



JHA

UNSW Cliffbrook Campus

JHA's Response to Acoustic Review



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DOCUMENT CONTROL SHEET

Title	JHA's Response to Acoustic Review
Project	UNSW Cliffbrook Campus Redevelopment
Description	Response to DA review
Key Contact	RO

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1. JHA RESPONSE TO BEATTY LEGAL LETTER

The following addresses the review prepared by Andrew Beatty of Beatty Legal letter dated 31 July 2017 on behalf of nearby residents of UNSW Cliffbrook Campus Proposal, and a review of JHA's Acoustic report for Development Application by Brian Clarke of Wilkinson Murray included with the letter.

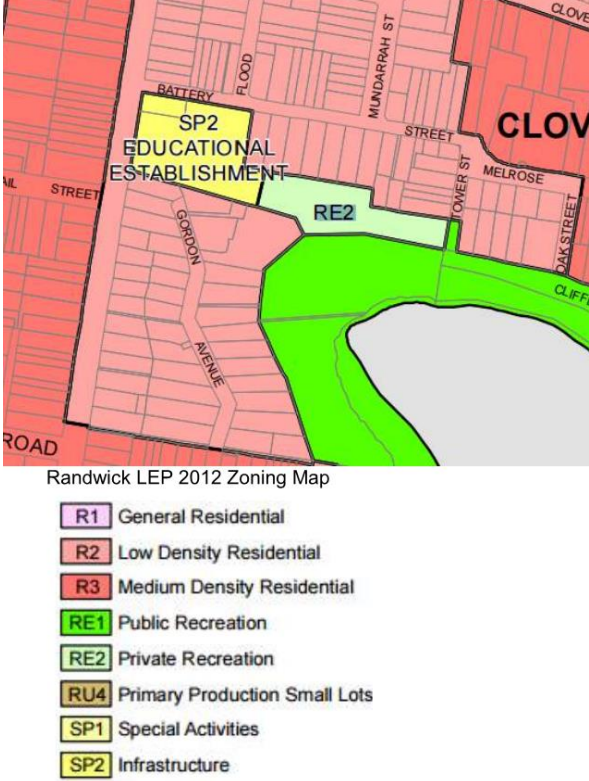
1.1 Issues addressed by Beatty Legal

Table 1: JHA's response to issues addressed by Beatty Legal

Issue	JHA's response
<p>As detailed in the attached expert acoustic report, the EIS fails to comply with clause 12 of the SEARs in that it does not provide a qualitative assessment of the main noise and vibration generating sources during either construction or operation:</p> <p>"12. Noise and Vibration Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction and operation. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land, including surrounding residential properties."</p>	<p>The Redevelopment of UNSW Cliffbrook Campus Secretary's Environmental Assessment Requirements (SSD 8126) Clause 12 states the following.</p> <p>"12. Noise and Vibration Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction and operation. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land, including surrounding residential properties. Consideration is to be given to restricting the hours of use of any outdoor recreation areas and the establishment of a system to effectively management resident complaints. → Relevant Policies and Guidelines: • NSW Industrial Noise Policy (EPA) • Interim Construction Noise Guideline (DECC) • Assessing Vibration: A Technical Guideline 2006".</p> <p>The SEARs clause 12 requires compliance with: - NSW Industrial Noise Policy (INP) - Interim Construction Noise Guideline - Assessing Vibration: A Technical Guideline (2006)</p> <p>JHA Report "Acoustic Report for the Redevelopment of UNSW Cliffbrook Campus 45-51 Beach Street, Coogee" for State Significant Development Submission (SSD 8126) dated 8 May 2017 covers each of these policies and guidelines: INP - Section 4 Logger and various operator attended measurements were performed and background noise criteria was determined as per INP methodology.</p> <p>Interim Construction Noise Guideline – Sections 8 – 11 and Appendix A Criteria was defined and likely noise levels of construction procedures and equipment were provided. Standard construction hours were</p>

	<p>recommended and management and mitigation measures were provided.</p> <p>Assessing Vibration: A Technical Guideline (2006) – Section 6 and Appendix A Vibration criteria was defined and vibration sources were identified. It was established that nearest affected receivers are located outside the minimum recommended buffer distance.</p> <p>In addition, further noise logger measurements (over 8 days) were conducted at Battery St to clear any doubt (expressed by Wilkinson Murray) over the accuracy of the measurements. These are shown below in section 2 of this report.</p>
<p>Further, clause 5 of the SEARs requires the proponent to: “detail amenity impacts including solar access, acoustic impacts, visual privacy, view sharing/loss, overshadowing and wind impacts. A high level of environmental amenity for any surrounding residential land uses must be demonstrated.” The proponent has failed to provide adequate detail regarding acoustic, privacy and visual impacts.</p>	<p>The acoustic impacts has been addressed in the JHA acoustic report dated 8 May 2017 and the development will comply with the requirements of the NSW Industrial Noise Policy (INP) 2000. A Noise Compliance and Management Plan has been included in the JHA report dated 8 May 2017.</p> <p>INP - Section 4 of JHA acoustic report Logger and operator attended measurements were performed and background noise criteria was determined as per INP methodology. Based on the measurements, the noise criteria for the surrounding residential land users has been established in the JHA Report “Acoustic Report for the Redevelopment of UNSW Cliffbrook Campus 45-51 Beach Street, Coogee” for State Significant Development Submission (SSD 8126) dated 8 May 2017.</p> <p>The noise criteria at the boundary with Nos. 12, 14 & 18 Battery St boundary with the University have been determined in accordance with the INP to be as follows (Section 4.2 of report). The following are the noise criteria at the boundaries with No.12.</p> <p>Day: 58 LAeq, 15 min Evening: 50 LAeq, Evening Night: 45 dB(A) LAeq, Night</p> <p>Additional logger measurements were conducted from 25/8/17 – 5/9/17 at 10 Battery St. Background noise as determined by NSW INP methodology are as follows:</p> <p>Day: 58 LAeq, 15min Evening: 48 LAeq, 15min Night: 45 LAeq, Night (Details of measurements in Section 2, below)</p> <p>Note: The location of the logger, near the ocean, resulted in similar results for LAeq and LA90. This is because the ocean is a relatively constant source of noise, so the documented LA90 (lowest 90% of levels in the measurement period) result is similar to the overall LAeq. The additional noise measurements, located further from the ocean,</p>

	document similar L_{Aeq} (overall noise) and a greater difference in L_{Aeq} and L_{A90} , which is to be expected further from the ocean as there are more irregular noise that have higher levels than ambient noise.
<p>In addition, the proponent has failed to demonstrate any substantial steps it intends to take in ensuring that a high level of environmental amenity for surrounding residential land will be maintained. Adequate, specific measures to mitigate and manage the acoustic, privacy and visual impacts are not provided in the Proposal. The proponent has simply failed to comply with the SEARs.</p>	<p>The acoustic design of the development will comply with the requirements of the NSW Industrial Noise Policy (INP) 2000 and the requirement of SEARs (SSD 8126).</p> <p>Glazing design and mechanical services acoustic treatment of the development has been addressed in JHA Report “Acoustic Report for the Redevelopment of UNSW Cliffbrook Campus 45-51 Beach Street, Coogee” for State Significant Development Submission (SSD 8126) dated 8 May 2017.</p> <p>JHA’s “Acoustic Report for the Redevelopment of UNSW Cliffbrook Campus 45-51 Beach Street, Coogee” for State Significant Development Submission (SSD 8126) dated 8 May 2017 addresses the SEARs (SSD 8126) compliance requirements with:</p> <ul style="list-style-type: none"> - NSW Industrial Noise Policy (INP) Section 4 - Interim Construction Noise Guideline Sections 8 – 11 and Appendix A - Assessing Vibration: A Technical Guideline (2006) Section 6 and Appendix A
<p>Furthermore, this non-compliance gives rise to a potential breach of the zone objectives of SP2, (see page 35 of the EIS). The relevant objective is to facilitate development that will not adversely affect the amenity of nearby and adjoining development. The neighbouring low density residential-zoned areas are susceptible to unacceptable adverse impacts.</p>	<p>The amenity of the neighbouring low density residential-zoned areas will be protected in accordance with the NSW Industrial Noise Policy (INP) 2000.</p> <p>The noise criteria at the boundary with Nos. 12, 14 & 18 Battery St boundary with the University have been determined in accordance with the INP to be as follows (Section 4.2 of report). The following are the noise criteria at the boundaries with No.12.</p> <p>Day: 58 $L_{Aeq, 15\text{min}}$ Evening: 50 $L_{Aeq, Evening}$ Night: 45 dB(A) $L_{Aeq, Night}$</p> <p>Additional logger measurements were conducted from 25/8/17 – 5/9/17 at 10 Battery St. Background noise as determined by NSW INP methodology are as follows:</p> <p>Day: 58 $L_{Aeq, 15\text{min}}$ Evening: 48 $L_{Aeq, 15\text{min}}$ Night: 45 $L_{Aeq, Night}$ (Details of measurements in Section 2, below)</p> <p>Note that only No.12 shares a boundary with Zone SP2 of the Randwick LEP2012 as shown below and in the JHA report dated 8 May 2017.</p>

	 <p>Randwick LEP 2012 Zoning Map</p> <ul style="list-style-type: none"> R1 General Residential R2 Low Density Residential R3 Medium Density Residential RE1 Public Recreation RE2 Private Recreation RU4 Primary Production Small Lots SP1 Special Activities SP2 Infrastructure
<p>Even allowing for the significant deficiencies in the proponent's noise assessment, it is clear that the Proposal will have significant and unacceptable noise impacts on neighbouring residential properties both during construction and, more importantly, throughout its operation. The local area is a quiet residential precinct. The large numbers of people (students, staff and visitors), vehicles, dining events and entertainment events to be facilitated by the Proposal will radically change the character of the neighbourhood, imposing unacceptable noise impacts on the local community (including our clients).</p>	<p>The amenity of the neighbouring low density residential-zoned areas will be protected in accordance with the NSW Industrial Noise Policy (INP) 2000 for operational noise.</p> <p>In terms of construction noise, it will be controlled and managed in accordance with the requirements of the Protection of the Environment Operations Act 1997 (NSW) Act, the Protection of the Environment Operations (Noise Control) Regulation 2008 (NSW) and the "Interim Construction Noise Guidelines" (2009) published by the NSW Environment Protection Authority (EPA). The Contractor will provide a Construction Noise and Vibration Management Plan prior to works commencing which would demonstrate compliance with the relevant Legislation.</p>
<p>As noted in Wilkinson Murray report, the proponent's acoustic assessment is fundamentally flawed and fails to appropriately predict the likely levels of noise created by the Proposal. The measures planned for the mitigation of acoustic impacts are equally flawed, lacking specificity and efficacy.</p>	<p>The Wilkinson Murray submission was comparing the measurements made at Battery Street (which the University does not share a boundary with No.12 Battery St and the "ocean-front" side where the university does share a boundary with No.12. The logger measurements reflect the continuous noise from the ocean, not from 'contaminated noise results'.</p>
<p>Considering Wilkinson Murray conclusions, the proposed path from the south of the development to Tower Street (Path), the meeting points along the Path (Pods) and the paved 'breakout' area are particularly objectionable.</p>	<p>The pods have been deleted from the Project scope and hence deleted from the SSDA.</p>
<p>Further, the size and positioning of the proposed dining room windows are</p>	<p>The dining room is air conditioned and apart from access doors, the glazing will be fixed closed.</p>

<p>inappropriate. Large, openable windows from a significant place of congregation are likely to emit substantial noise projected towards neighbouring properties along Battery Street, especially at night.</p>	<p>The purpose of the glazing is principally to take advantage of the available views.</p>
<p>In an otherwise quiet residential area, the proposed hours of operation are entirely unsuitable. The facilitation of electronically amplified events until 10pm will produce a high level of noise in the evening. The noise subsequently produced by departing attendees after such events will continue even later. The absence of any proposed hours of operation in the Proposal regarding the Path and Pods is completely objectionable. The generation of noise from passers-by and congregators in this part of the Proposal could arise at any time of day or night in the absence of restrictions on access to this area.</p> <p>As a combination of classes and seminars are planned for the Proposal from 8am to 10pm, Monday to Sunday, coupled with other uncertain hours of operation and the timing of people arriving and departing the site, neighbouring properties will be expected to endure noise impacts with little to no respite. Any Proposal that generates such impacts could not be approved by any reasonable decision-maker.</p>	<p>Refer to the Operational Management Plan for hours of operation.</p> <p>Electronically amplified events are contained within fully air-conditioned spaces and in spaces not adjoining any other property boundary.</p> <p>Where the space is air-conditioned and can be fully closed, such electronically amplified equipment will not present any noise issues at Nos. 12, 14 & 18 Battery Street.</p> <p>Arrival and departures are via the main entry that is remote from the shared boundaries with Battery Street residences and buffered by the full building width.</p> <p>The pods have been removed from the proposal.</p> <p>Arrivals and departures are infrequent due to the residential natures of the coursework.</p>

1.2 Issues addressed by Wilkinson Murray

Table 2: JHA's response to issues addressed by Wilkinson Murray

Issue	JHA's response
<p>The area is noted as being a quiet residential location. A 15-minute noise measurement was conducted at the southern boundary of the site and a background noise levels of 38 dBA was recorded. The ambient noise was made up of local traffic and birds.</p>	<p>We have conducted numerous 15 minute measurements with a calibrated and certified sound level meter at Battery St and our measurements and existing daytime background noise is between 42 and 43dB(A) $L_{A90,15min}$. Further logger measurements were conducted to resolve this (perceived discrepancy by Wilkinson Murray) with the measurements in the Wilkinson Murray Submission.</p> <p>Background noise as determined by NSW INP methodology for the additional logger measurements at 10 Battery St. from 25/8/17 – 5/9/17 are as follows: Day: 58 $L_{Aeq, 15min}$ Evening: 48 $L_{Aeq, 15min}$ Night: 45 $L_{Aeq, Night}$ (Details of measurements in Section 2, below)</p> <p>Notwithstanding this, the Battery Street noise level measurements only affect the garage façade of Nos. 12, 14 and 18 Battery St.</p>
<p>It is to be expected that the acoustic report should address the requirements of item 12 of the SEARs. However, based on a review of the report there are many issues that have not be addressed as detailed in the following sections.</p>	<p>The issues in item 12 have been addressed. The requirements of the NSW Industrial Noise Policy (INP) 2000 & the "Interim Construction Noise Guidelines" (2009) published by the NSW Environment Protection Authority will be met.</p> <p>JHA's report covers each of the policies and guidelines the SEARs clause 12 requires compliance with:</p> <ul style="list-style-type: none"> - NSW Industrial Noise Policy (INP) - Noise criteria determined as per INP methodology in Section 4 of report. - Interim Construction Noise Guideline Sections 8 – 11 and Appendix A - Assessing Vibration: A Technical Guideline (2006) Section 6 and Appendix A

Unfortunately, the results of noise logging appear to be contaminated in that noise levels measured by the logger are much higher than those measured by JHA in the surrounding streets or by myself when on site. For example, street attended background noise measurements in the day were reported to be 42 dBA whilst noise data from the loggers for the day is reported to be 53dBA, this is a significant difference. In addition, my measurements in the afternoon were in the order of 38 dBA compared to the reported logger noise levels.



Figure 5 Aerial View of the Site with Nearest Affected Receiver Locations, Operator Attended Measurements and Logger Position



Figure 6 Noise Logger located at the boundary with 12 Battery St

Wilkinson Murray was comparing the measurements made at Battery Street (where the University does not share a boundary with No.12 Battery St) with the “ocean-front” side where the university does share a boundary with No.12. The logger measurements reflect the continuous noise from the ocean, not from ‘contaminated noise results’. Refer to the circled logger location and plan above taken from the JHA report dated 8 May 2017. Additional logger measurements were made to show that the measurements are not ‘contaminated’ as asserted by Wilkinson Murray. These additional results are included at the end of this report in Section 2.

Furthermore, the fact that night L_{Aeq} and L_{A90} noise levels are reported at the same level further indicates that the noise logger data is unreliable and not suitable for the establishment of site specific noise criteria. Therefore, it can be concluded that correct site-specific noise criteria, both for construction and operation, has not been established therefore no correct assessment can be conducted on the development. As such the potential impacts or appropriate mitigation measures cannot be established.

The logger L_{Aeq} and L_{A90} noise level measurements from the JHA report dated 8 May 2017 reflect the continuous noise from the ocean, not from contaminated noise results. Hence the closeness of the L_{Aeq} and L_{A90} noise levels, not from contaminated noise results.

The location of the logger, near the ocean, resulted in similar results for L_{Aeq} and L_{A90} . This is because the ocean is a relatively constant source of noise, so the documented L_{A90} (lowest 90% of levels in the measurement period) result is similar to the overall L_{Aeq} . The additional noise measurements, located further from the ocean, document similar L_{Aeq} (overall noise) and a greater difference in L_{Aeq} and L_{A90} , which is to be

	<p>expected further from the ocean as there are more irregular noise that have higher levels than ambient noise.</p>
<p>The SEAR's require a "quantitative" assessment of construction noise consistent with the Interim Construction Guideline. However, no assessment has been conducted which requires establishment of Construction Noise Management Levels along with predictions of resultant cumulative noise levels at surrounding residences. Rather a table of individual equipment noise levels at 2 distances has been provided with no reference to potentially affected residences. How this relates to the cumulative noise levels of equipment operating for construction activities at specific receivers is unclear.</p> <p>Due to the limited assessment, no specific construction management measures have been determined for the project. Only generic construction noise management procedures have been presented.</p> <p>It can be concluded that the construction noise assessment is inadequate as it has not determined the potential impact of construction noise and therefore does not meet the SEARs requirements.</p>	<p>The noise impact of the various construction equipment has been quantified based on the typical equipment likely to be used of the site. Further detailed quantification of the noise level will be conducted once a builder has been appointed and proposed equipment details nominated, at the construction certificate phase.</p> <p>The Contractor's Construction Noise and Vibration Management will be produced to comply with the "Interim Construction Noise Guidelines" (2009) published by the NSW Environment Protection Authority.</p>
<p>In the case of construction vibration relevant vibration criteria have been presented. However, no predictions of resultant vibration levels at receivers has been conducted. As there is no description of construction scenarios it is not possible to determine potential impacts. I note that there are recommendations which, for example, recommend at safe working distance of 5 metres for "jackhammers". Whilst it is unclear if a "jackhammer" is a rock-breaker it is noted that a vibration level of 2 mm/s (as noted by JHA would) be unacceptably high at residences.</p> <p>It can be concluded that the vibration assessment is inadequate and does not meet the SEARs requirements.</p>	<p>The location of No.12 Battery St is more than 5 metres from the major site works likely to use rock breakers. This distance is the recommended buffer distance to mitigate vibration disturbance in "Assessing Vibration: A Technical Guideline (2006)"</p> <p>Where vibration levels are assessed to exceed the prescribed levels, it will be recommended that the rock removal works be carried out with concrete saws. Vibration mitigation measures as recommended by "Assessing Vibration: A Technical Guideline (2006)" have been detailed in Appendix A of the report.</p> <p>The prescribed maximum daytime levels vibration at the residences in the x, y & z axes and the maximum VDV (vibration dose values) are shown in Appendix A Section 13.8 of our report.</p>
<p>A review of the JHA noise assessment indicates that the only noise assessment that has been addressed in any way is noise from mechanical services. Unfortunately, the criteria on which it is assessed is incorrect as detailed in early sections.</p> <p>In the case of noise from occupants in outdoor areas, breakout cocktail areas, carpark, property maintenance and the use of the premises outside normal hours there is no predicted noise at surrounding receivers. Given that indoor events and external events are proposed a quantitative assessment should be conducted to determine potential impacts at residences.</p>	<p>The criteria on which it is assessed is the INP as detailed in Section 4 of the JHA "Acoustic Report for the Redevelopment of UNSW Cliffbrook Campus 45-51 Beach Street, Coogee" for State Significant Development Submission (SSD 8126) dated 8 May 2017.</p> <p>The event spaces are air-conditioned and the glazed windows are fixed closed, operational noise can be contained and will not present any noise issues at Nos. 12, 14 & 18 Battery Street.</p>

<p>For example, assuming 50 persons occupied the Breakout / Cocktail areas in the evening an assessment based on half of these people speaking in a raised voice (each with a sound pressure levels of 68 dBA at 1 m) would result in a noise level of 54 dBA at the residence at 12 Battery Street. Clearly this magnitude of noise would be unacceptable and warrant the implementation of noise control measures such as physical enclosure, restriction of hours or elimination this activity. No such assessment has been conducted rather generalist noise control measures such as response to complaints, noise monitoring and restriction of hour to 9 or 10 pm are proposed in the report. Such a cursory approach to management of potential noise emissions is considered unacceptable nor is it consistent with the SEARs in my opinion. Other potential issues, such as noise from students congregating on the outdoor lawn area on the south-east corner of the campus (the start of the trail), students using the trail and students occupying the "pods" along the trail have not been addressed at all. These activities have the potential to impact on the subject residences particularly in the evenings and weekends when ambient noise levels are lower.</p>	<p>As noted above the Dining Room/ Cocktail areas has glazed windows that are now fixed closed resulting in physical enclosure.</p> <p>Refer to the Operational Management Plan for revised hours of operation.</p> <p>The pods are now deleted. The lawn area to the south east has been reduced.</p>
<p>In the EIS there is a statement in relation to noise stating: To provide suitable amenity for the future course participants, noise mitigation management strategies including glazing, noise barriers and noise management strategies have been provided for the proposed development. However there has been no assessment of noise impacts to determine any specifics of these measures. It is not suitable to state that "Detailed design of the building glazing, envelope and acoustic barriers will be provided in the design development phase", as it is the purpose of the development application assessment to identify the potential impacts and suitable mitigation that demonstrates that the acoustic amenity of surrounding receivers can be adequately protected.</p>	<p>Glazing type that has the required acoustic qualities has been described in section 5.11 of the JHA report dated 8 May 2017.</p>
<p>Furthermore, it is noted in the report that amplified music is proposed to be controlled by closing of doors (section 7.1) however no assessment of this noise source has been considered. These sources are acoustically significant and in my opinion, require detailed assessment rather than a response to complaints / noise measurement approach to noise management. Assessment of proposed activities with respect to site specific noise criteria must be conducted so that effective physical and operational</p>	<p>The event spaces are air-conditioned and the glazed windows are fixed closed.</p> <p>The glazing and façade design has been provided to deal with the anticipated indoor noise. Glazing type that has the required acoustic qualities has been provided in section 5.11 of the JHA report dated 8 May 2017.</p>

<p>measures can be determined. These measures can then be included in the design of the development along with the operational plan of management.</p>	
<p>The plan of management in relation to noise control reflects the recommendations of the acoustic report. As such the acoustic assessment only provides general recommendations that are not based on any detailed assessment of potential noise impact. In relation to noise plan of management it commits to:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Relevant noise policy; <input type="checkbox"/> On-going noise monitoring; <input type="checkbox"/> Signage; and <input type="checkbox"/> Noise complaints register. <p>There are no specific noise mitigation methods on how or where these will be detailed and documented. Nor are there any site-specific noise criteria by which complaints and monitoring will be assessed. Having reviewed the operational noise assessment and the plan of management I have no confidence that noise emissions from the proposal can be adequately controlled and managed by the University.</p>	<p>The University is to develop a procedures manual in conjunction with JHA to address the issues of noise complaints, complaints register, methodology of addressing the complaints and provide noise monitoring where required to address and resolve the noise complaints.</p> <p>Noise mitigation has been incorporated into the design, i.e. the design of façade and glazing is based on expected noise levels from dining area including amplified sound to be mitigated to a level that achieves compliance with the (site-specific) noise amenity criteria. The site-specific noise criteria has been established through long-term noise logging using NSW INP methodology.</p>
<p>It is my opinion that the noise and vibration assessment UNSW Cliffbrook Campus at 45-51 Beach Street, Coogee State Significant Development Submission (SSD 8126) needs to be reassessed and that the noise and vibration assessment should be conducted by a company that has membership to the Association of Australasian Acoustical Consultants (AAAC) or the consultant conducting the assessment is a member of the Australian Acoustical Society (AAS) or Institution of Engineers Australia with competency in environmental acoustics.</p>	<p>The Wilkinson Murray submission was comparing the measurements made at Battery Street (where the University does not share a boundary with No.12 Battery St) with the “ocean-front” side where the university does share a boundary with No.12. The logger measurements reflect the continuous noise from the ocean, not from contaminated noise results.</p> <p>The Team authoring and verifying the JHA Consulting Engineers acoustic report, namely Dr Riduan Osman and the Acoustics Group Manager Claudiu Pop have formal qualification in the complex field of acoustics. Dr Riduan Osman holds a PhD degree from the University of Sydney in Acoustics, while Claudiu Pop has a Masters in Acoustics from the Technical University of Denmark, in addition to the Mechanical and Structural Engineering Degrees respectively.</p> <p>The Team has also published a large number of prestigious international acoustics papers and journals.</p> <p>It is our opinion that membership of an organisation for an annual fee cannot replace formal postgraduate acoustics education, and a bachelor undergraduate degree in an unrelated field and marketing does not give sufficient competency to prepare peer reviews of state significant developments.</p>

2. RESULTS OF ADDITIONAL NOISE LOGGING

2.1 Measured noise data

Long term noise monitoring with a Rion NL-52 Type 1 noise logging sound level meter were conducted between Friday 25th August 2017 and Tuesday 5th September 2017 at Logger location shown in Figures 1 below to supplement the noise logging undertaken for the development application. The sound level meter was calibrated before and after the measurements using a Bruel & Kjaer Acoustic Calibrator. No calibration deviations were recorded. Detailed results of the logger measurements are shown in the graphs in Section 2.3 below. Sections marked in blue show times when there was rainfall, and have been omitted from measurement results.



Figure 1: Logger location 25th August – 5th September

The median statistical noise levels for each time of day over the measurement period are as follows:

Table 4: Measurement results

Time of day	L _{Aeq, 15 min} - dB(A)	L _{Amax, 15 min} - dB(A)	L _{Amin, 15 min} - dB(A)	L _{A10, 15 min} - dB(A)	L _{A90, 15 min} - dB(A)
Day 7:00am – 6:00pm Monday – Saturday 8:00 am – 6:00pm Sunday	52	67	43	55	45
Evening 6:00pm – 10:00pm Monday - Sunday	50	65	40	52	43
Night 10:00pm – 7:00am Monday – Saturday 10:00pm – 8:am Sunday	46	60	39	47	41

2.2 Noise criteria

The noise criteria at the logger location were determined using the methodology as described in Section 3.1 of the NSW INP. Criteria are shown in bold in Table 5.

Table 5: Noise criteria at 10 Battery Street (location shown in Figure 1)

Time fo day	Intrusiveness Criteria – dB(A)	Amenity Criteria – dB(A)
Day 7:00am – 6:00pm Monday – Saturday 8:00 am – 6:00pm Sunday	50 L _{Aeq, 15 min} (45 + 5)	60 L _{Aeq, Day}
Evening 6:00pm – 10:00pm Monday - Sunday	48 L _{Aeq, 15 min} (43 + 5)	50 L _{Aeq, Evening}
Night 10:00pm – 7:00am Monday – Saturday 10:00pm – 8:am Sunday	46 L _{Aeq, 15 min} (41 + 5)	45 L _{Aeq, Night}

2.3 Noise levels over measurement period

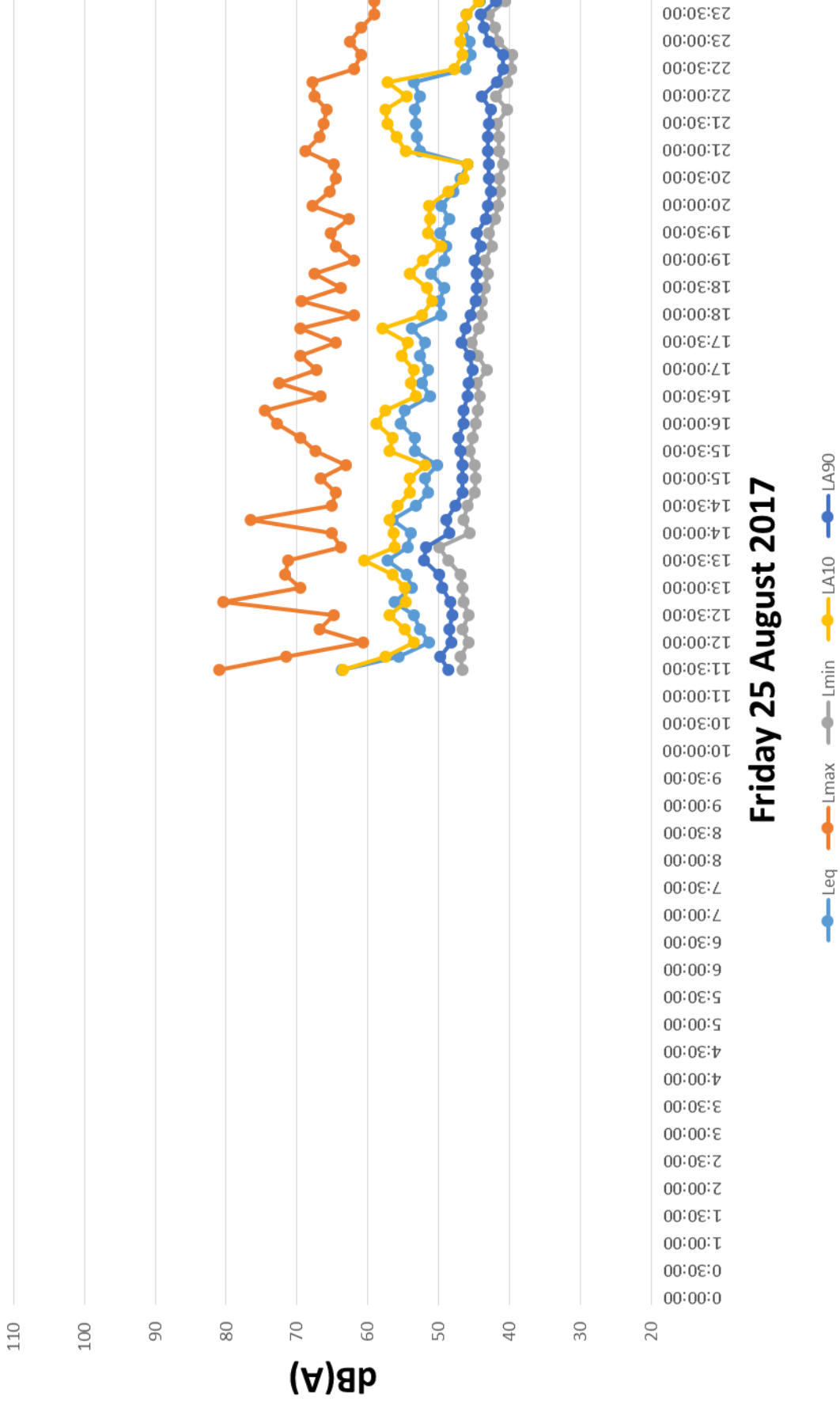
Statistical noise levels

The details of the noise logging measurements are shown below. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are plotted in the graphs below, are here defined.

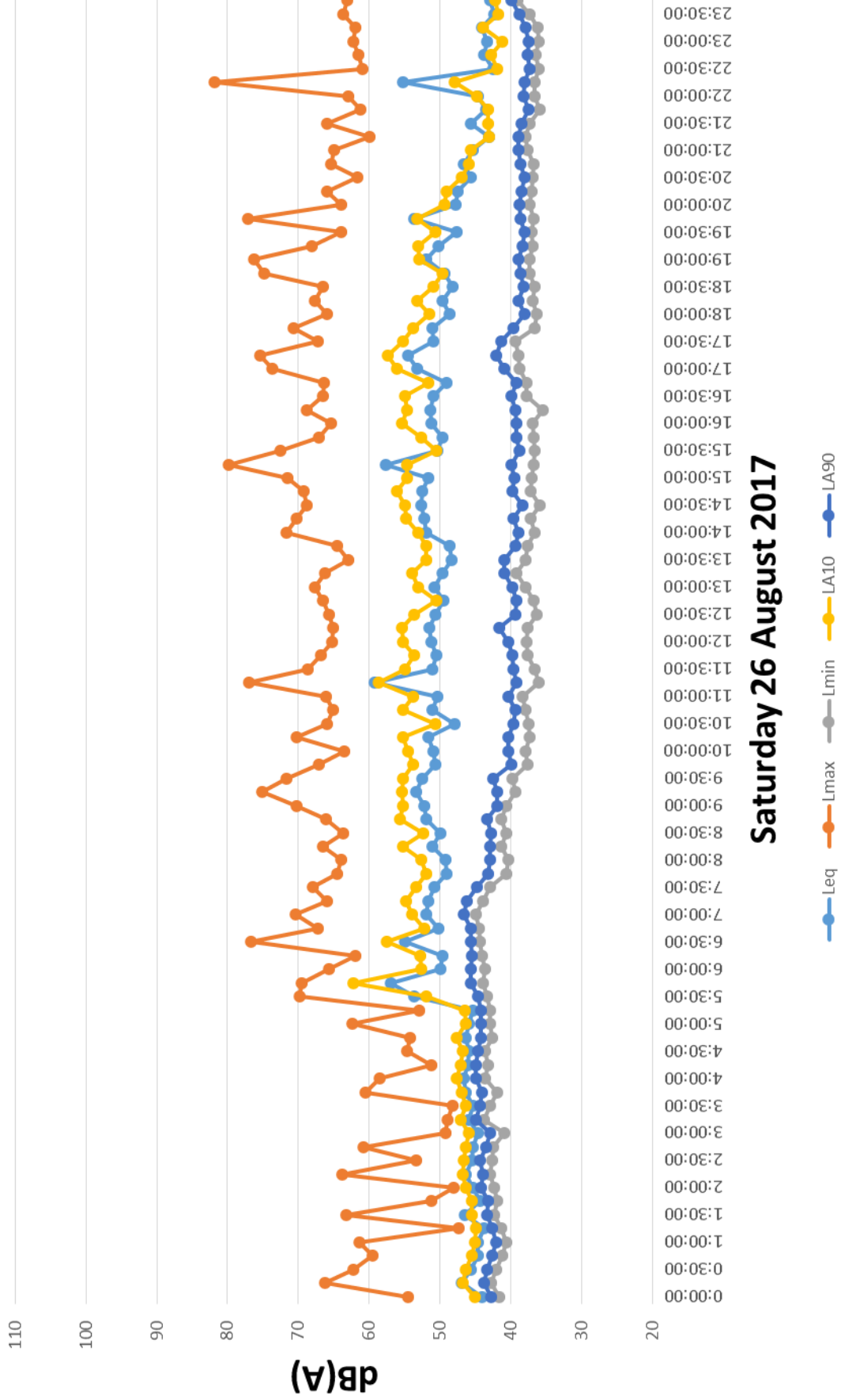
The sections marked in blue have been omitted due to rain that may have affected the measurements.

- Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.
- L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.
- L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.
- L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.
- Minimum Noise Level (L_{Amin}) – The minimum noise level over a sample period is the minimum level, measured on fast response, during the sample period.

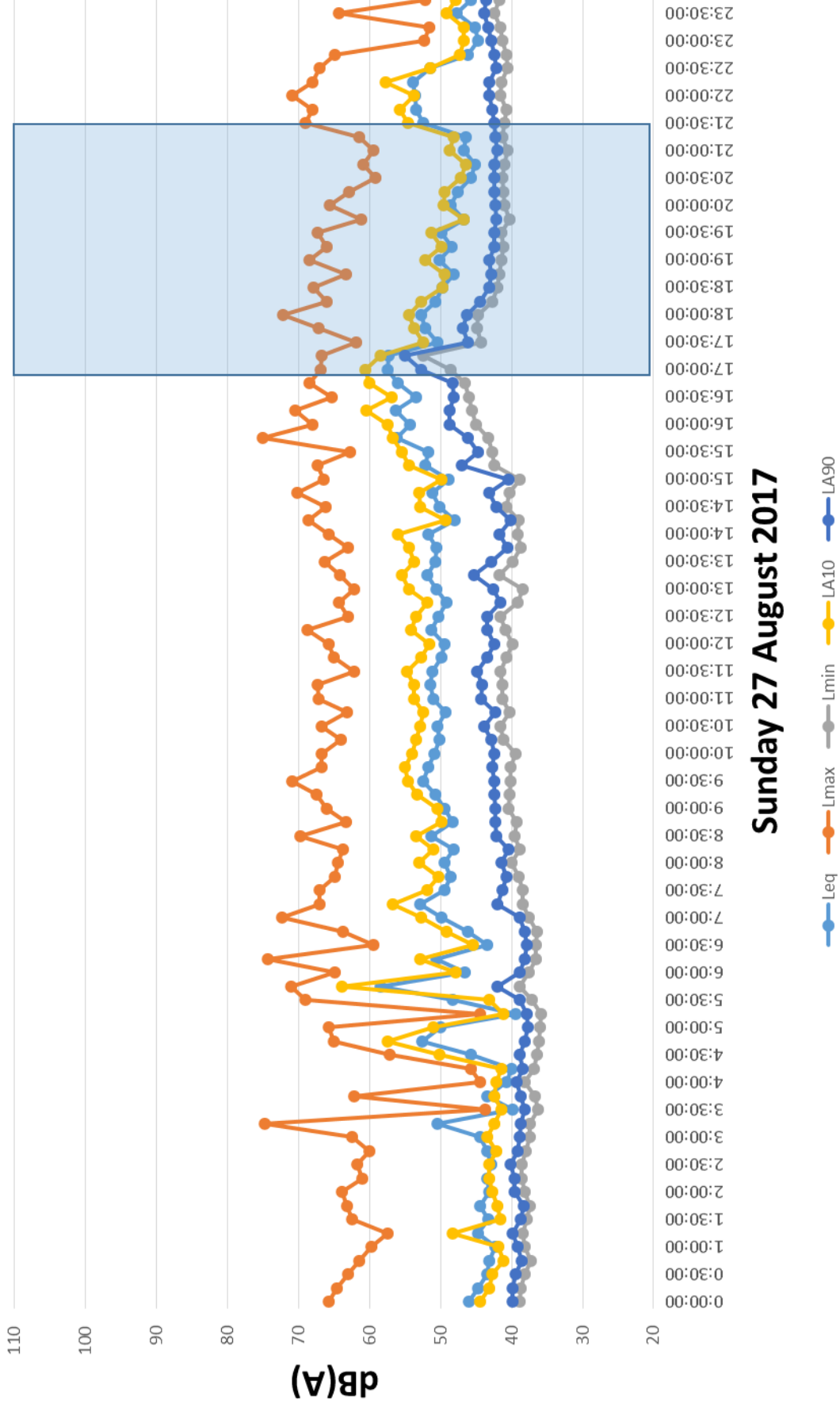
Logger - Battery Street, Clovelly



Logger - Battery Street, Clovelly



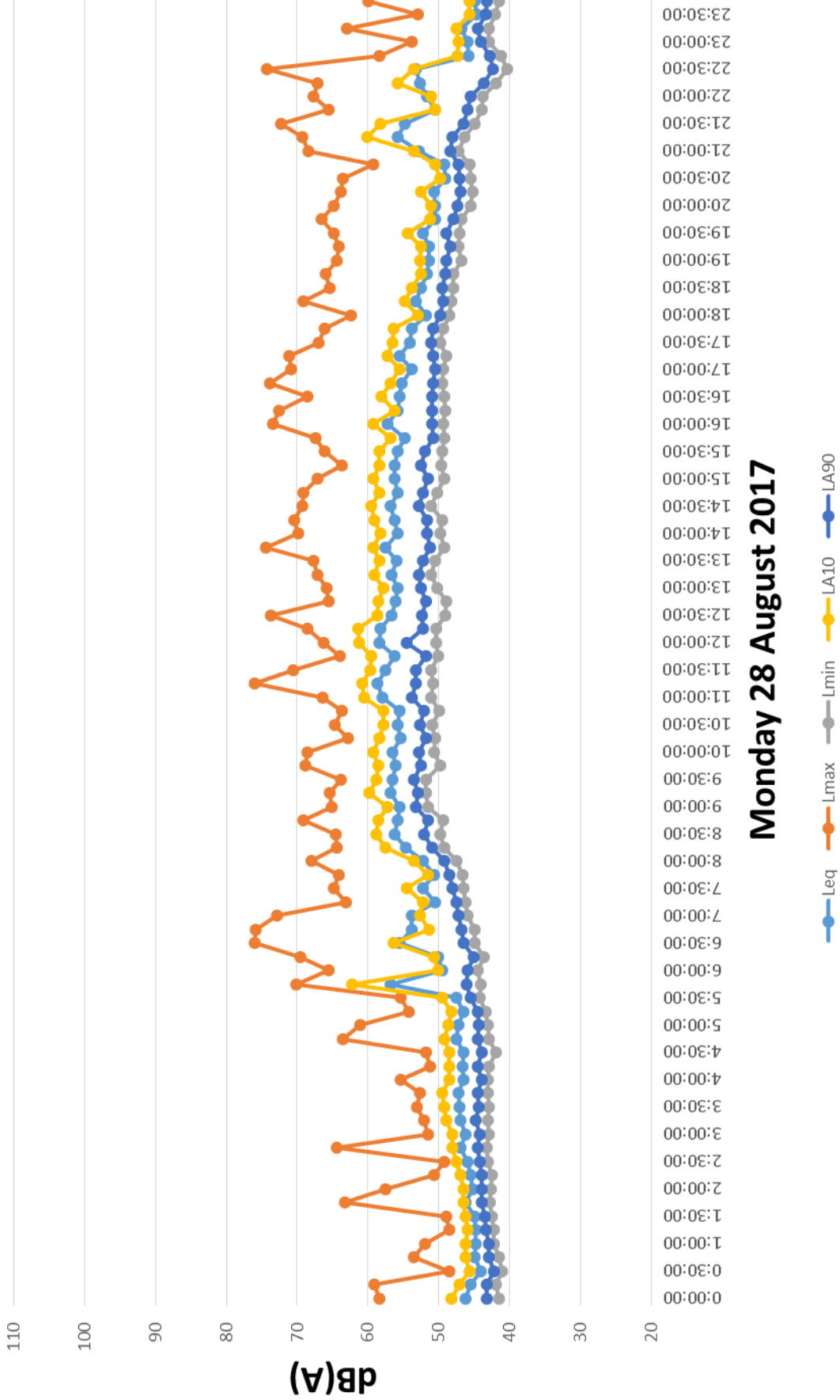
Logger - Battery Street, Clovelly



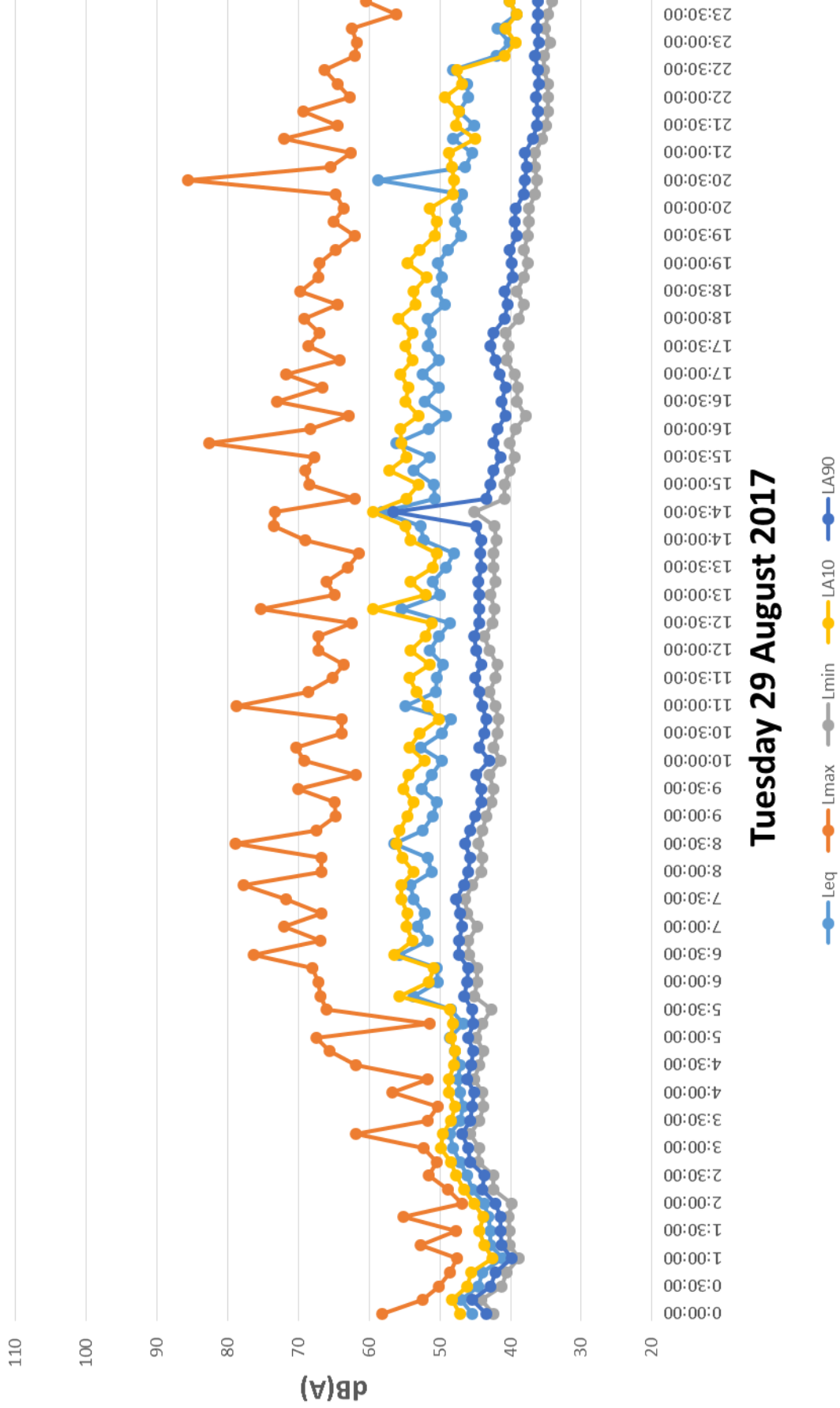
Sunday 27 August 2017

Legend: Leq (blue), Lmin (grey), LA10 (yellow), Lmax (orange), LA90 (dark blue)

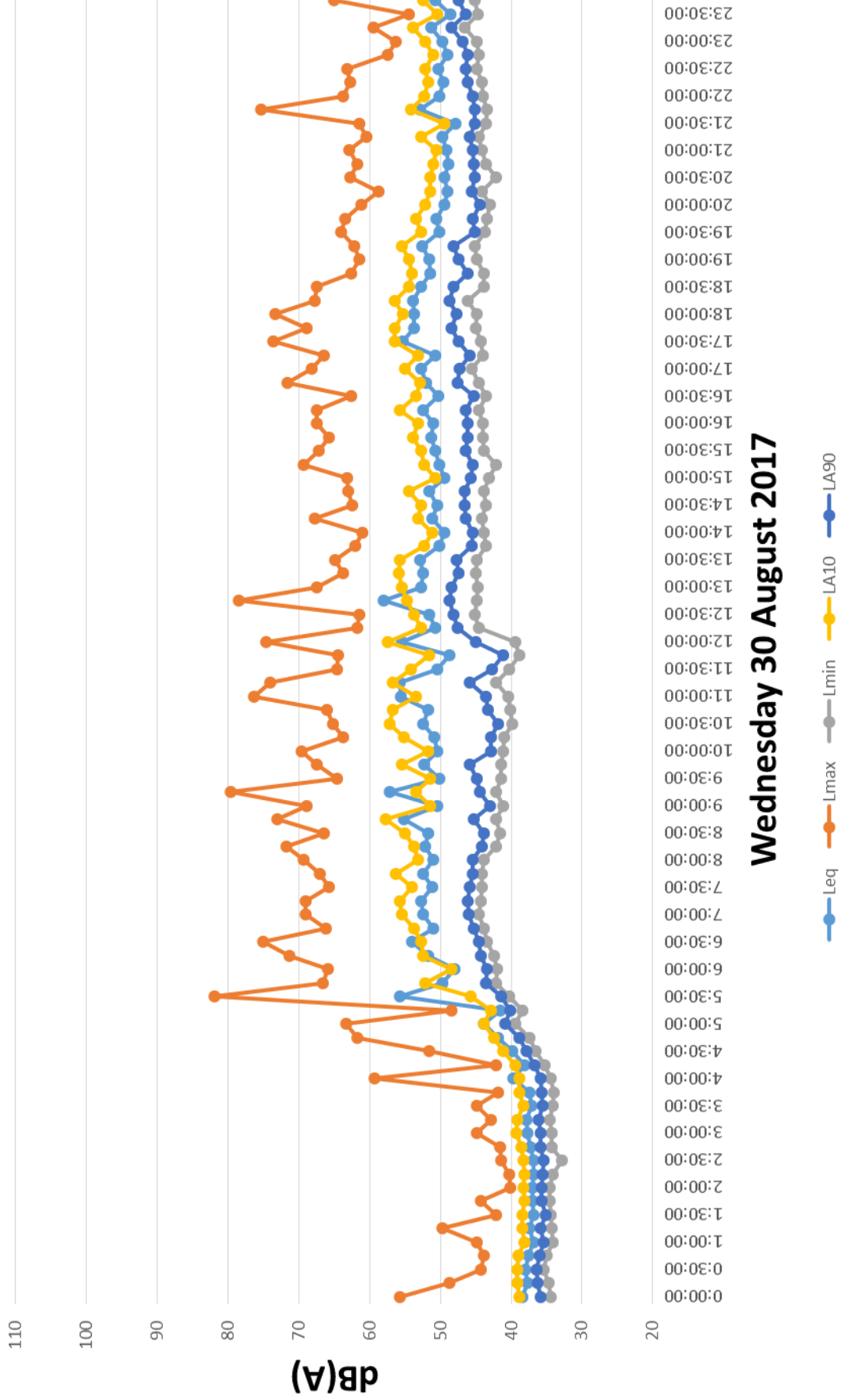
Logger - Battery Street, Clovelly



Logger - Battery Street, Clovelly

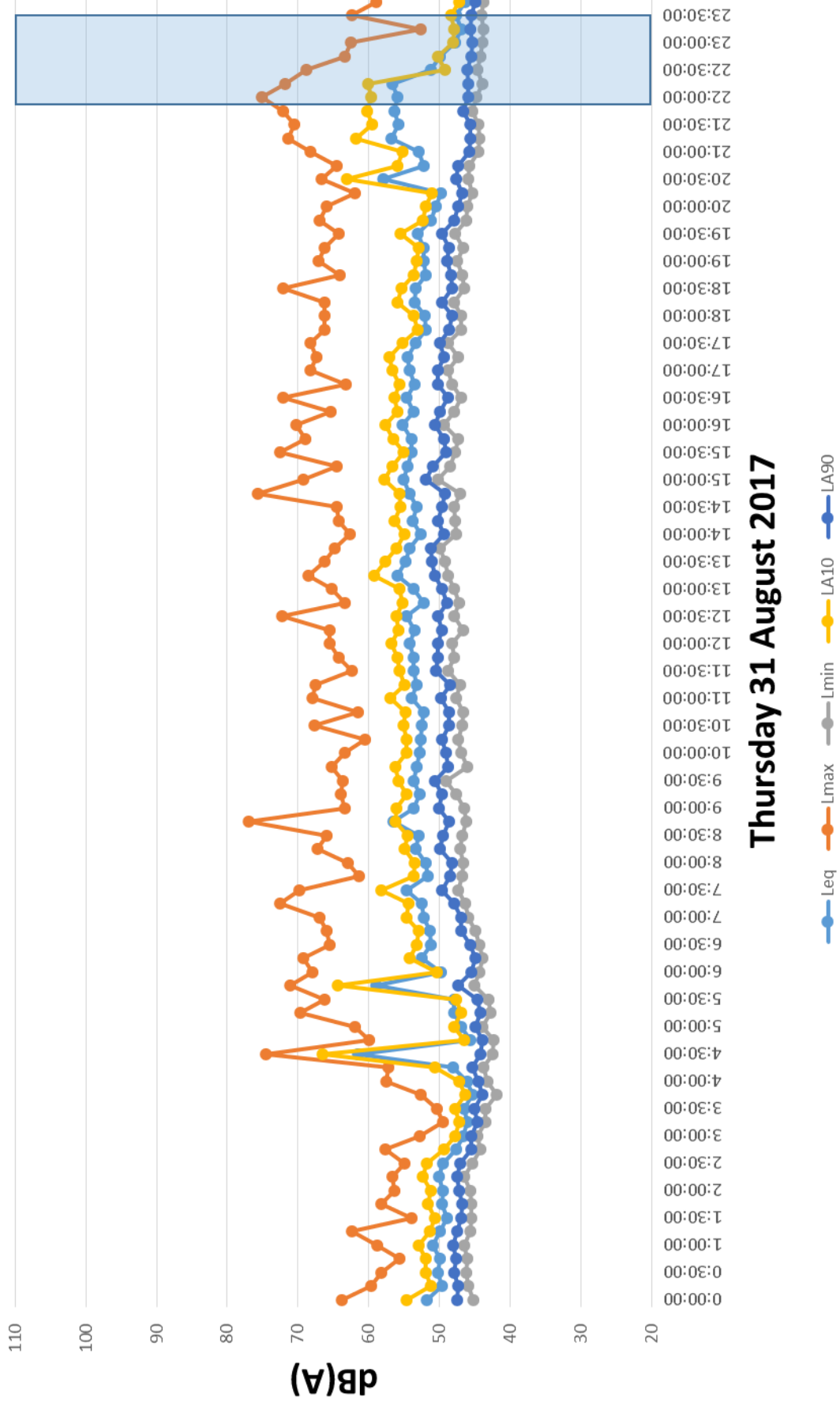


Logger - Battery Street, Clovelly



Wednesday 30 August 2017

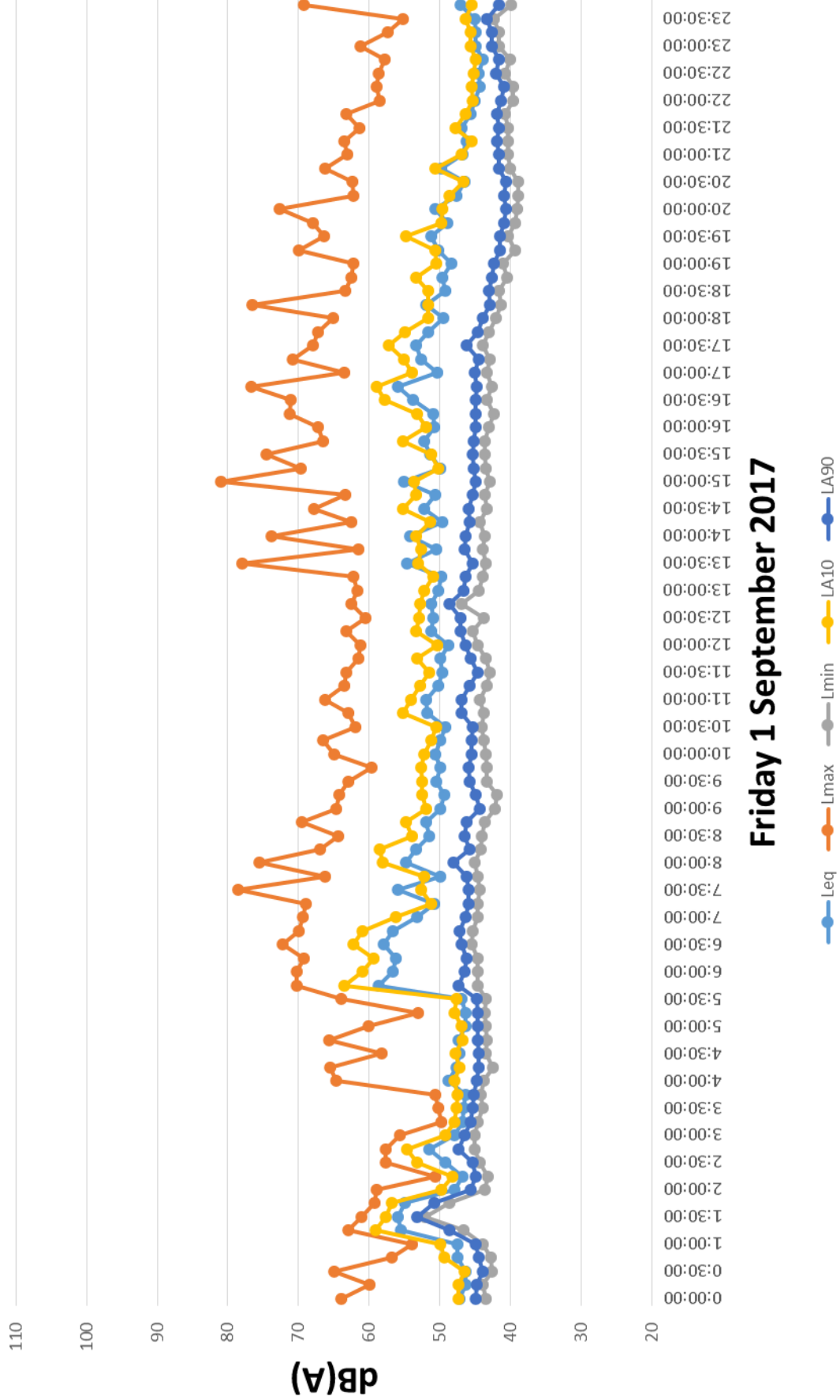
Logger - Battery Street, Clovelly



Thursday 31 August 2017

Legend: Leq (blue), Lmax (orange), Lmin (grey), LA10 (yellow), LA90 (dark blue)

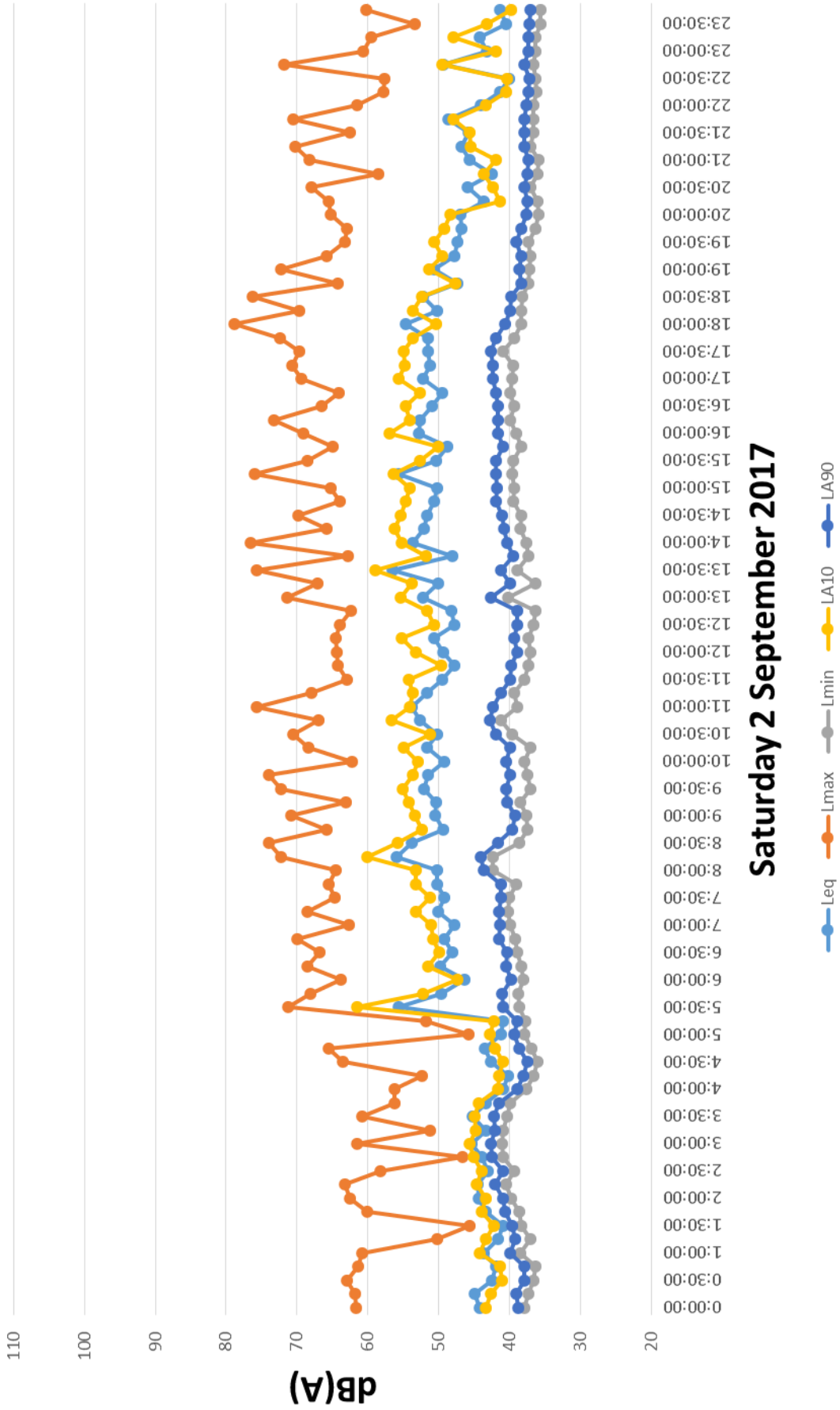
Logger - Battery Street, Clovelly



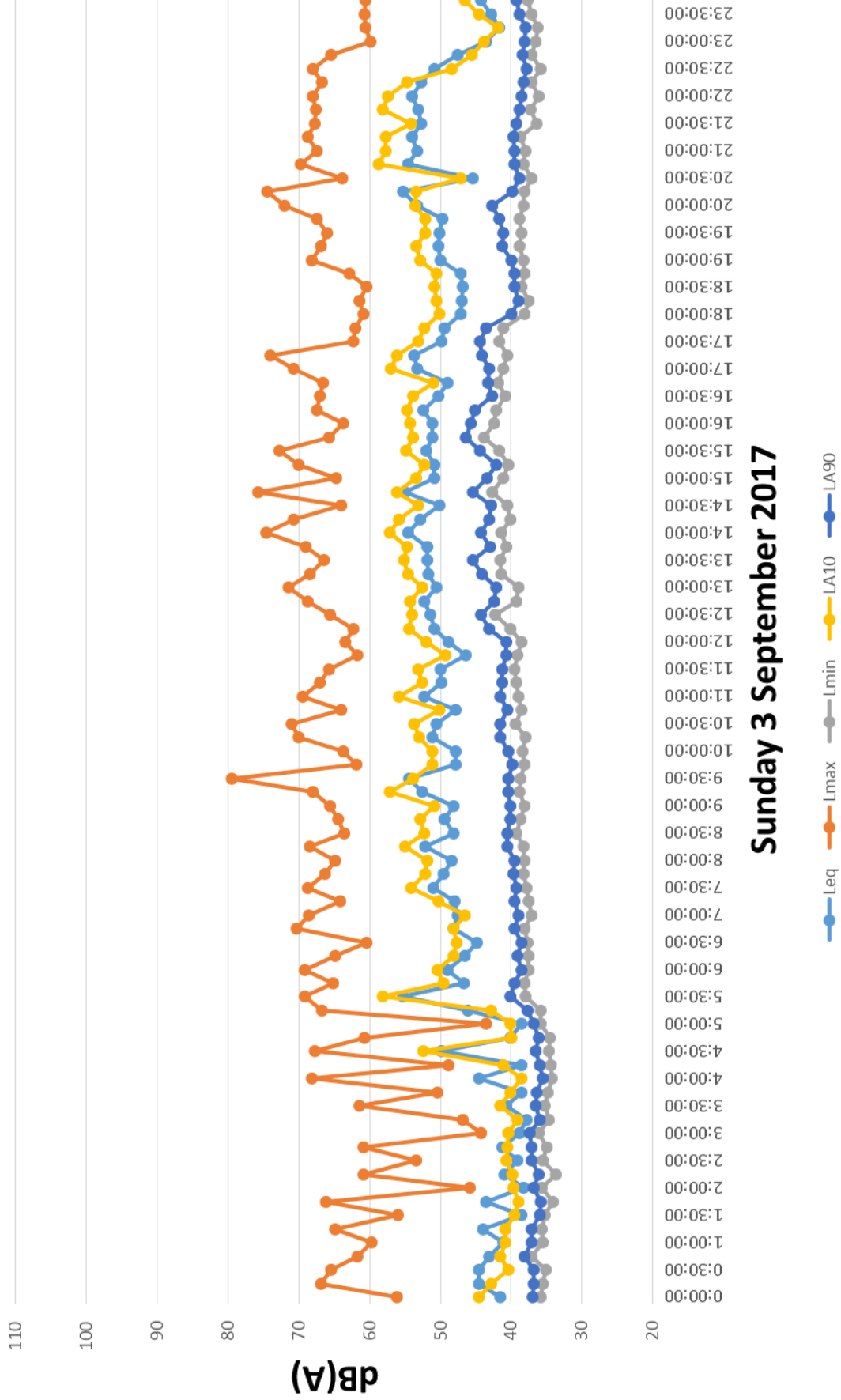
Friday 1 September 2017

Legend: Leq (blue), Lmax (orange), Lmin (grey), LA10 (yellow), LA90 (dark blue)

Logger - Battery Street, Clovelly



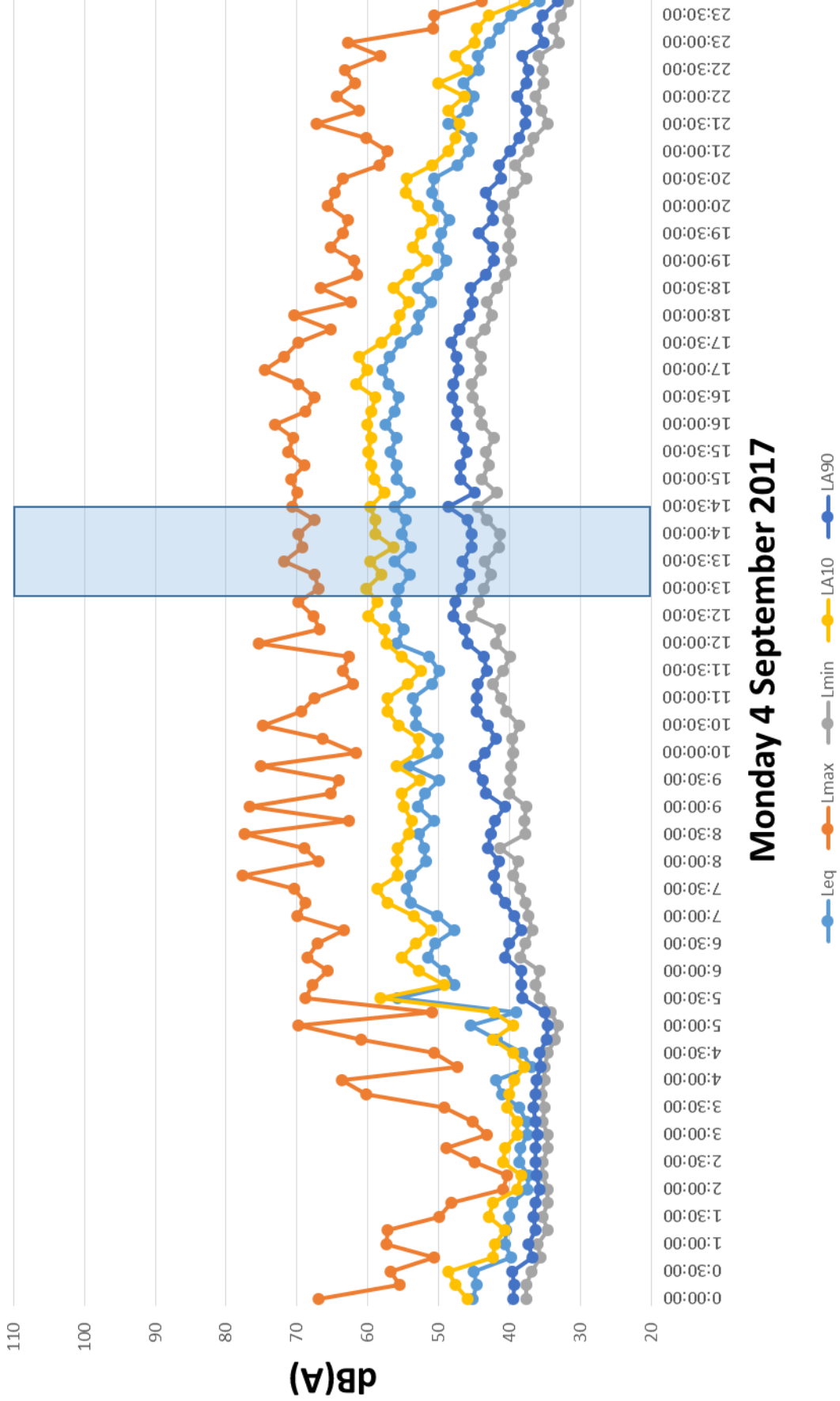
Logger - Battery Street, Clovelly



Sunday 3 September 2017

Legend: Leq (blue), Lmax (orange), Lmin (grey), LA10 (yellow), LA90 (dark blue)

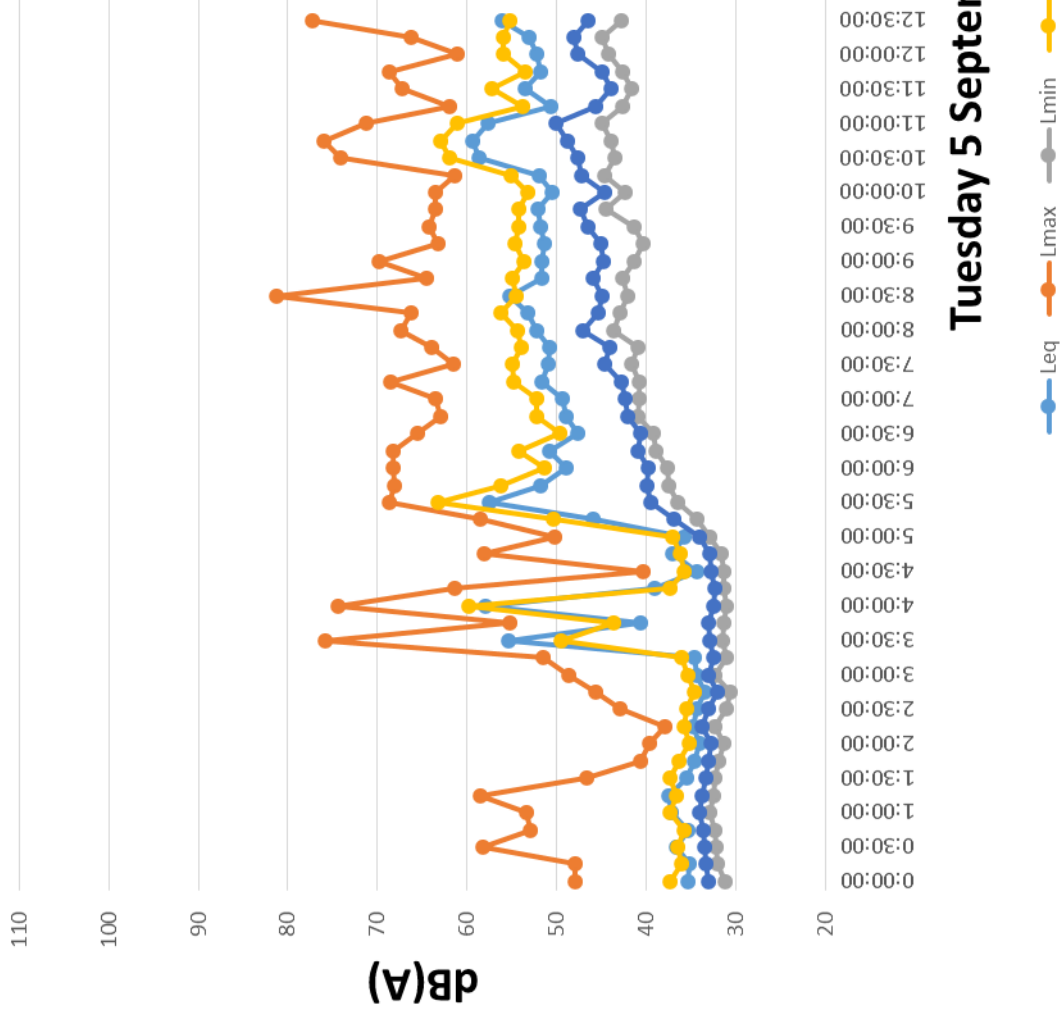
Logger - Battery Street, Clovelly



Monday 4 September 2017

Leq Lmax Lmin LA10 LA90

Logger - Battery Street, Clovelly



Tuesday 5 September 2017

Legend: Leq (blue), Lmax (orange), Lmin (grey), LA10 (yellow), LA90 (dark blue)