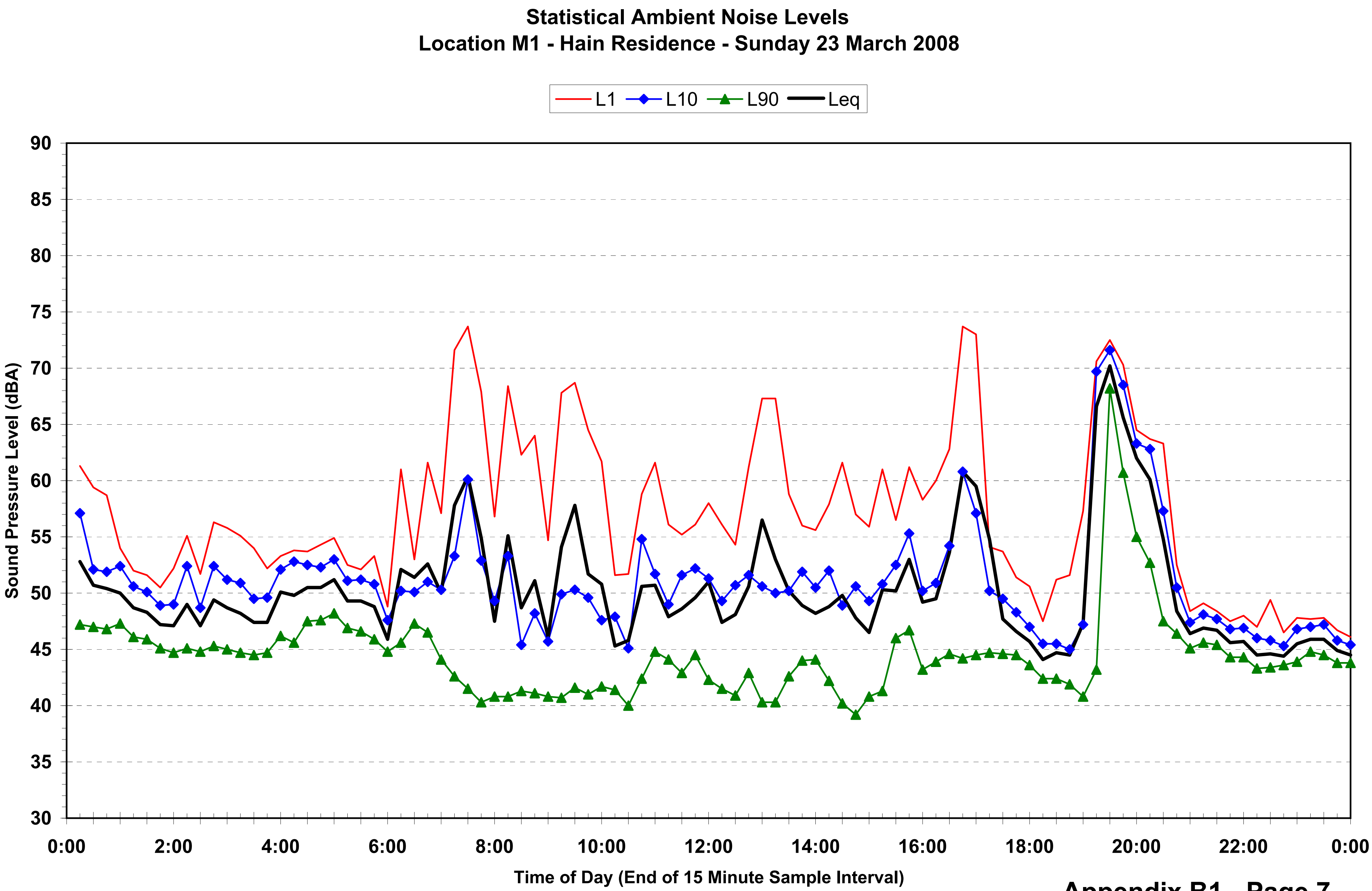
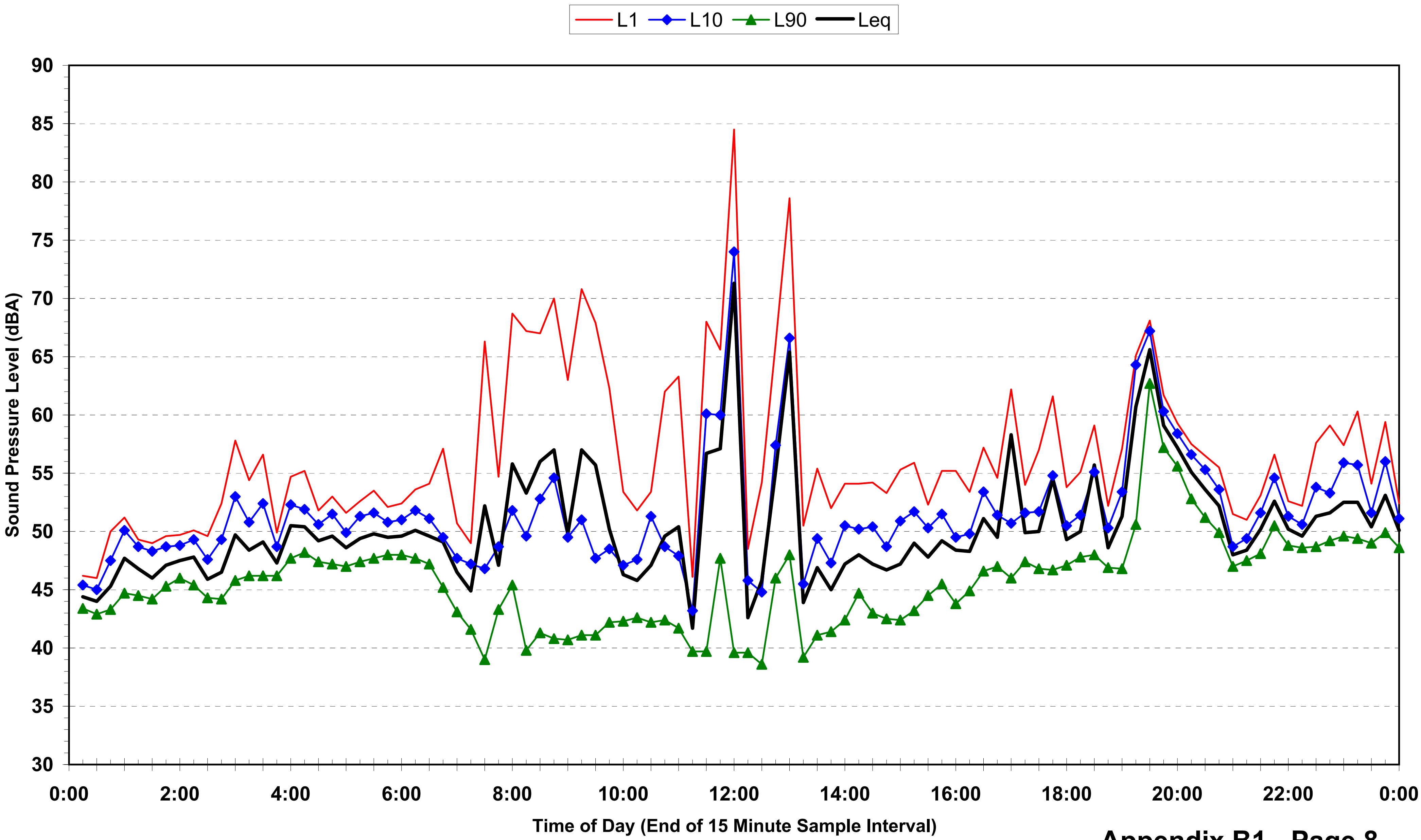
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)

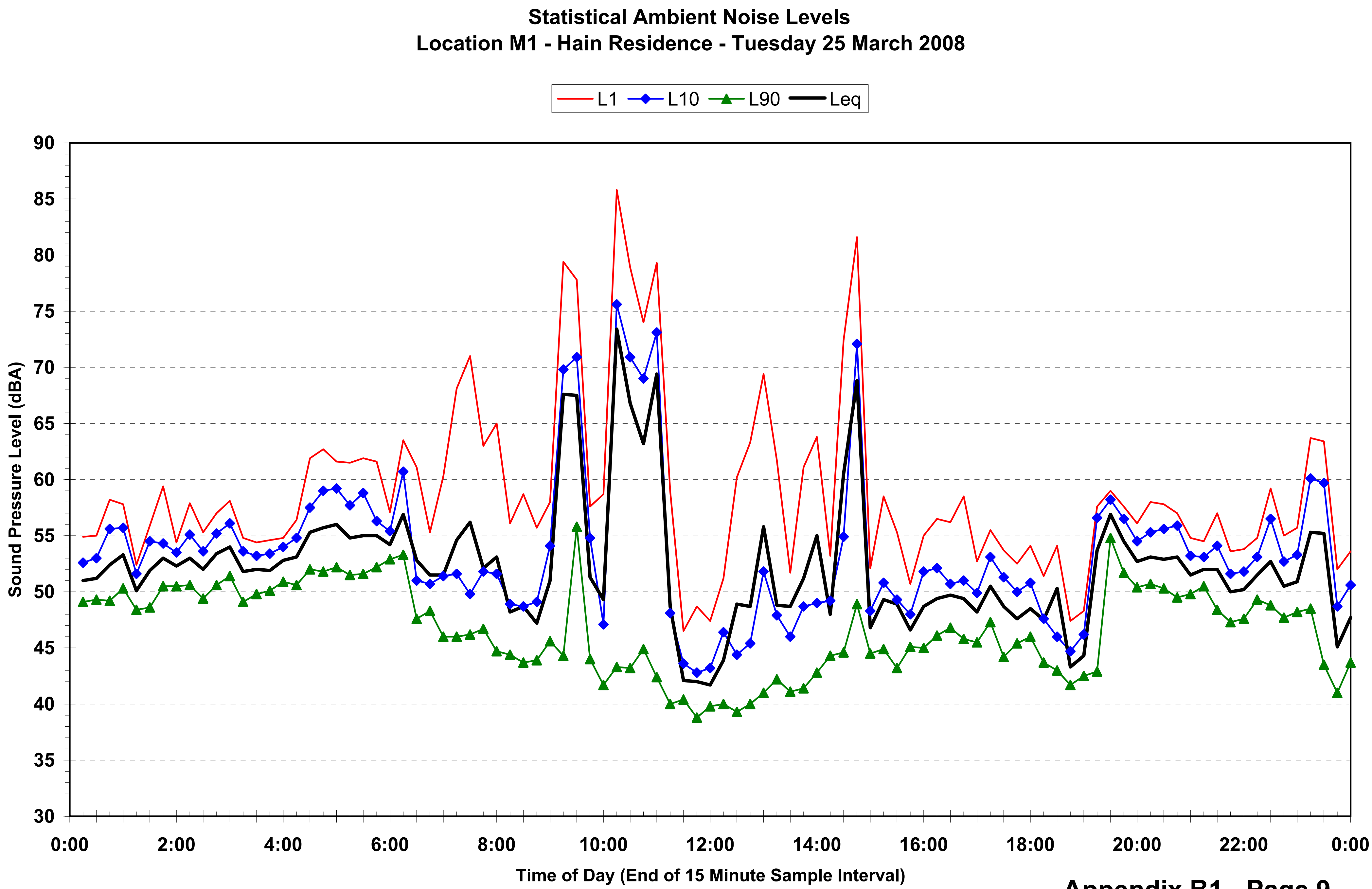


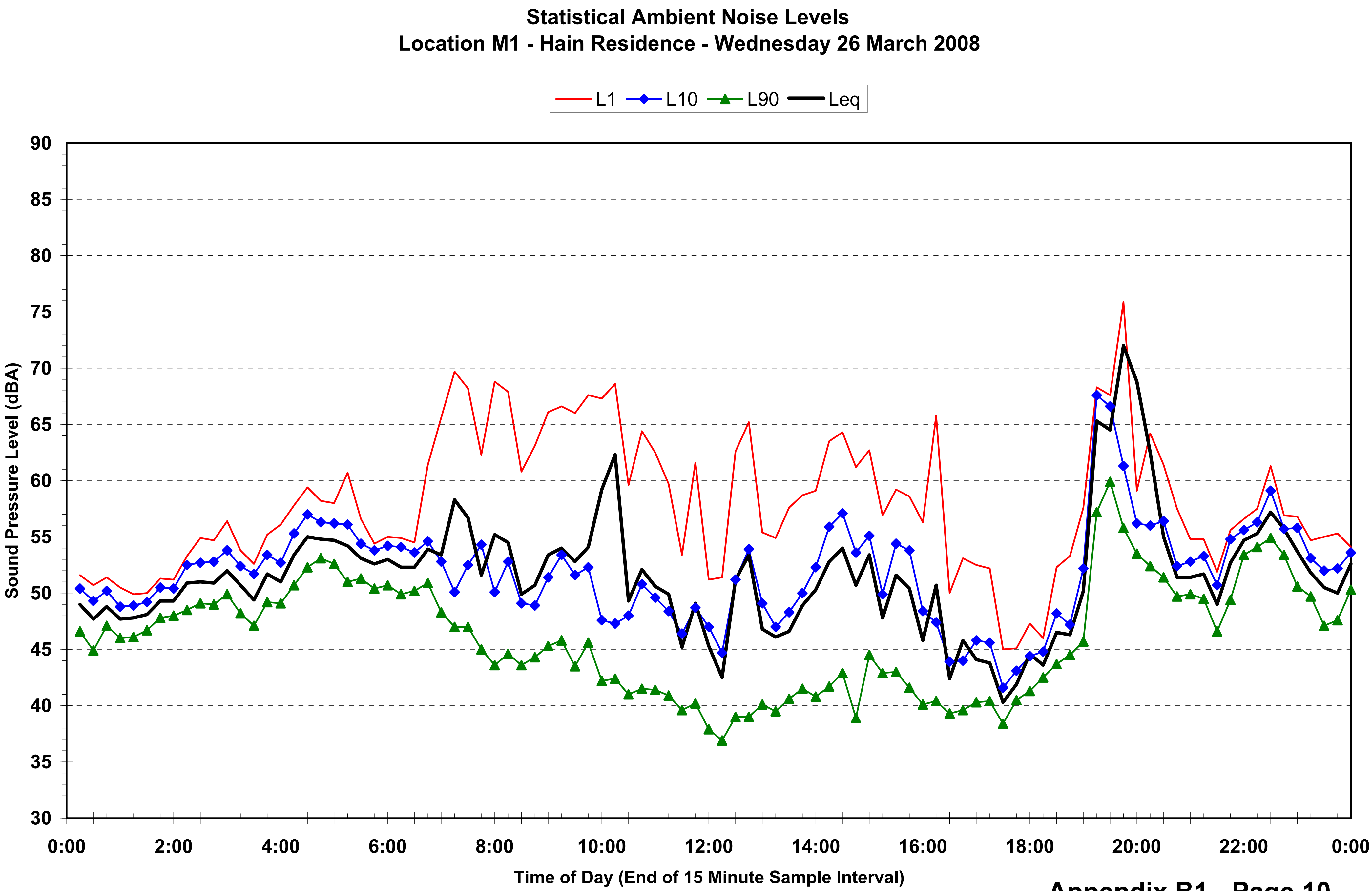
Statistical Ambient Noise Levels
Location M1 - Hain Residence - Saturday 22 March 2008
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Location M1 - Hain Residence - Sunday 23 March 2008
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)

Statistical Ambient Noise Levels
Location M1 - Hain Residence - Monday 24 March 2008




Statistical Ambient Noise Levels
Location M1 - Hain Residence - Tuesday 25 March 2008
L1
L10
L90
Leq
90
85
80
75
70
65
60
55
50
45
40
35
30
Sound Pressure Level (dBA)
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)



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Statistical Noise Levels

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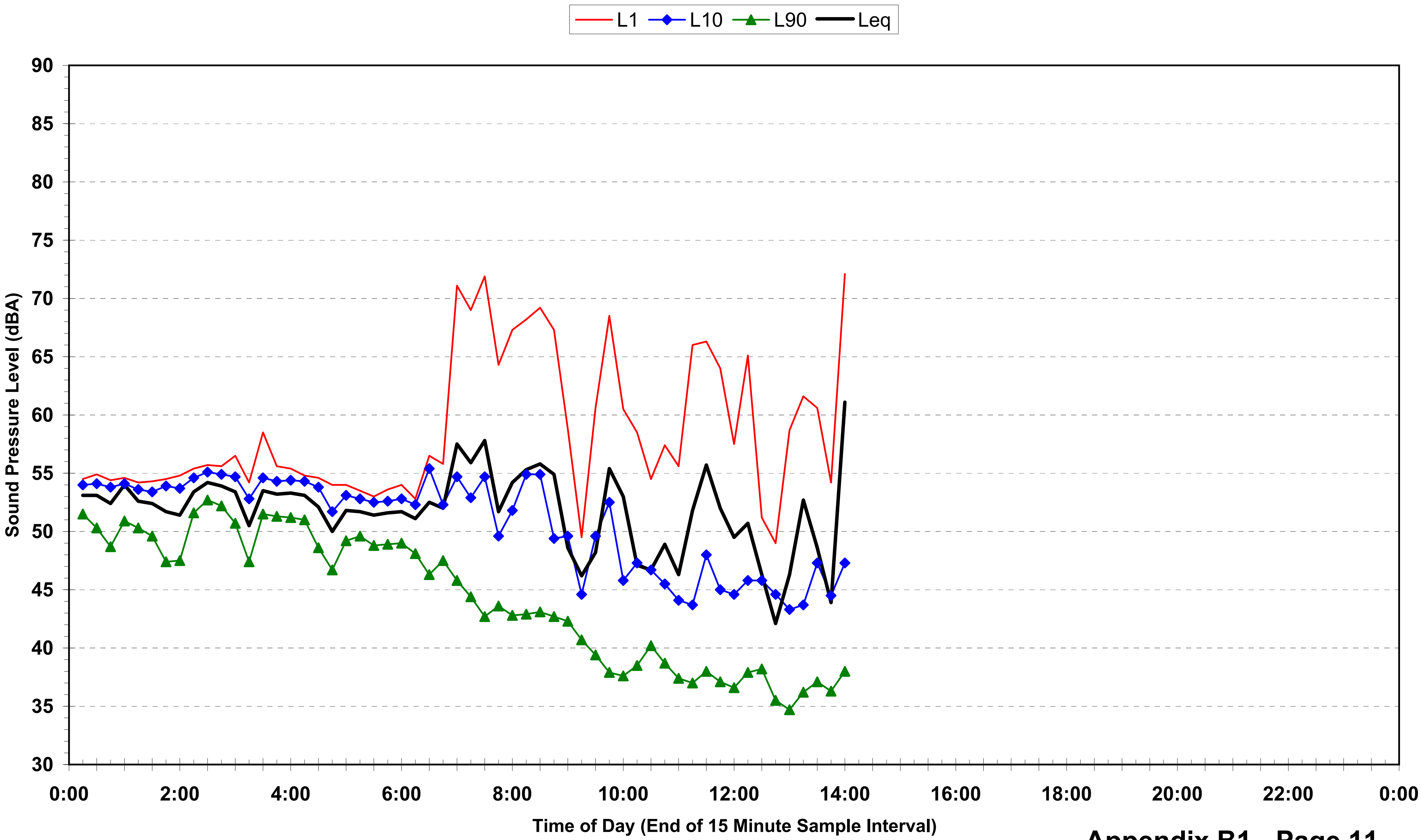
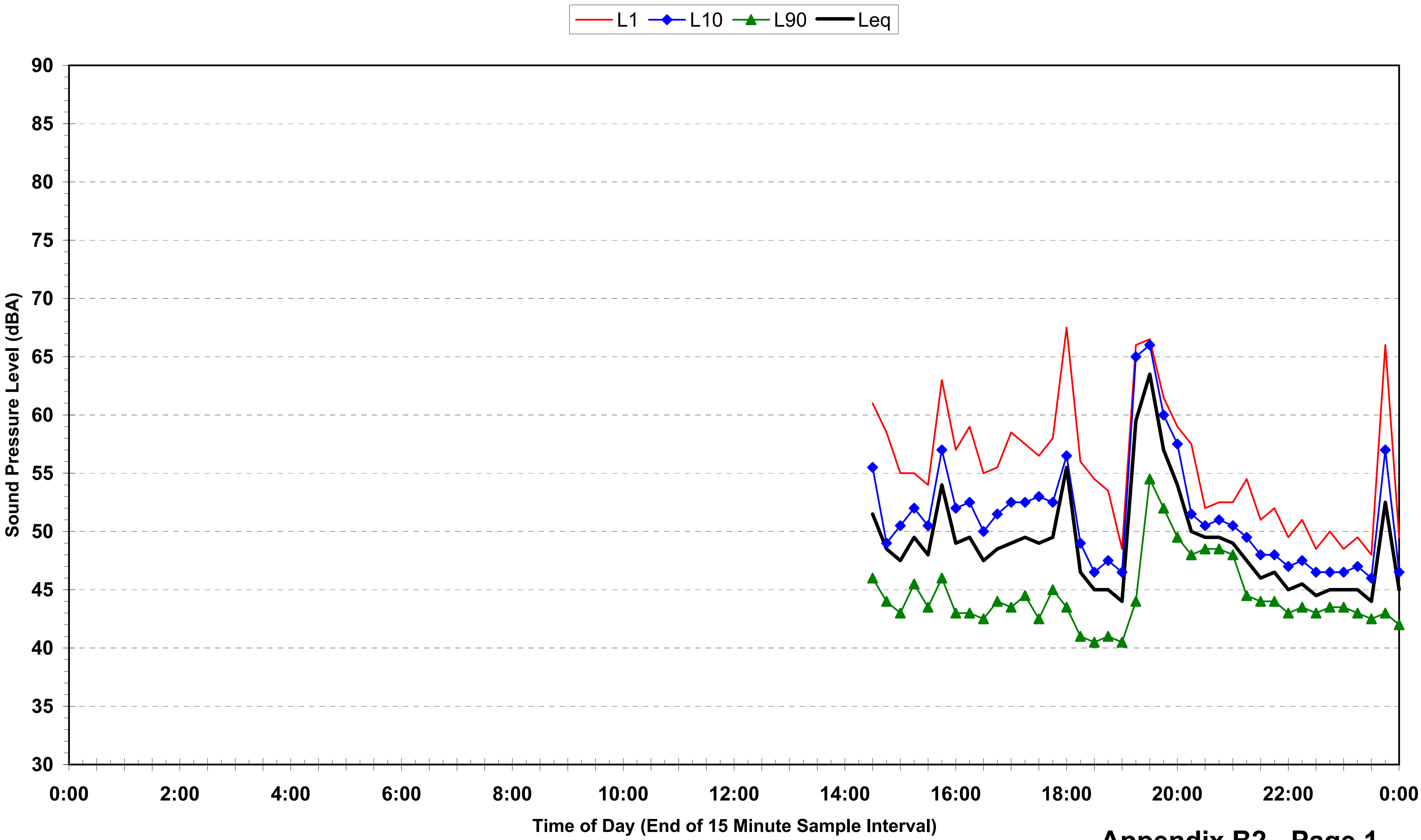
Statistical Ambient Noise Levels
Location M1 - Hain Residence - Thursday 27 March 2008



Statistical Noise Levels
SLR Consulting Report 30-1858

Statistical Ambient Noise Levels
Location M3 - Old Maitland Road - Friday 17 March 2056



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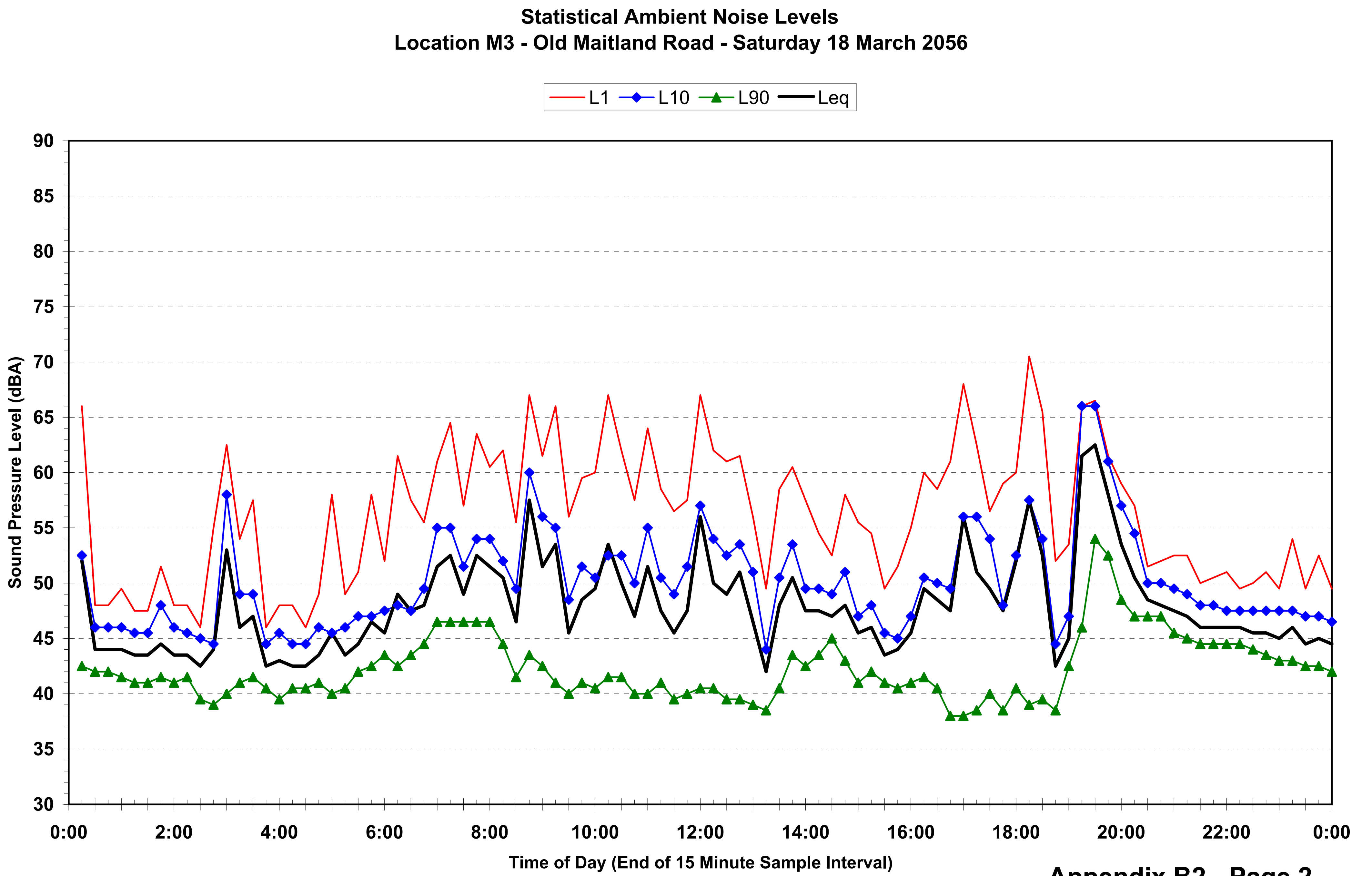

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Statistical Noise Levels

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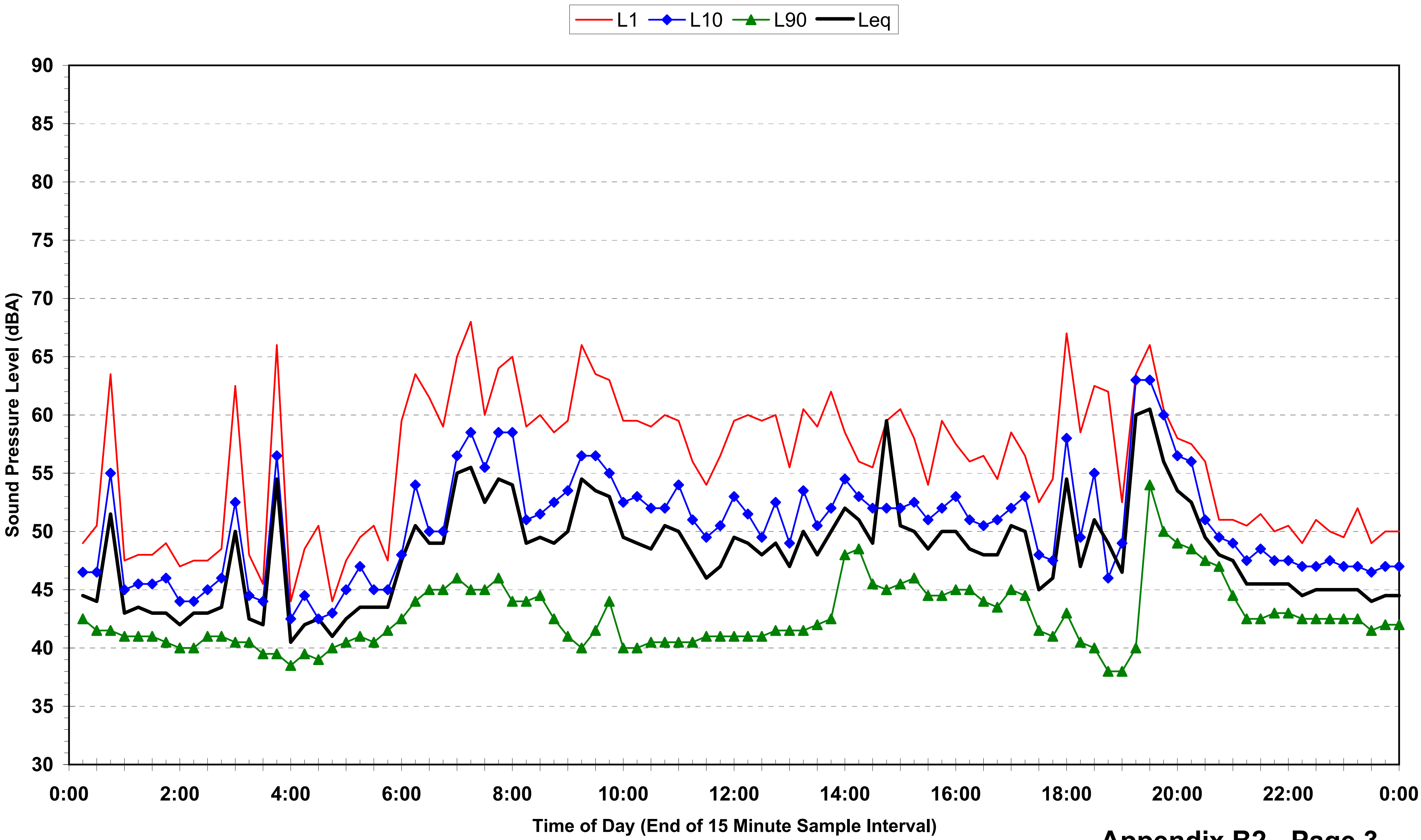
Statistical Ambient Noise Levels
Location M3 - Old Maitland Road - Sunday 19 March 2056



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Statistical Noise Levels

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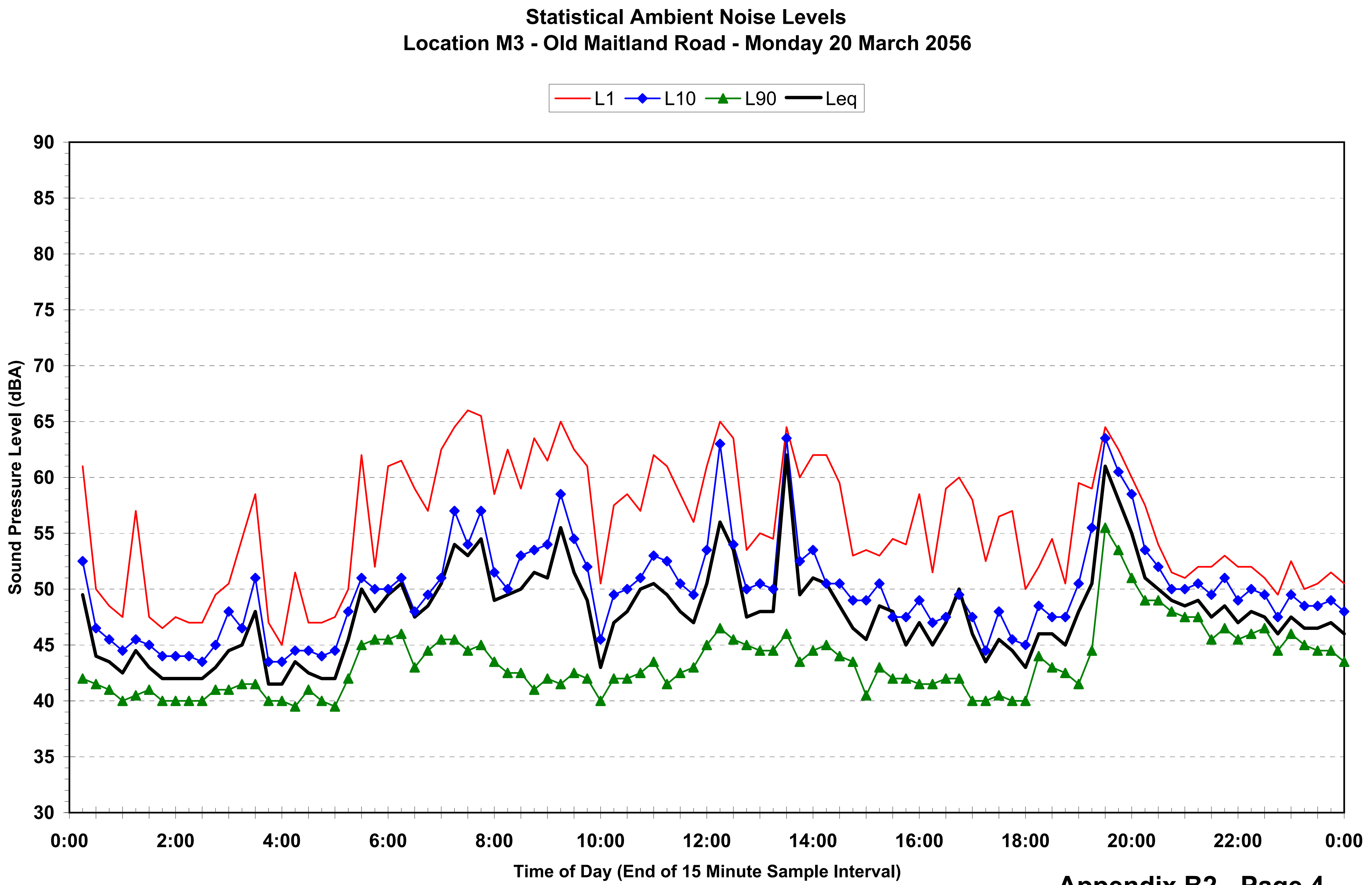

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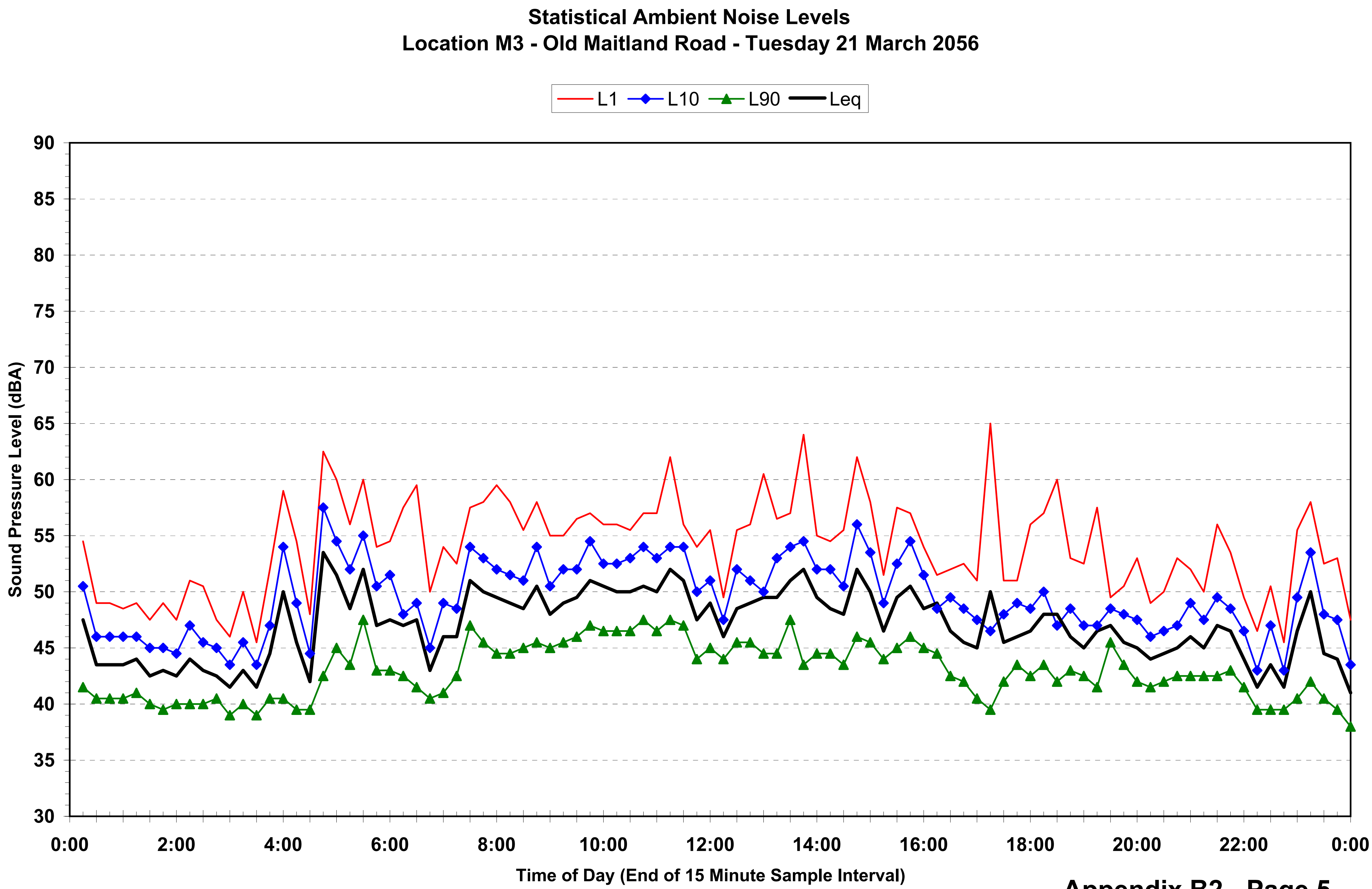
Statistical Noise Levels

SLR Consulting Report 30-1858



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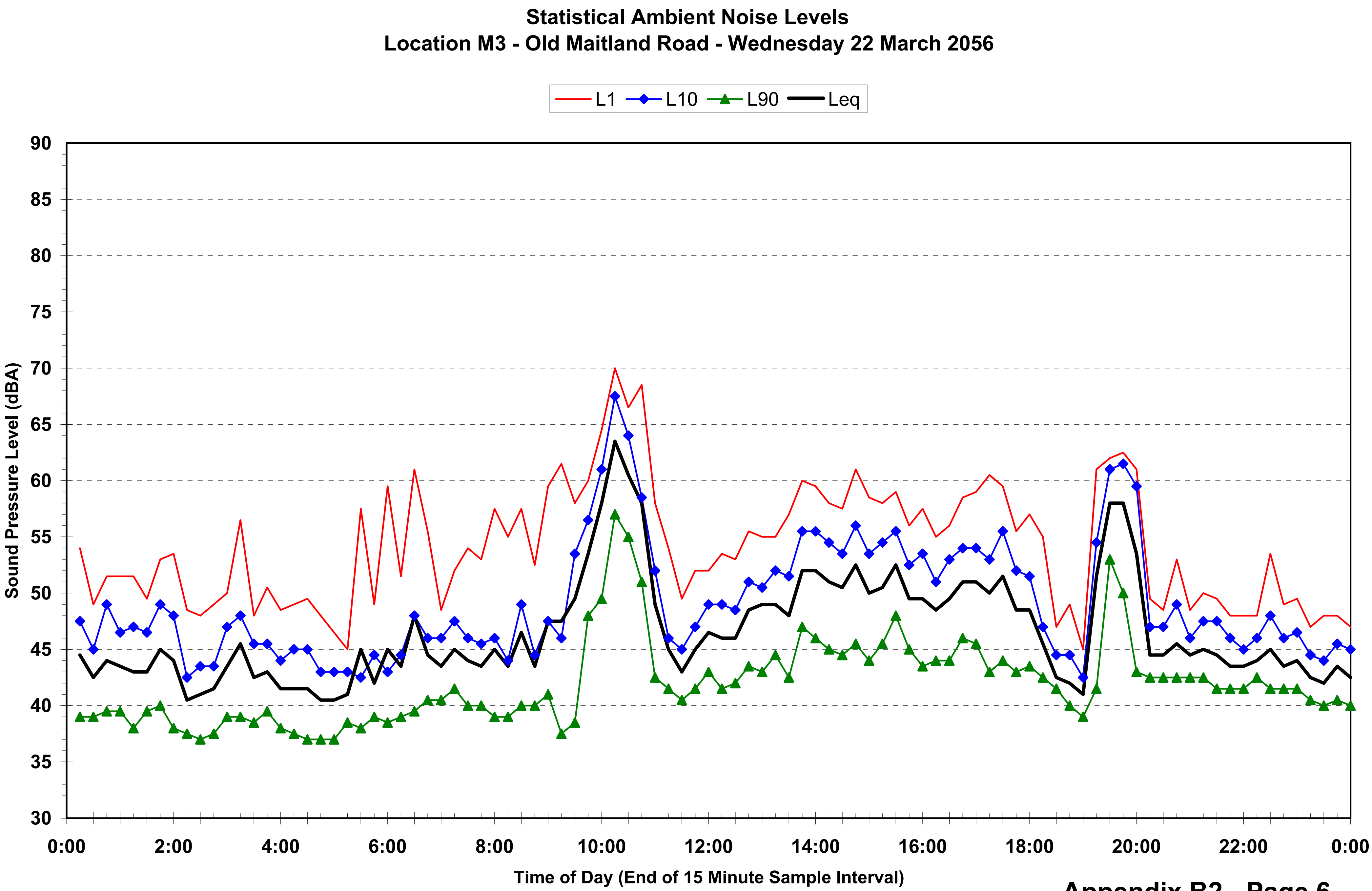
Statistical Ambient Noise Levels
Location M3 - Old Maitland Road - Wednesday 22 March 2056
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
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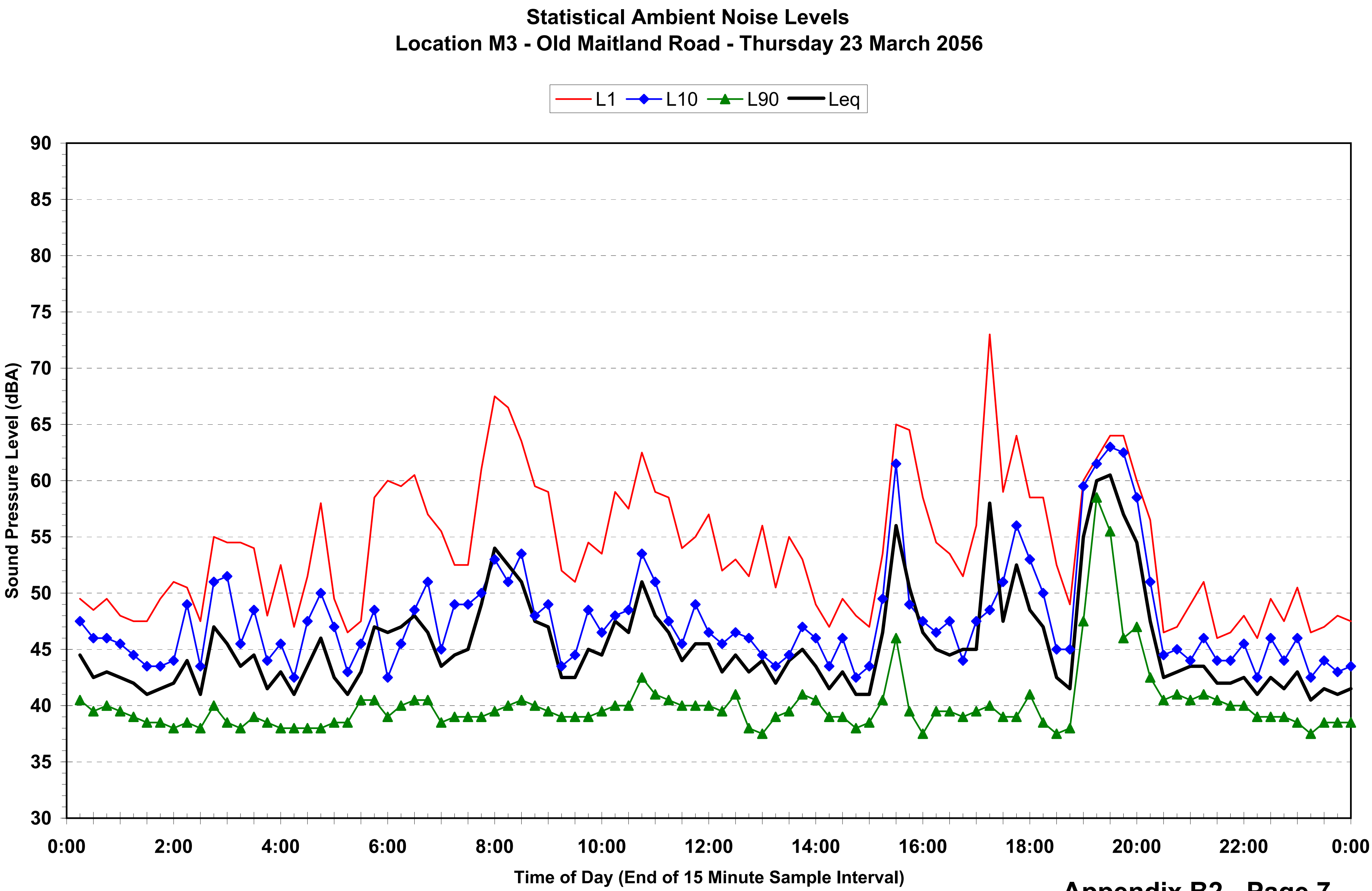
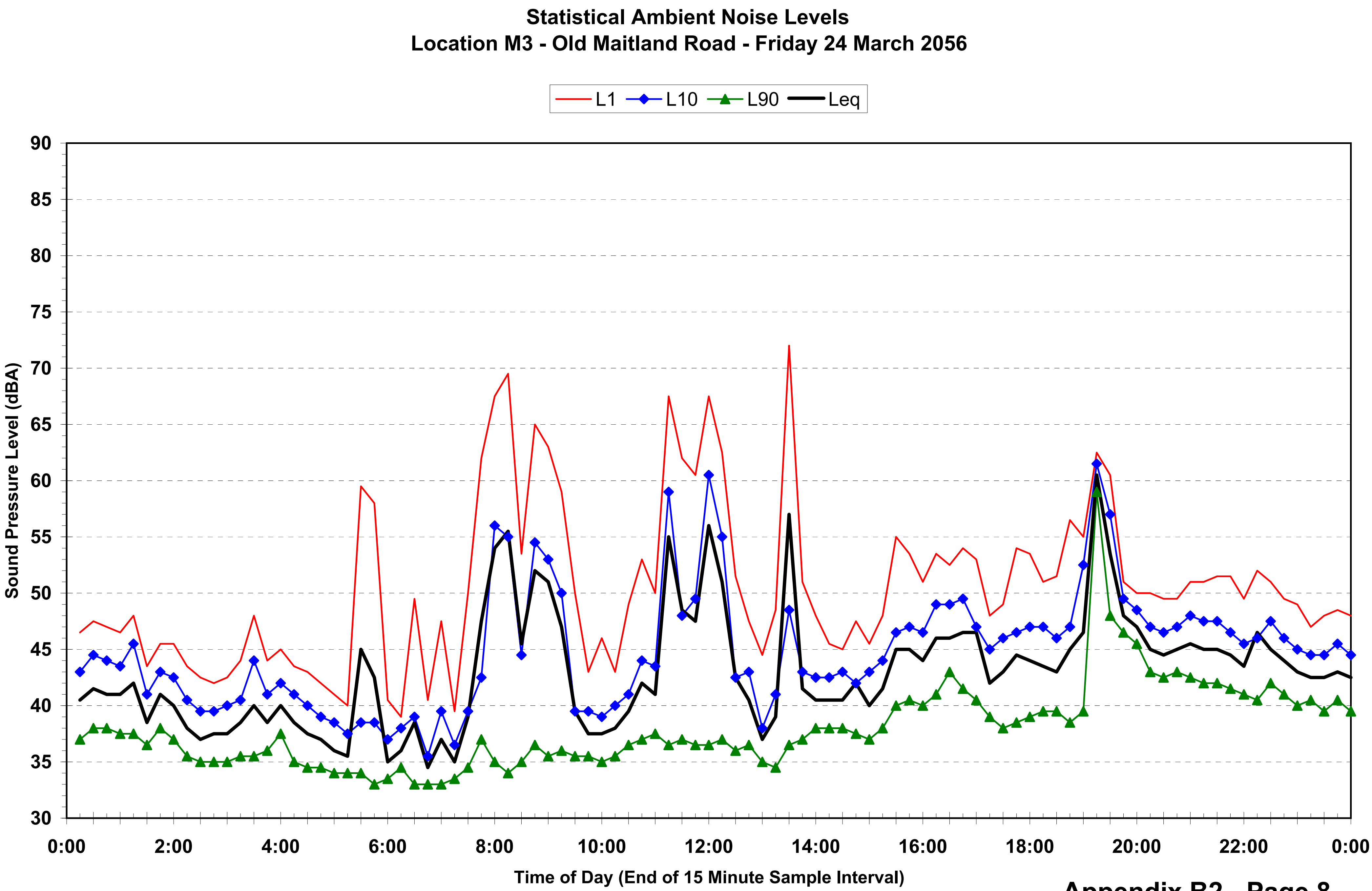
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Location M3 - Old Maitland Road - Thursday 23 March 2056
L1
L10
L90
Leq
90
85
80
75
70
65
60
55
50
45
40
35
30
Sound Pressure Level (dBA)
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)



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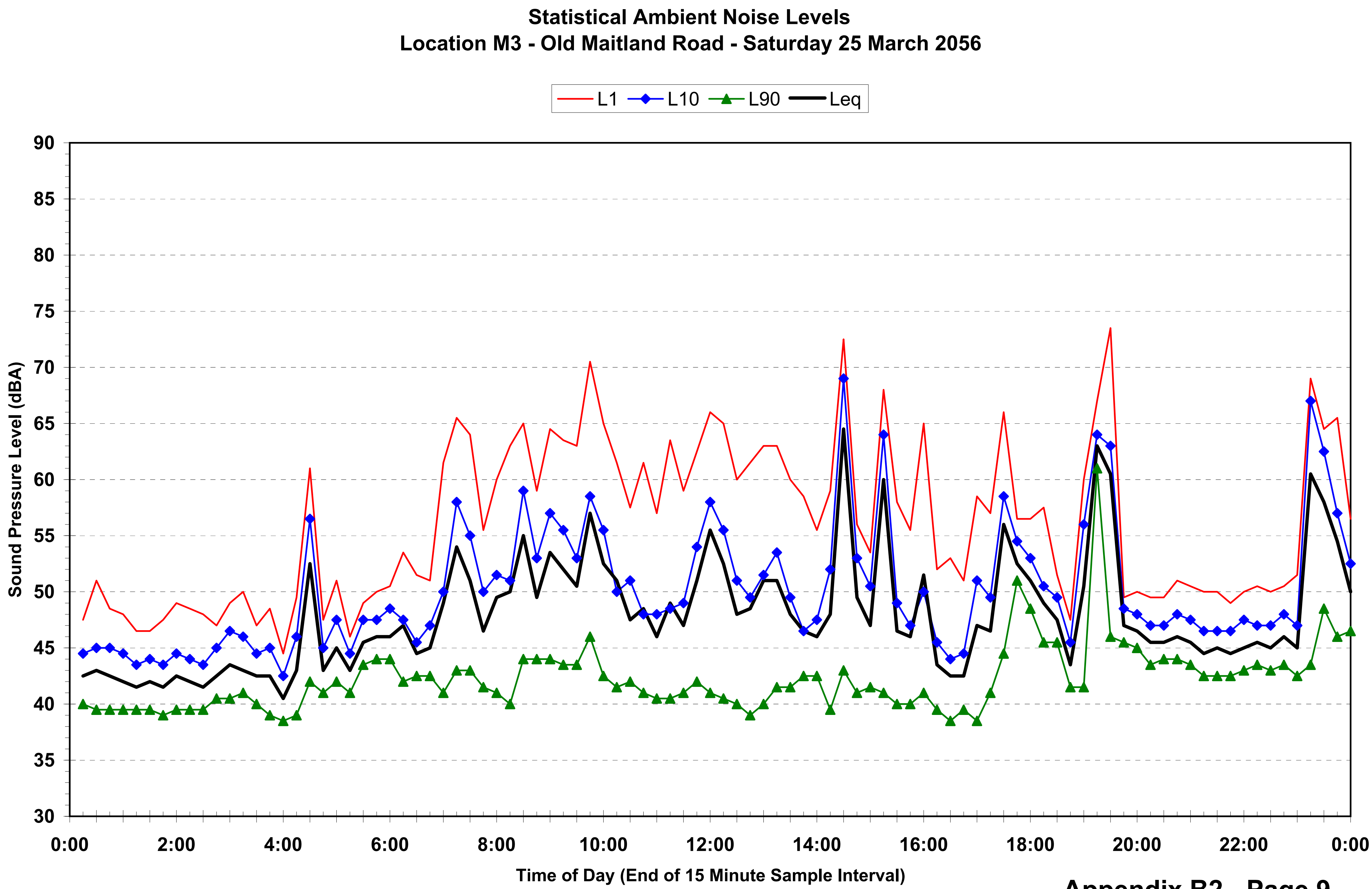
Statistical Noise Levels

SLR Consulting Report 30-1858



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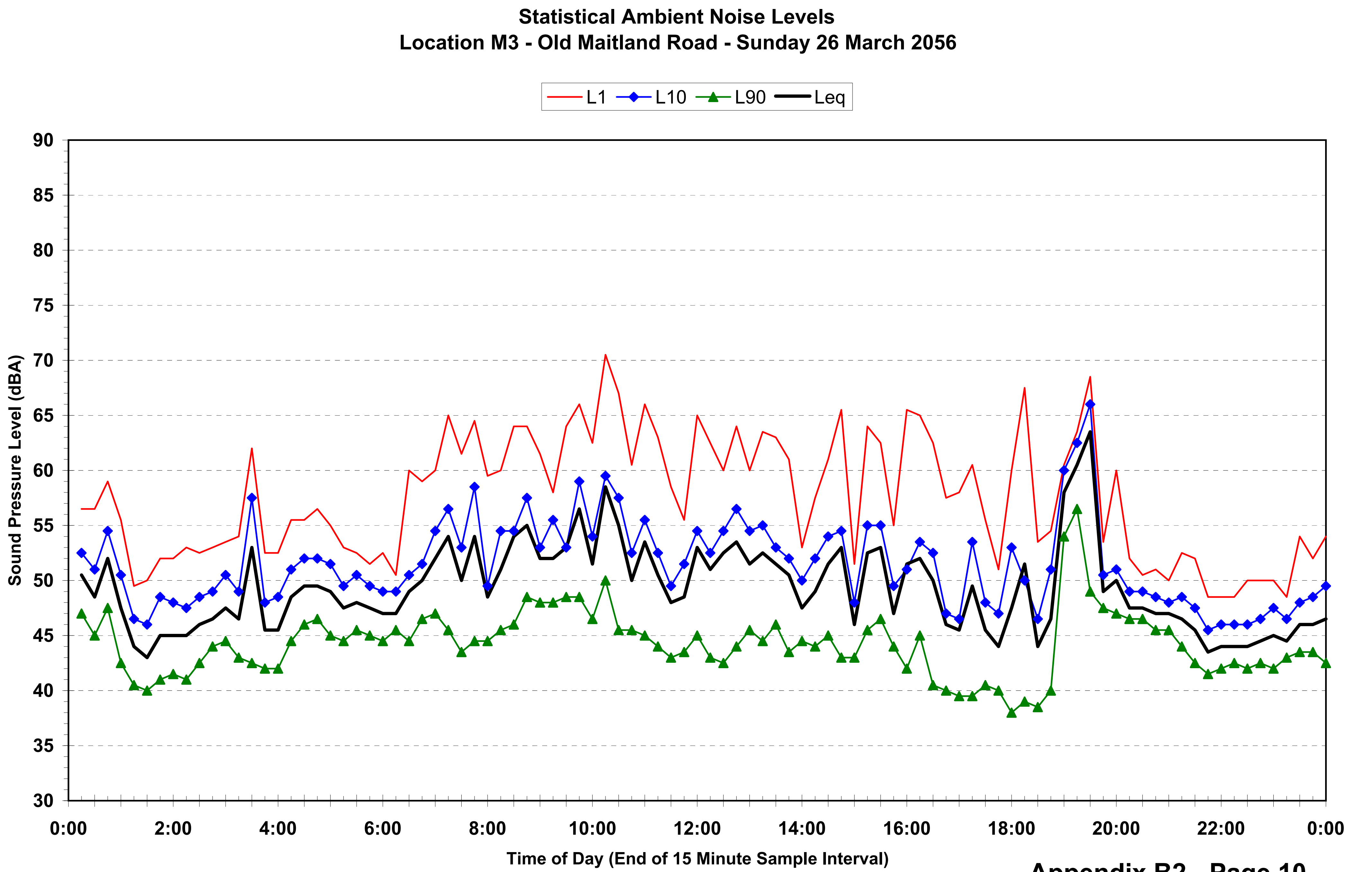
Statistical Noise Levels

SLR Consulting Report 30-1858



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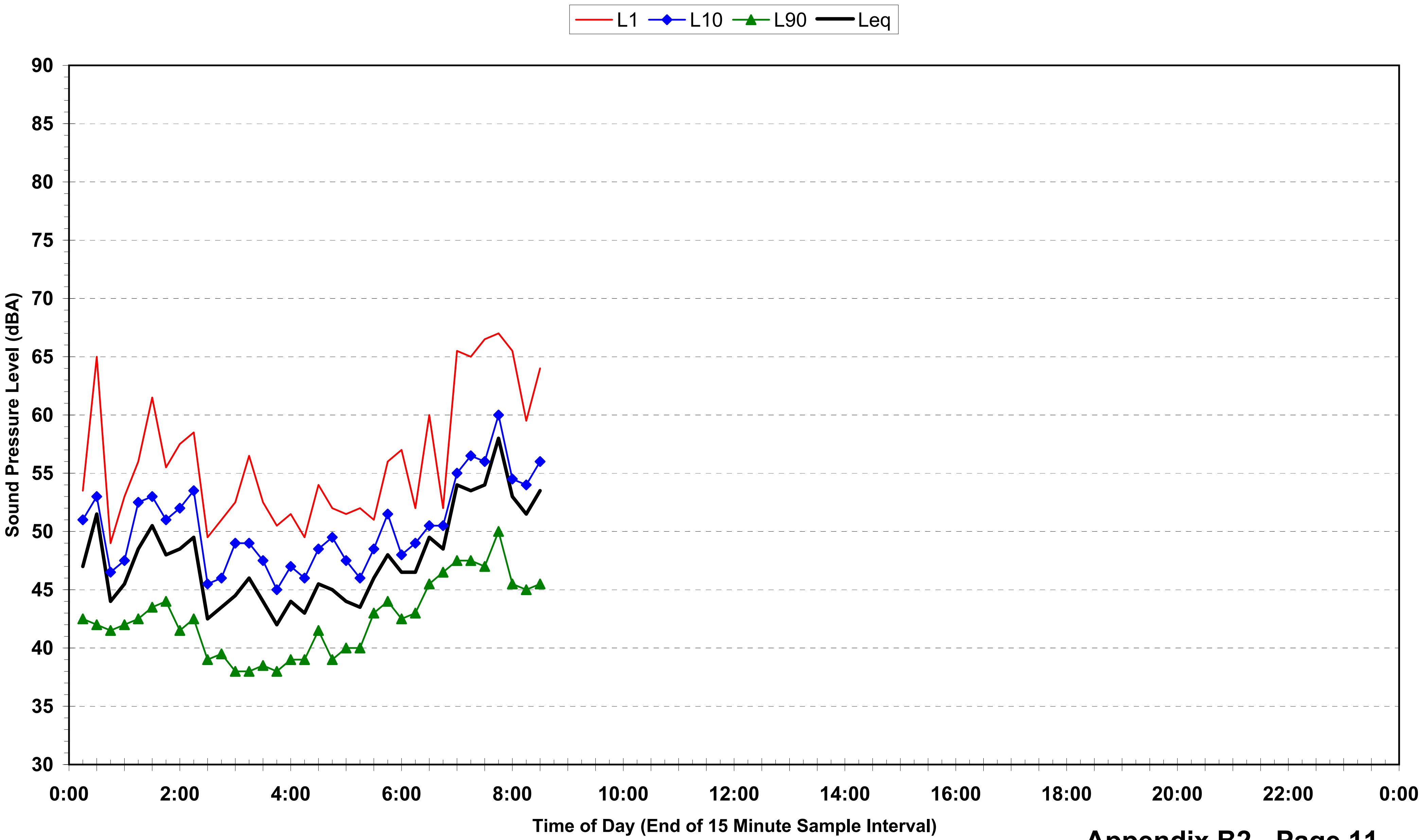
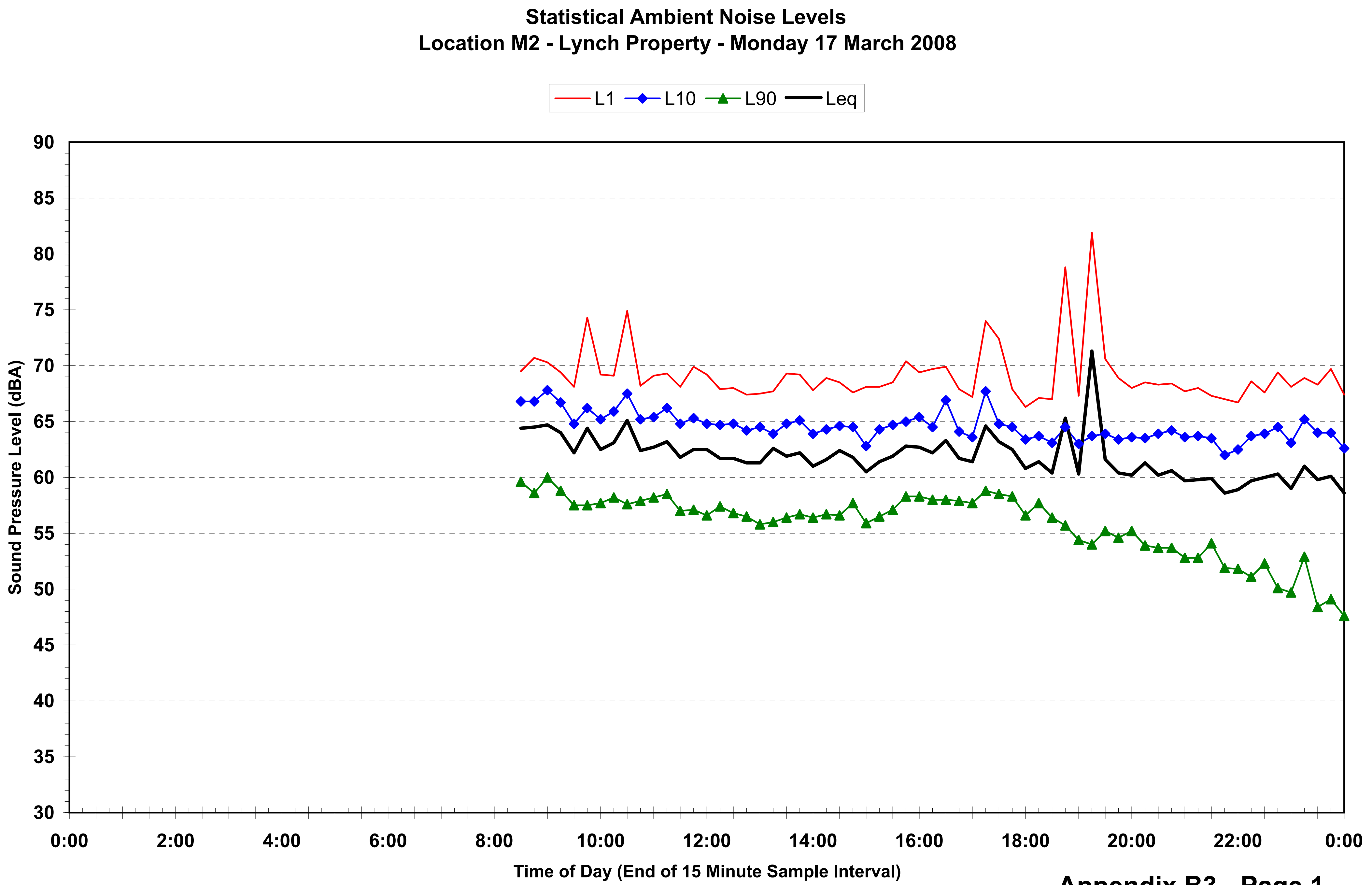
Statistical Ambient Noise Levels
Location M3 - Old Maitland Road - Monday 27 March 2056





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Statistical Noise Levels

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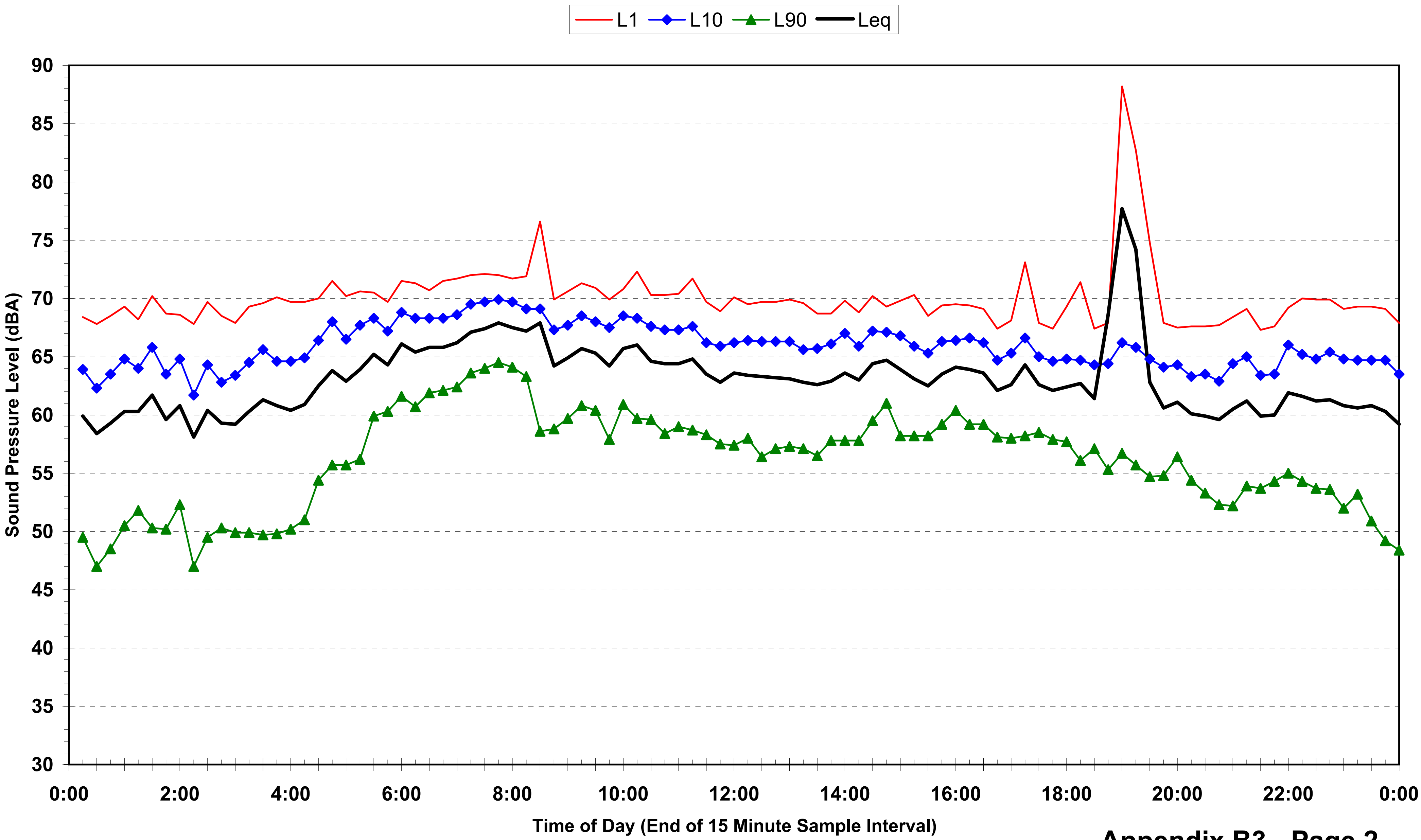
Statistical Ambient Noise Levels
Location M2- Lynch Property - Tuesday 18 March 2008



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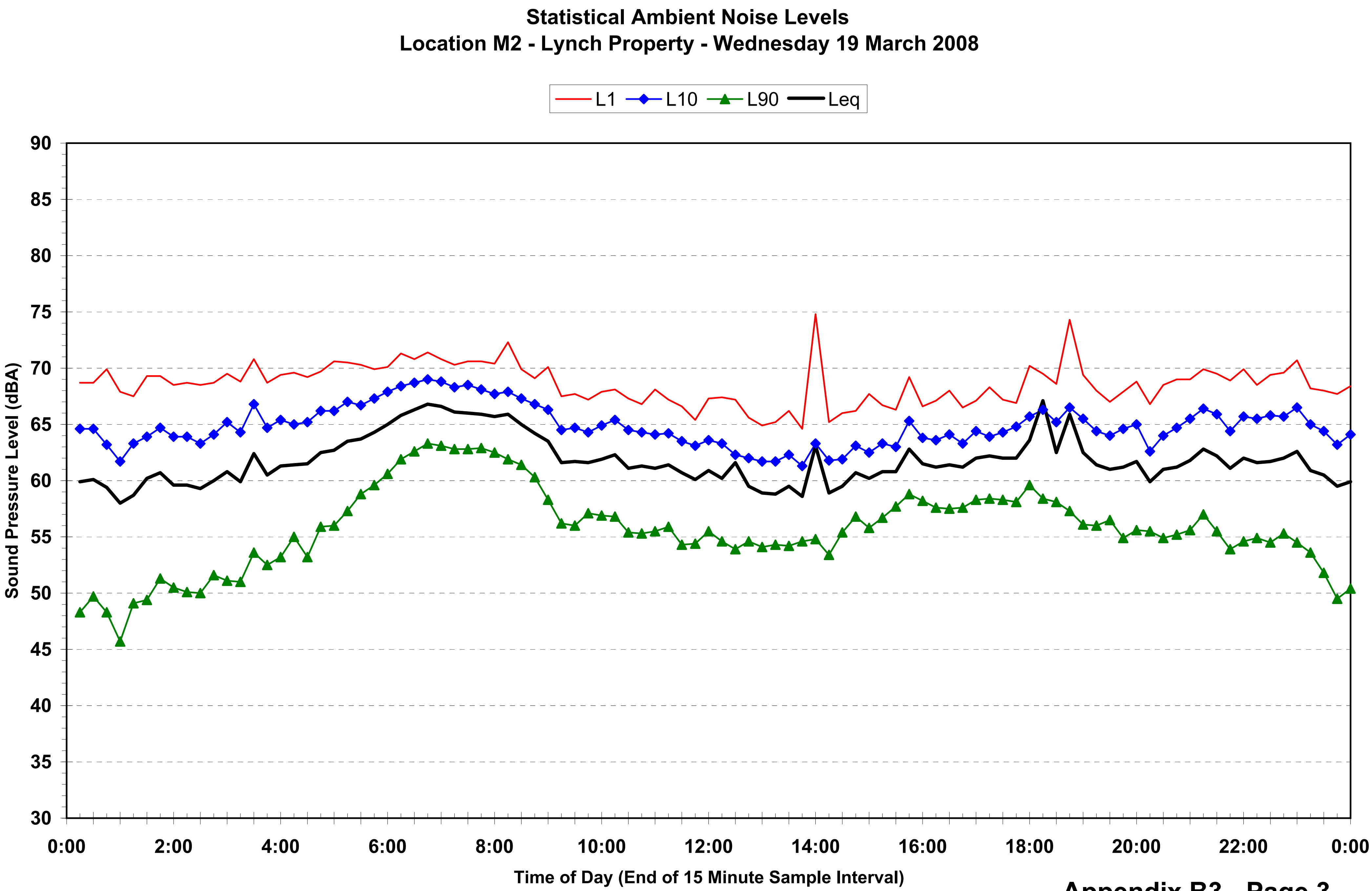
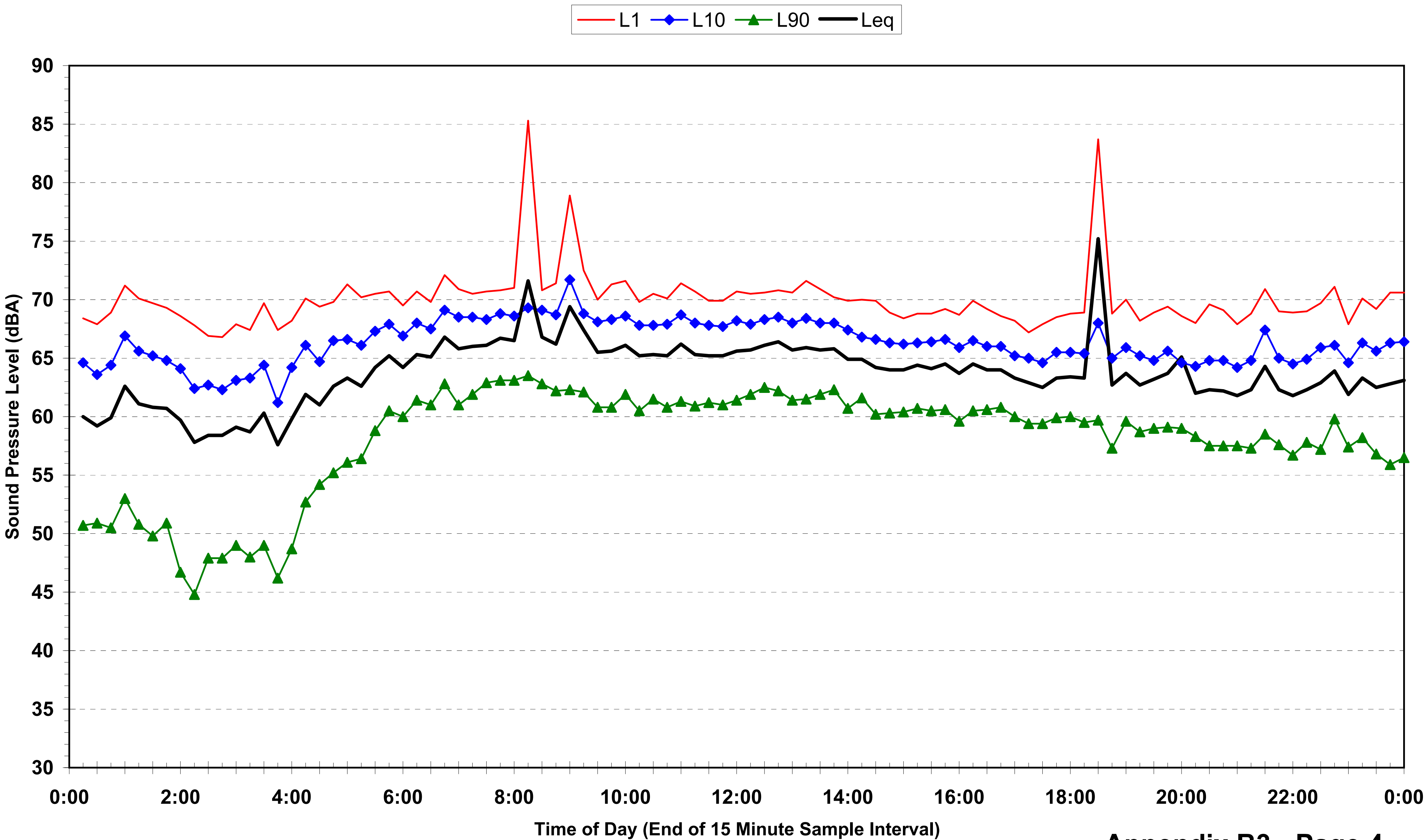
Statistical Noise Levels
SLR Consulting Report 30-1858



Statistical Ambient Noise Levels
Location M2 - Lynch Property - Wednesday 19 March 2008
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)

Statistical Ambient Noise Levels
Location M2 - Lynch Property - Thursday 20 March 2008



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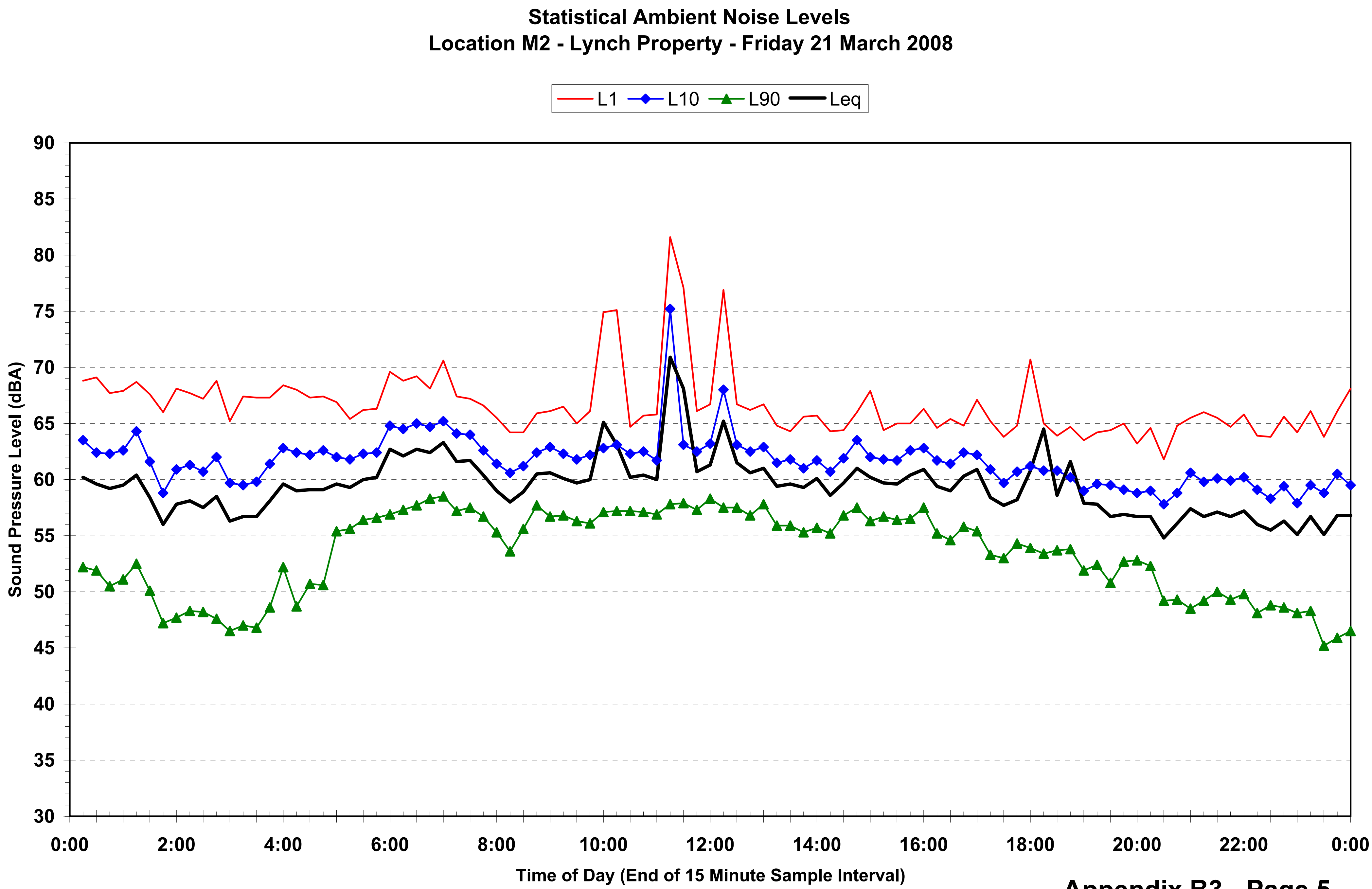
Statistical Noise Levels

SLR Consulting Report 30-1858


Statistical Ambient Noise Levels
Location M2 - Lynch Property - Friday 21 March 2008
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
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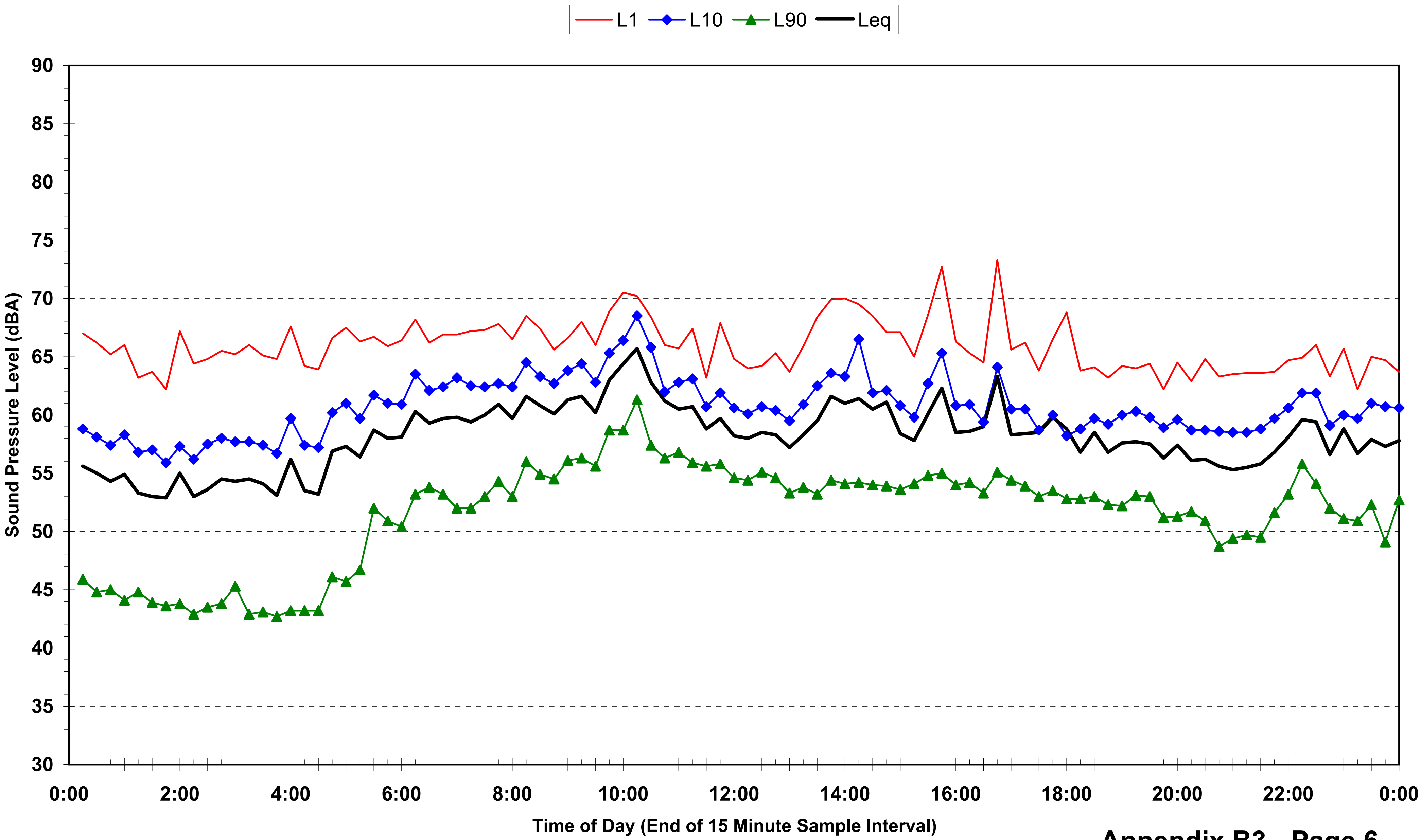
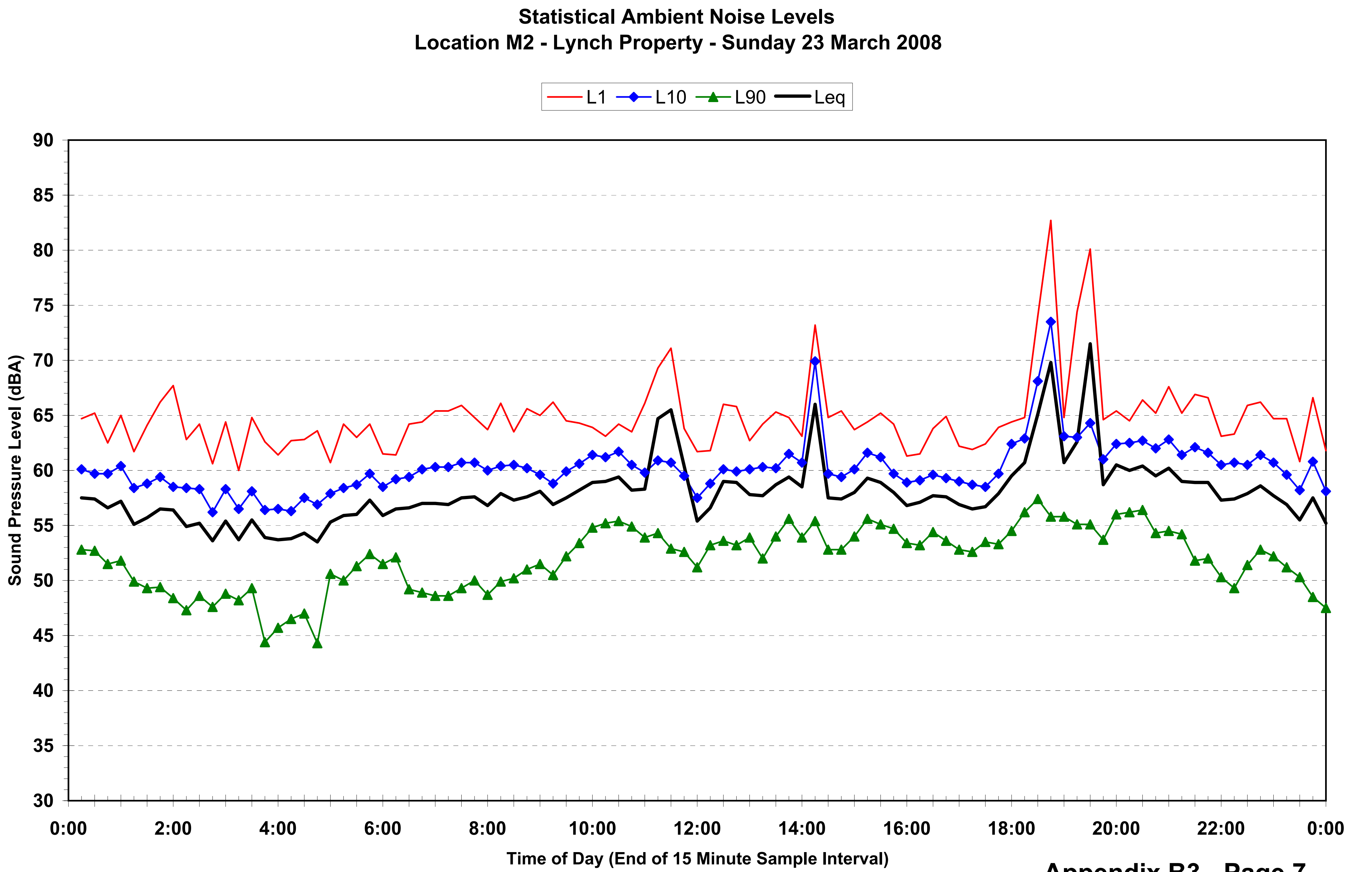
Time of Day (End of 15 Minute Sample Interval)

Statistical Ambient Noise Levels
Location M2 - Lynch Property - Saturday 22 March 2008





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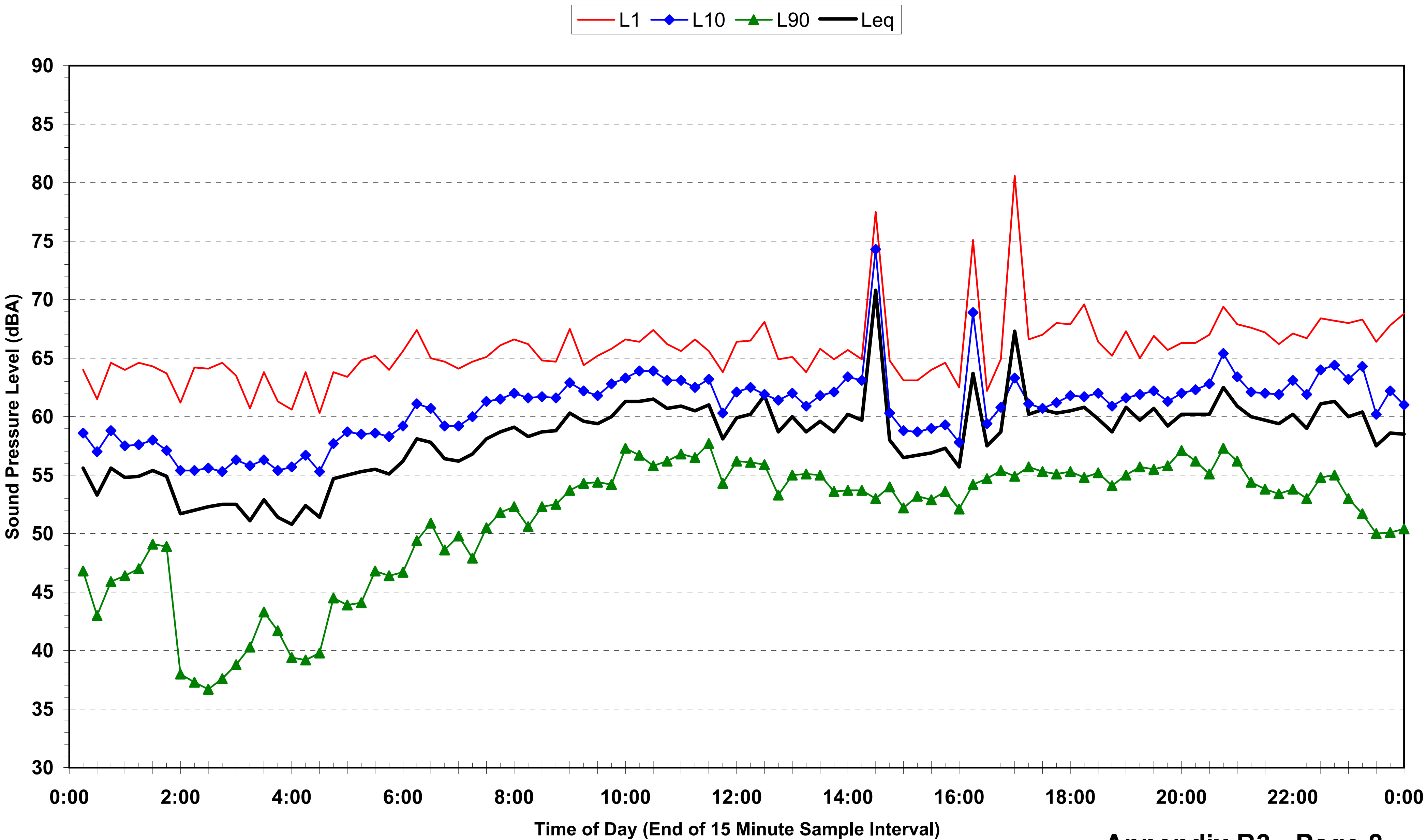
Statistical Ambient Noise Levels
Location M2- Lynch Property - Monday 24 March 2008



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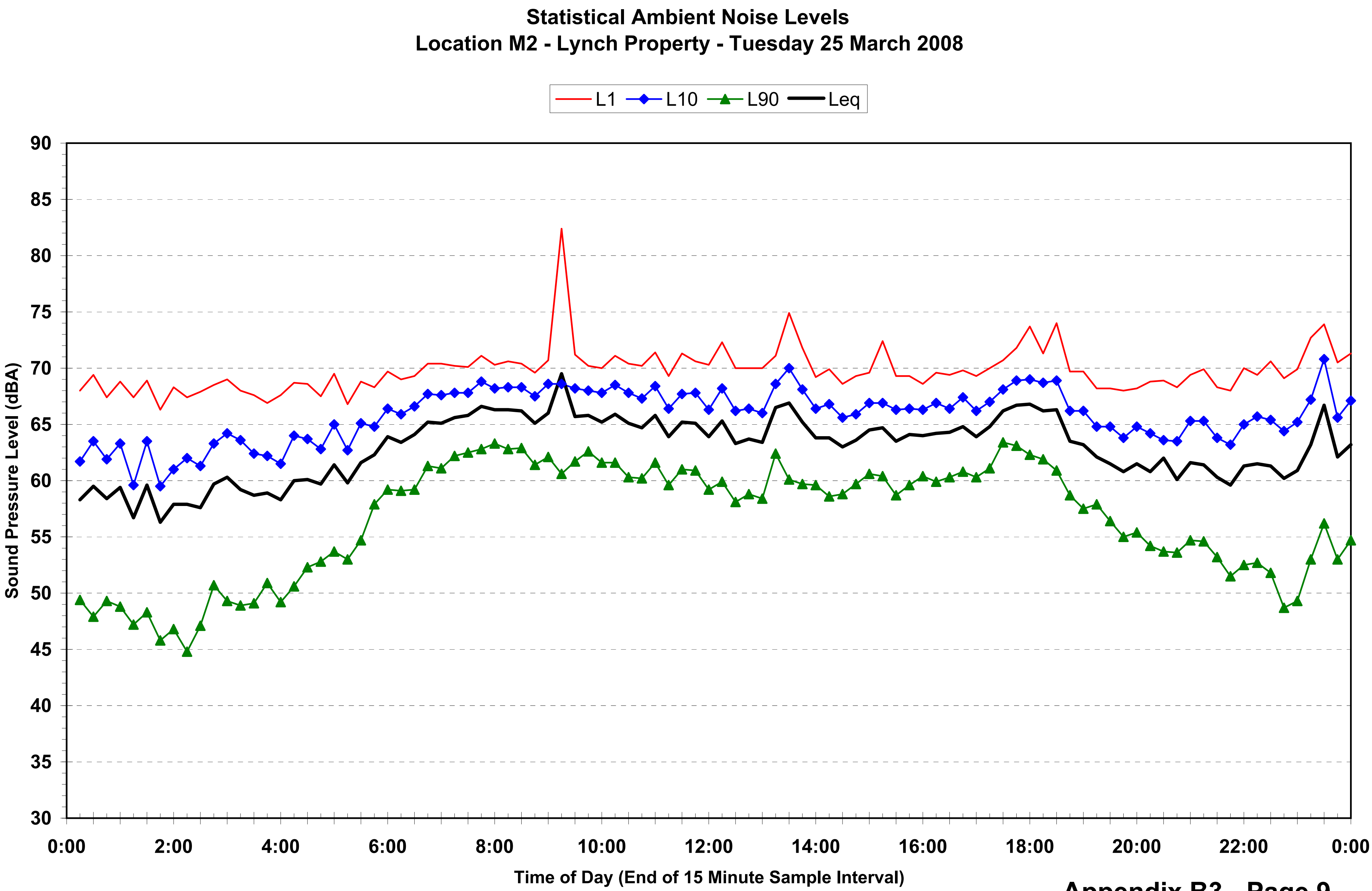
Statistical Noise Levels

SLR Consulting Report 30-1858


Statistical Ambient Noise Levels
Location M2 - Lynch Property - Tuesday 25 March 2008
L1
L10
L90
Leq
90
85
80
75
70
65
60
55
50
45
40
35
30
Sound Pressure Level (dBA)
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
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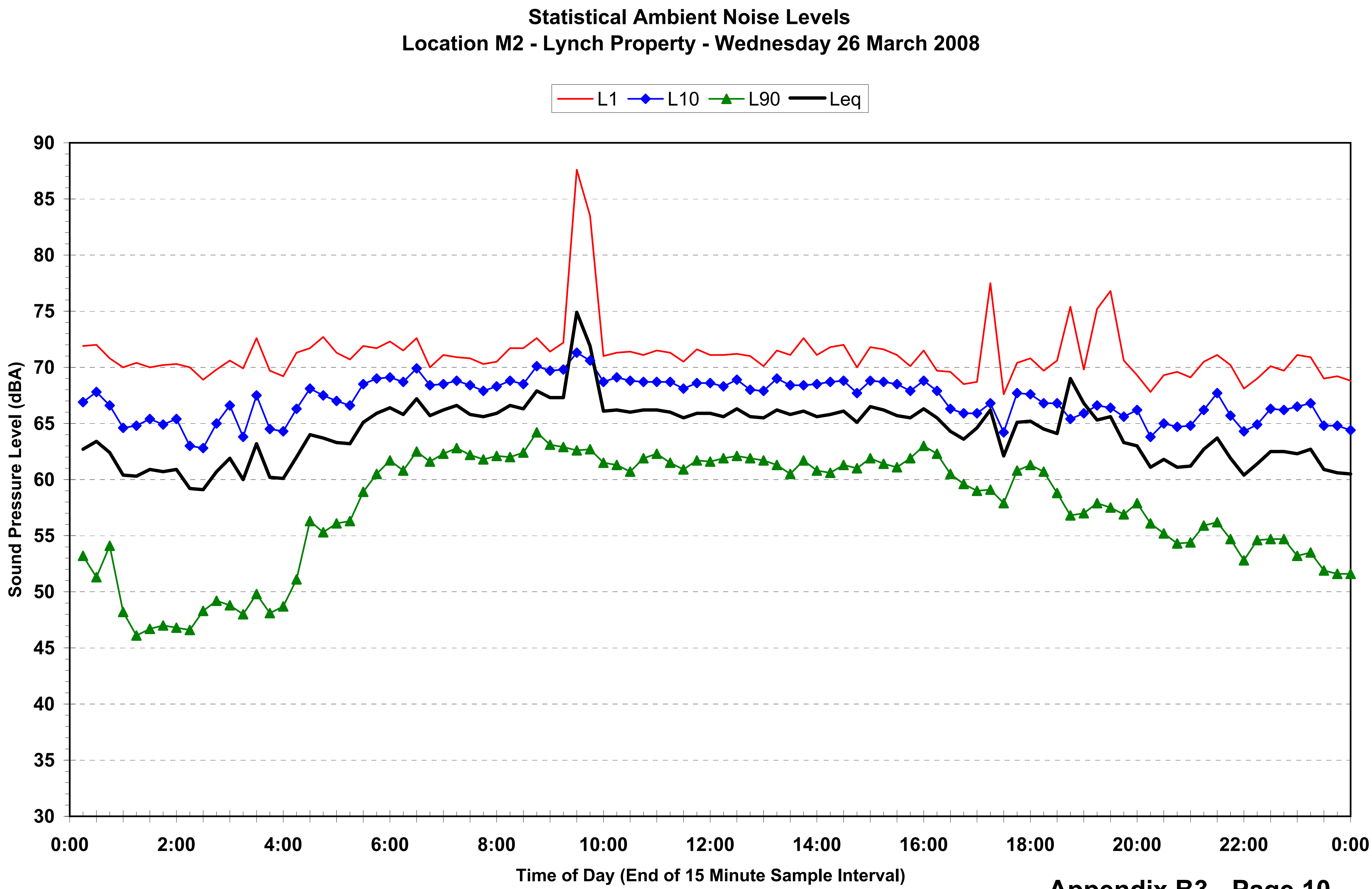
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)



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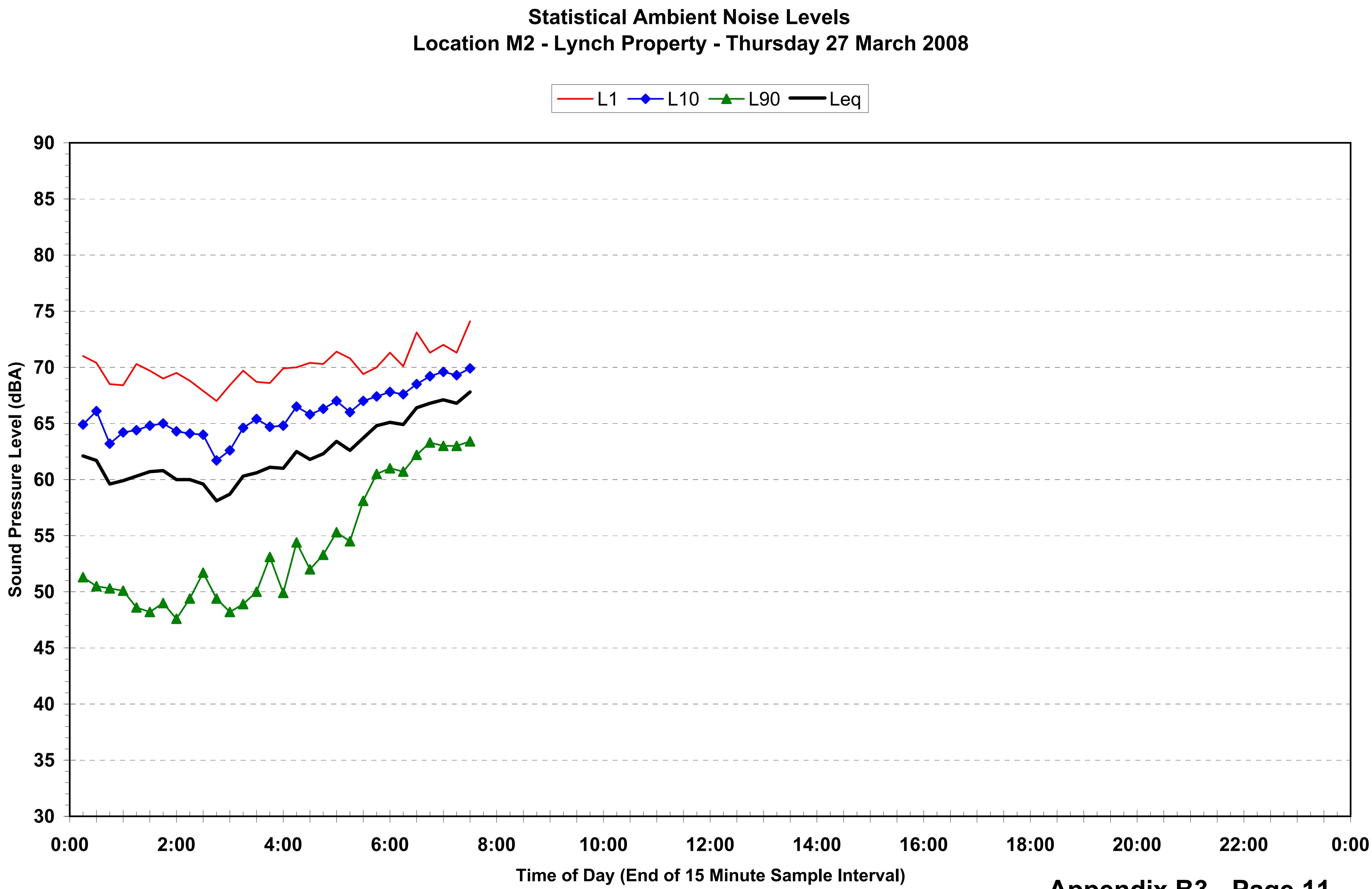
Statistical Noise Levels

SLR Consulting Report 30-1858


Statistical Ambient Noise Levels
Location M2 - Lynch Property - Thursday 27 March 2008
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)

Equipment Sound Power Levels

Equipment Description	Octave Band Centre Frequency (Hz) - dBL re 1pW										dB Lin	dBA
	31.5	63	125	250	500	1k	2k	4k	8k	16K	Overall	Overall
Operational Noise Assessment												
Provisioning Facility												
4 x Locomotives (notch setting 1)	114.3	117.9	122.1	107.6	107.8	104.3	103.1	99.5	96.6	-	124.3 dB	111.7 dBA
Wagons	106.8	100.6	99.4	94.3	91.5	87.8	85.2	80.2	79.1	84	108.7 dB	94.1 dBA
Compressor	106	102	98	93	90	86	86	79	73	73	108.2 dB	93.0 dBA
Forklift	92	107	97	95	95	96	98	93	86	77	108.8 dB	102.4 dBA
Hand tools	92	105	97	94	94	95	96	91	86	77	107.2 dB	100.8 dBA
Loco Maintenance Shed, Wash Bay and Wagon Shop												
4 x Locomotives (notch setting 1)	114.3	117.9	122.1	107.6	107.8	104.3	103.1	99.5	96.6	-	124.3 dB	111.7 dBA
1 x Stationary Locomotive Notch setting 8	121.3	124.8	129.1	114.5	114.8	111.3	108.9	106.5	103.6	-	131.3 dB	118.5 dBA
Locomotive wash	81.2	87.5	84.7	84.4	85.2	85.3	91.0	87.8	87.6	88	97.0 dB	95.5 dBA
Compressor	106	102	98	93	90	86	86	79	73	73	108.2 dB	93.0 dBA
Forklift	92	107	97	95	95	96	98	93	86	77	108.8 dB	102.4 dBA
Hand tools	92	105	97	94	94	95	96	91	86	77	107.2 dB	100.8 dBA
Wagon Placement tractor	85.0	94.0	93.0	92.0	97.0	94.0	97.0	97.0	98.0	84	104.8 dB	103.6 dBA
Train Shunting	52	67	91	104	114	119	119	118	111	97	124.2 dB	124.6 dBA
Onsite Vehicles												
Truck Drive off	96.0	104.0	106.0	99.0	100.0	98.0	92.0	85.0	77.0	77	109.8 dB	102.0 dBA
Sleep Disturbance Assessment												
Train Shunting	52	67	91	104	114	119	119	118	111	97	124.2 dB	124.6 dBA
Construction Noise Assessment												
Construction - TSF Road												
Truck Drive off	96.0	104.0	106.0	99.0	100.0	98.0	92.0	85.0	77.0	77	109.8 dB	102.0 dBA
Excavator Loading	104.0	103.0	108.0	99.0	98.0	99.0	97.0	94.0	85.0	85	111.4 dB	103.8 dBA
Dozer D9	111.0	116.0	111.0	109.0	109.0	106.0	103.0	97.0	88.0	88	119.4 dB	111.0 dBA

Equipment Sound Power Levels

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	31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16K**	**Overall**	**Overall**
Grader 12G	103	109	111	112	108	106	101	96	83	82	117.0 dB	110.7 dBA
Compactor	99	104	109	112	107	105	102	96	90	90	115.7 dB	110.3 dBA
Compactor Flat	99	104	109	112	107	105	102	96	90	90	115.7 dB	110.3 dBA
Backhoe	85	94	93	92	97	94	88	101	95	84	104.9 dB	103.9 dBA
Frontend Loader	120	121	115	110	108	106	102	99	96	90	124 dB	111 dBA
Concrete batching, including concrete truck	113	113	116	108	104	103	101	101	96	95	119 dB	109 dBA
Trucks unloading into hopper	118	113	115	112	112	109	107	107	98	89	122 dB	115 dBA
Cement Tanker unloading	124	122	110	103	104	103	101	100	97	91	127 dB	109 dBA
Conveyor Drive	95	94	95	97	97	90	86	82	71	58	103 dB	97 dBA
Crusher	119	119	122	114	110	109	107	107	102	101	121 dB	115 dBA
Construction - TSF Railworks												
Front end loader (30t crane)	103.0	107.0	109.0	103.0	103.0	103.0	100.0	92.0	86.0	86	113.5 dB	107.0 dBA
Truck Drive off	96.0	104.0	106.0	99.0	100.0	98.0	92.0	85.0	77.0	77	109.8 dB	102.0 dBA
Roller	105.0	105.0	110.0	113.0	108.0	106.0	103.0	97.0	91.0	91	116.9 dB	111.3 dBA
Tamping machine	105.0	105.0	103.0	105.0	110.0	111.0	111.0	110.0	108.0	108	118.4 dB	117.3 dBA
Grader 12G	103.0	109.0	111.0	112.0	108.0	106.0	101.0	96.0	83.0	82	117.0 dB	110.7 dBA
Frontend Loader	120	121	115	110	108	106	102	99	96	90	124 dB	111 dBA
Concrete batching, including concrete truck	113	113	116	108	104	103	101	101	96	95	119 dB	109 dBA
Trucks unloading into hopper	118	113	115	112	112	109	107	107	98	89	122 dB	115 dBA
Cement Tanker unloading	124	122	110	103	104	103	101	100	97	91	127 dB	109 dBA
Conveyor Drive	95	94	95	97	97	90	86	82	71	58	103 dB	97 dBA
Crusher	119	119	122	114	110	109	107	107	102	101	121 dB	115 dBA
Construction - TSF General/Demolition and Drainage												
Truck Drive off	96.0	104.0	106.0	99.0	100.0	98.0	92.0	85.0	77.0	77	109.8 dB	102.0 dBA
Excavator loading	104.0	103.0	108.0	99.0	98.0	99.0	97.0	94.0	85.0	85	111.4 dB	103.8 dBA

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	31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**16K**	**Overall**	**Overall**
Excavator with hammer	112.0	111.0	116.0	107.0	106.0	107.0	105.0	102.0	93.0	93	119.4 dB	111.8 dBA
Dozer D8	111.0	116.0	111.0	109.0	109.0	106.0	103.0	97.0	88.0	88	119.4 dB	111.0 dBA
Concrete Agi	70	70	68	87	93	104	105	105	106	101	111.6 dB	111.5 dBA
Backhoe	85	94	93	92	97	94	88	101	95	84	104.9 dB	103.9 dBA
Loader 950	101	111	110	104	105	100	96	90	86	79	114.9 dB	105.8 dBA
Frontend Loader	120	121	115	110	108	106	102	99	96	90	124 dB	111 dBA
Concrete batching, including concrete truck	113	113	116	108	104	103	101	101	96	95	119 dB	109 dBA
Trucks unloading into hopper	118	113	115	112	112	109	107	107	98	89	122 dB	115 dBA
Cement Tanker unloading	124	122	110	103	104	103	101	100	97	91	127 dB	109 dBA
Conveyor Drive	95	94	95	97	97	90	86	82	71	58	103 dB	97 dBA
Crusher	119	119	122	114	110	109	107	107	102	101	121 dB	115 dBA
Construction - TSF Building Works												
Truck Drive off	96.0	104.0	106.0	99.0	100.0	98.0	92.0	85.0	77.0	77	109.8 dB	102.0 dBA
Concrete Agi	70	70	68	87	93	104	105	105	106	101	111.6 dB	111.5 dBA
Backhoe No.1	85	94	93	92	97	94	88	101	95	84	104.9 dB	103.9 dBA
Crane No.1	99.0	106.0	96.0	96.0	99.0	97.0	93.0	89.0	87.0	87	108.6 dB	101.4 dBA
Pile driving	106	112	111	109	115	118	123	120	117	117	127.2 dB	127.0 dBA
Frontend Loader	120	121	115	110	108	106	102	99	96	90	124 dB	111 dBA
Concrete batching, including concrete truck	113	113	116	108	104	103	101	101	96	95	119 dB	109 dBA
Trucks unloading into hopper	118	113	115	112	112	109	107	107	98	89	122 dB	115 dBA
Cement Tanker unloading	124	122	110	103	104	103	101	100	97	91	127 dB	109 dBA
Conveyor Drive	95	94	95	97	97	90	86	82	71	58	103 dB	97 dBA
Crusher	119	119	122	114	110	109	107	107	102	101	121 dB	115 dBA