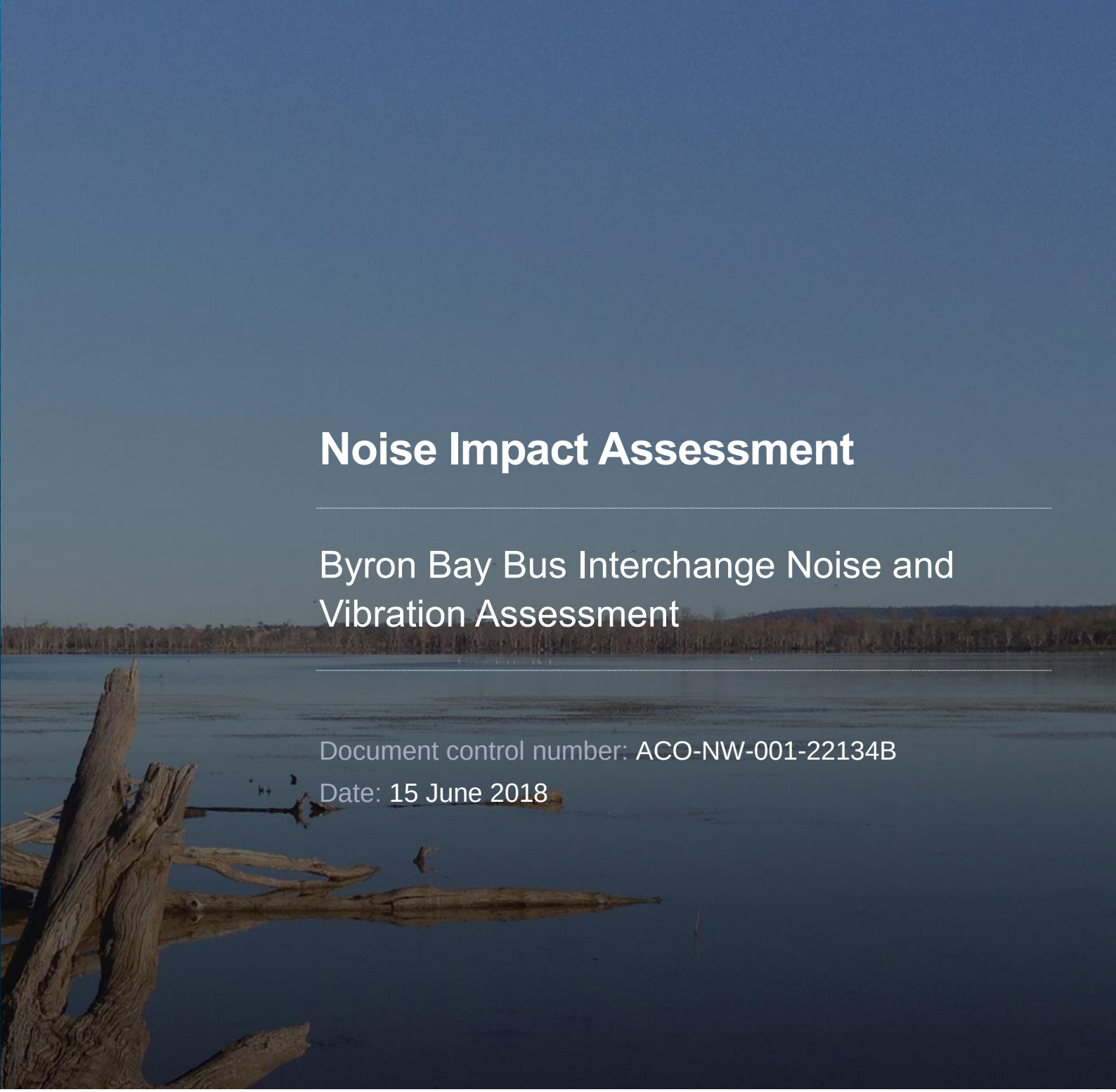


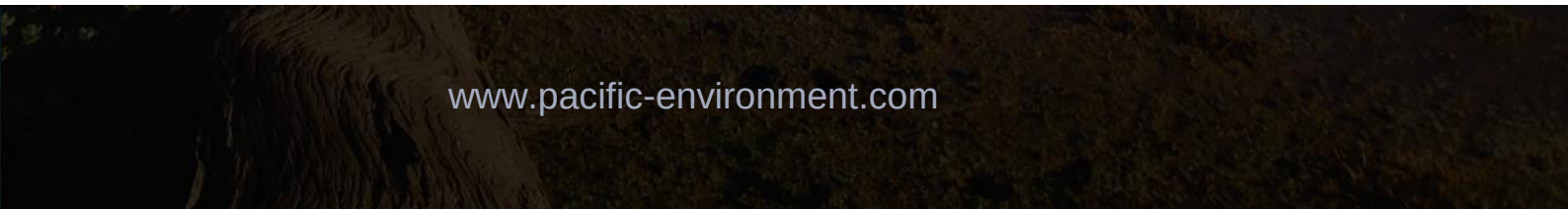
Noise Impact Assessment

Byron Bay Bus Interchange Noise and Vibration Assessment

Document control number: ACO-NW-001-22134B

Date: 15 June 2018

Pacific Environment



www.pacific-environment.com

Project name: Byron Bay Bus Interchange Noise and Vibration Assessment

Document control number: ACO-NW-001-22134B

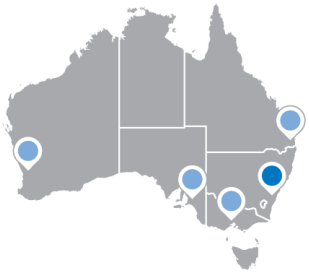
Prepared for: SMEC

Approved for release by: Aaron McKenzie

Disclaimer & copyright: This report is subject to the copyright statement located at www.pacific-environment.com © Pacific Environment Pty Ltd ABN 86 127 101 642

Document Control

Version	Date	Comment	Prepared by	Reviewed by
01	03.05.2018	Draft	Rebecca Warren	Aaron McKenzie
02	07.06.2018	Final Draft	Rebecca Warren, Robbie Cain	Aaron McKenzie
02b	15.06.2018	Final Draft	Rebecca Warren	Aaron McKenzie



Adelaide

The Hub, 5 Peel Street Adelaide
SA 5000
Ph: +61 8 8332 0960
Fax: +61 7 3844 5858

Brisbane

Level 4, 201 Leichhardt Street
Spring Hill Qld 4000
Ph: +61 7 3004 6400
Fax: +61 7 3844 5858

Melbourne

Level 6, 99 King Street
Melbourne Vic 3000
Ph: +61 3 9111 0021
Fax: +61 2 9870 0999

Perth

Level 18,
140 Georges Terrace, Perth
WA 6000
Ph: +61 8 9481 4961
Fax: +61 2 9870 0999

Sydney Head Office

Suite 1, Level 1, 146 Arthur Street
North Sydney, NSW 2060
Ph: +61 2 9870 0900
Fax: +61 2 9870 0999

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Disclaimer

Pacific Environment acts in all professional matters as a faithful advisor to the Client and exercises all reasonable skill and care in the provision of its professional services.

Reports are commissioned by and prepared for the exclusive use of the Client. They are subject to and issued in accordance with the agreement between the Client and Pacific Environment. Pacific Environment is not responsible for any liability and accepts no responsibility whatsoever arising from the misapplication or misinterpretation by third parties of the contents of its reports.

Except where expressly stated, Pacific Environment does not attempt to verify the accuracy, validity or comprehensiveness of any information supplied to Pacific Environment for its reports.

Reports cannot be copied or reproduced in whole or part for any purpose without the prior written agreement of Pacific Environment.

Where site inspections, testing or fieldwork have taken place, the report is based on the information made available by the client or their nominees during the visit, visual observations and any subsequent discussions with regulatory authorities. The validity and comprehensiveness of supplied information has not been independently verified and, for the purposes of this report, it is assumed that the information provided to Pacific Environment is both complete and accurate. It is further assumed that normal activities were being undertaken at the site on the day of the site visit(s), unless explicitly stated otherwise.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Executive summary

Overview

Pacific Environment was commissioned to conduct a noise and vibration assessment for the proposed operation of a bus interchange on Butler Street, Byron Bay NSW.

The interchange is proposed to replace an existing bus stop/interchange on Jonson Street, Byron Bay.

Existing Environment

The existing acoustic environment was characterised by completion of unattended monitoring and short term (attended) noise measurements. The proposal is located in a suburban noise amenity area. Noise criteria was determined with consideration to the newly released *Noise Policy for Industry (EPA 2017).*

The background noise environment and associated noise criteria were developed with reference to background monitoring data and historical data. Trends over time between collected and historical data were analysed and it is considered that the background data collected for the project is representative of the environment at the nearest receivers to the proposed interchange site.

A qualitative assessment of operational vibration was completed due to the separation distance between the proposal and the nearest potentially affected receivers.

Operational Noise

Predictive modelling was completed for the assessment based on site plans and traffic volumes. The noise model was developed for theoretical operational scenarios to predict noise levels at the surrounding sensitive receivers.

The noise model included operational noise sources associated with bus and taxi movements, and accounted for attenuation due to ground effects, shielding from topographical features and barriers, air absorption and geometrical spreading.

Two scenarios were developed for the purpose of this assessment.

Scenario 1 assessed the operation of the interchange alone. The results indicate that while the interchange is likely to generate some impacts at the nearest receivers, for average traffic conditions, noise levels are predicted to comply with all criteria at all affected sensitive receivers. Exceedances of noise criteria of up to 2 dB at the nearest residence (receiver R5) on Butler Street during peak hour movements.

Scenario 2 compares the impacts of the interchange concurrent with the Byron Bay Bypass. The results indicate that while the interchange is likely to generate minor impact at the nearest receivers, the impacts will likely be the masked by the operational road noise impacts of the Bypass which was predicted (GHD 2016) to be significantly louder than the interchange, and some receivers would benefit from mitigation measures required as part of the Bypass Project.

Road Noise

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Calculations were made to estimate the impact of additional proposal-related traffic on local roads using the Calculation of Road Traffic Noise (CoRTN).

Operational road traffic noise levels are predicted to result in a small increase in received noise levels at residences on Butler Street during the day period due to the increases in heavy vehicle percentages; however the relative change is less than 2 dB based on noise levels without the proposal.

Noise Management and Monitoring

Noise management and monitoring measures have been recommended to assist in the control and reduction of adverse noise impacts during the operation of the proposal. It is anticipated that any impacts can be effectively managed and mitigated by the implementation of the recommendations provided in this report, and will be significantly lower than predicted noise levels from the Byron Bay Bypass project.

A number of receivers are to be considered for noise mitigation as a result of the Byron Bay Bypass project (Scenario 2); this has been discussed in this report.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Table of contents

Proprietary information for SMEC only. Property of Pacific Environment Limited.

List of Figures

List of Tables

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

1 Introduction

Pacific Environment has been commissioned by SMEC on behalf of Sydney Trains to conduct a noise and vibration assessment for the proposed operation of a bus interchange.

The proposed new Byron Bay Bus Interchange is located within existing Sydney Trains land adjacent the former Byron Bay Railway Station, approximately 772 km north of Sydney, in the Byron Shire Local Government Area (LGA).

The interchange is proposed to replace an existing bus stop/interchange on Jonson Street, Byron Bay. There are no proposed changes to the bus timetable for these railway buses.

The proposal is to be located on Butler Street, east of residences on Butler Street and the former railway line.

The assessment considers two scenarios, assessing the proposal only and the cumulative impacts of the proposal and the Byron Bay Bypass. It is expected that the Bypass would be operational before the interchange becomes operational.

It is noted that a number of residences on Butler Street were identified for mitigation as part of the Bypass Approval (Development Application 10.2016.77.1). This has been considered as part of the cumulative assessment, as these receivers are within the proposal affectation area.

This assessment has been conducted with consideration to the following documents:

- Noise Policy for Industry (EPA 2017)
- Road Noise Policy (RNP) (DECCW, 2011)
- Assessing Vibration, A Technical Guideline (Vibration Guideline) DEC 2004

A glossary of the acoustic terms used in this report are presented in Appendix A.

Due to the distances between sources and receivers, and the lack of impact-generating vibration sources during operation of the interchange, operational vibration has not been assessed further for the purpose of this assessment.

The proposal does not incorporate any additional car parking, and it is understood that any car parking requirements associated with the interchange would utilise existing facilities at the Butler Street Reserve, however impacts associated with this car parking activity have been excluded for the purposes of this assessment.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

2 Proposal Description

2.1 Proposal Location and Description

The proposal is located within Sydney Trains land adjacent the former Byron Bay Railway Station off Butler Street. The Byron Bay town centre is located approximately 80 metres to the east of the site, which is primarily retail and commercial in nature. Surrounding the project site to the west and south are low and medium residential land uses. Commercial areas, including the main shopping strip, are located to the east of the site on Jonson Street, including Byron Tourist Information Centre and Railway Friendly Bar. The proposal area is undeveloped and vegetated, with a water tank located within the site. This tank will remain in-situ as part of the proposal. A disused rail corridor runs north to south, within the eastern boundary of the site.

2.2 Need and Objectives of the Proposal

The Byron Bay public transport service is characterised by a disused rail line, a congested Railway Park and an infrequent local bus service. The Byron Bay Railway Station ceased to operate in May 2004 when the Murwillumbah to Casino rail line was closed. The station building is now used as a Countrylink coach terminal.

Traffic congestion has been identified as significant issue in the Byron Bay Town Centre Master Plan (Byron Shire Council, 2016). The existing road network within the township of Byron Bay has little to no spare capacity and is restricted by the rail line, which runs parallel to Jonson Street.

To relieve some of the traffic congestion from coaches currently travelling through the town centre, a road bypass has been proposed for construction to the west of the rail corridor. The bypass aims to improve traffic efficiency via a number of upgrades along Shirley Street, Lawson Street and Butler Street, including the construction of a new road and level rail crossing (Appendix B).

To support the proposed bypass, Sydney Trains is proposing to construct a new bus interchange at Byron Bay as part of the Transport Access Program (TAP). The TAP is an initiative by Transport for NSW (TfNSW) to provide a better experience for public transport customers.

The interchange has been included as various improvements are required to improve the experience for customers. Sydney Trains will be undertaking the delivery of these upgrades on behalf of TfNSW.

The TAP encompasses the associated interchange facilities and passenger access between interchange facilities and the service building. It includes interchange platforms, buildings, gates, pedestrian and cycle access paths, pedestrian linkages to the adjacent streets and the commuter car park, bus stops and shelters, taxi stands, Kiss and Ride locations and bicycle facilities.

2.3 Description of the Proposal

The proposal would include the following elements:

- Provision of dedicated stops for regional coaches within the interchange.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

- Associated customer facilities such as shelters, waiting areas and a toilet block.
- Provision of drop off/pick up area for taxis and kiss and ride.

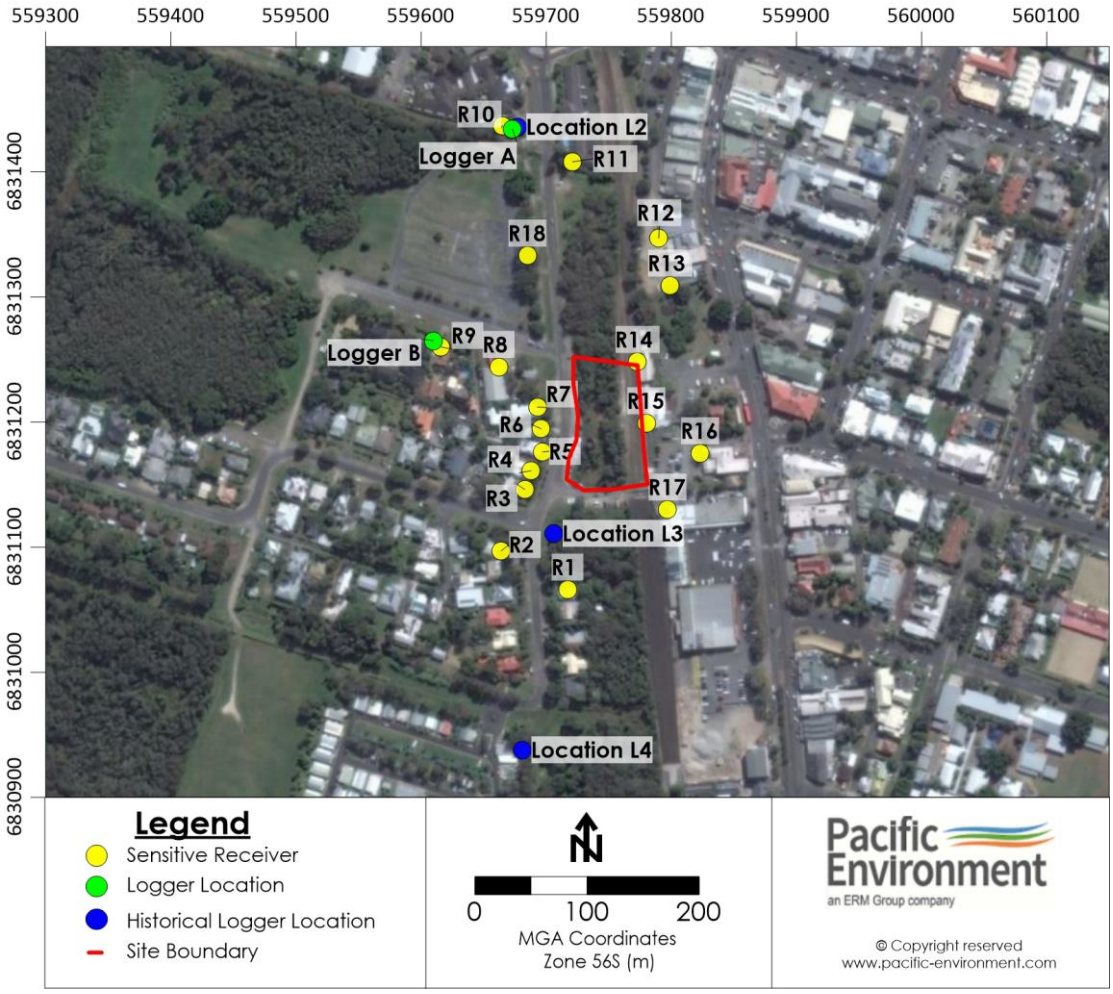


Figure 2-1: *Site Layout, Monitoring Locations and Historical Monitoring Locations*

A concept plan of the proposed interchange is presented in Appendix B.

2.4 Link to Bypass

Byron Council and a Joint Regional Planning Panel has approved the Byron Bay Bypass which will involve the construction of a bypass from Browning Street to the south to Shirley Street in the north. An extract of the relevant concept design is presented in Appendix B.

Identified receivers and monitoring locations consistent with those of the associated Noise and Vibration Impact Assessment (GHD 2016) have been identified for comparative purposes and to facilitate the assessment of cumulative impacts from the proposal and the bypass, once operational.

2.5 Sensitive Receivers

Proprietary information for SMEC only. Property of Pacific Environment Limited.

The nearest sensitive receivers are located to the west, east and south of the proposal, approximately 20-30 m from the site boundary to the west and eat, and 70 m to the south. The receivers are summarised in Table 2-1 and Figure 2-1.

Table 2-1. *Closest Sensitive Receivers*

Receiver ID	Address	Receiver Type	Approx. closest distance to site boundary (m)
R1	69 Butler St	Residence	80
R2	2 Burns St	Residence	75
R3	62 Butler St	Residence	30
R4	60 Butler St	Residence	30
R5	58 Butler St	Residence	25
R6	56 Butler St	Residence	30
R7	54 Butler St	Residence	30
R8	52 Butler St[2]	Residence	60
R9	3 Somerset[1]	Residence/backpackers	100
R10	1 Butler St	Residence / Aged Care Facility	200
R11	11 Butler (Motor Lodge)	Hotel	160
R12	52 Jonson St (Restaurant)	Restaurant / Commercial	110
R13	56 Jonson St	Commercial Area	70
R14	86 Railway Station-disused [3]	Railway Station	15
R15	Railway Bar	Commercial Area	20
R16	Travel Centre	Commercial Area	60
R17	Commercial Area	Commercial Area	40
R18	Recreational Area	Recreational Area	50

Note : 1. This receiver may be a backpackers but has been assessed as a residence for the purpose of this assessment.

2. This appears to be a shed but may have a residence attached, and has been assessed as a residence for the purpose of this assessment.

3. This railway station has been repurposed as a site office for Countrylink trains.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

3 Background Noise Levels

3.1 Background Noise Levels

The existing acoustic environment was characterised by unattended monitoring and short term (attended) noise measurements. The proposal is located in a suburban noise amenity area. The primary activities which dominate the local noise environment are road traffic, other suburban influences.

A combination of attended (15 minute duration) measurements and unattended noise logging were undertaken at the closest sensitive receivers.

The locations of sensitive receivers and monitoring locations are shown in **Figure 3-1.** Appendix C contains daily monitoring results.

Monitoring was completed with consideration to AS1055.1:1997: Description and measurement of environmental noise.

3.2 Unattended Monitoring

Noise logging was undertaken with NTI Audio XL2 and Rion logger kits. The noise logger was set to record A-weighted noise levels every 15 minutes and set to 'fast' response time. Calibration of the logger kits was checked before and after each measurement with no significant drift observed. The loggers were installed from 23rd to 31st October 2017.

Location A was selected to be representative of existing and future traffic noise conditions to the north of the site. The logger location was within the grounds of an aged care facility to the north of the site, shielded from direct road exposure by a fence and approximately 25 m from the kerbside of Butler Street.

Location B was identified as being representative of receivers to the south of the project on Somerset Street. Unfortunately due to adverse weather conditions logger data was unavailable at this location due to logger malfunction. Observations and inferences were made based on attended measurement data at this location. Measured data was supplemented with historical measurements made at locations within the project area.

Background noise levels at Location A are considered to be representative of the background environment at the nearest receivers to the proposed interchange site (R3-R7), situated at a similar offset to the Butler Street alignment (approx. 10 m), being a dominant noise contributor at both locations.

Ambient noise levels are defined in terms of day (7.00am to 6.00pm), evening (6.00pm to 10.00pm) and night (10.00pm to 7.00am) periods for the determination of construction noise goals in accordance with the INP and Interim *Construction Noise Guideline* (ICNG).

Weather conditions recorded at the nearest Bureau of Meteorology (BoM) automatic weather station Cape Byron (no 058216) were reviewed to identify periods of potentially adverse weather conditions (i.e. rain and wind speed > 3m/s). Ambient noise levels, processed from the noise logger, are presented in Table 3-1. Periods excluded from the collected noise data are shown in Appendix C. Review of the collected data indicates that the location is typical of a suburban area, with L_{90} levels relatively consistent during the day and evening periods,

Proprietary information for SMEC only. Property of Pacific Environment Limited.

reducing during the night time periods with intermittent traffic passbys affecting the recorded L_{10} and L_{eq} levels.

Table 3-1. *Unattended Noise Measurement Results – Ambient Noise Levels*

Receiver ID	L_{90}			L_{eq}			L_{max}		
	D	E	N	D	E	N	D	E	N
A	43	43	39	52	50	48	69	65	64

Note: 1.Day (7.00am to 6.00pm Monday to Saturdays and 8.00am to 6.00pm Sundays and Public Holidays). Evening (6.00pm to 10.00pm Monday to Sunday). Night (10.00pm to 7.00am Monday to Saturdays and 10.00pm to 8.00am Sundays and Public Holidays).

3.3 Previous Monitoring

Background monitoring was completed at a location consistent with this assessment as part of the Byron Bay Bypass Noise and Vibration Impact Assessment (GHD 2016). The results of this assessment are summarised below for Locations L2 and L3. Data was collected in April and May 2015, and is considered valid for consideration in this assessment as there has been no significant development in the intervening period that would have significantly impacted the background noise environment (e.g. industrial development, changes in land uses, etc). Location L2 is at the same address as the logger location A for the current model, however more exposed to traffic noise on Butler Street. Location L3 is located adjacent the residences to the south of the proposal area, and representative of background levels within the vegetated area to be modified as part of the proposal. Location 3 is also situated at a similar offset to the Butler Street alignment as receivers to the west, and noise contributors to this location would be representative of those at R3-R7.

Table 3-2: *Ambient Noise Levels – Noise logging April-May 2017*

Receiver ID (equiv. Logger)	L_{90}			L_{eq}		
	D	E	N	D	E	N
L2 (A)	52	49	42	60	58	55
L3	42	47[2]	46[2]	53	52	52

Note: 1.Day (7.00am to 6.00pm Monday to Saturdays and 8.00am to 6.00pm Sundays and Public Holidays). Evening (6.00pm to 10.00pm Monday to Sunday). Night (10.00pm to 7.00am Monday to Saturdays and 10.00pm to 8.00am Sundays and Public Holidays).

2. The RBL of the evening and night time periods cannot be higher than the day time period (EPA 2000). In setting assessment criteria, the daytime RBL has been adopted where evening or night time RBLs were measured to be higher.

Source: GHD 2016.

3.4 Attended Monitoring

To characterise the existing noise environment, short term (attended) noise measurements were undertaken at Locations A and B on 23rd and 31st October 2017.

Measurements were undertaken over 15 minute intervals using an NTi Audio XL2 Type 1 sound level meter. Field calibration was checked before and after each measurement occasion with no drift (<0.1 dB) observed. Weather conditions on both days included some cloud cover with light winds.

Attended monitoring indicated the noise environment was influenced by occasional vehicle passbys. Background noise levels were observed to be between 44 and 45 dB(A) at Location

Proprietary information for SMEC only. Property of Pacific Environment Limited.

A and influenced by traffic movements on Butler Street. Background noise levels at Location B ranged between 42 and 46 dB(A), largely affected by local influences including intermittent traffic with no industrial influences audible. A summary of the attended noise measurements is shown in Table 3-3.

Table 3-3. *Attended Noise Measurement Results*

Date and Time	Location (equiv.)	Measured Noise Level dB(A)				Comments
		$L_{Aeq,15m}$	$L_{A10,15m}$	$L_{A90,15m}$	L_{Amax}	
23/10/17 12:55	Butler St (Logger A)	50	54	44	70	Background noise environment 44-45. Regular traffic passbys on bridge. L_{max} events from cars crossing bridge. People walking past on bike path
23/10/17 13:35	Somerset St (Logger B)	51	53	42	70	Local noise influences, intermittent car passbys. Occasional pedestrian traffic.
31/10/17 13:00	Butler St (Logger A)	54	56	45	79	Noise from cars on bridge, L_{max} cars crossing bridge. People walking past on bike path.
31/10/17 13:28	Somerset St (Logger B)	51	54	46	72	Relatively quiet, local noise, intermittent car passbys.

Note: All noise levels in dB(A) rounded to nearest decibel.

3.5 Summary of Background Monitoring Environment

The background noise environment in the vicinity of the proposed interchange is characterised by local traffic movements and rural influences.

Background noise levels at Location A, selected to be representative of existing and future traffic noise conditions to the north of the site, were found to be affected by local traffic movements on Butler Street.

Background noise levels at Location A were measured at 43 dB(A) L_{90} (daytime), 43 dB(A) L_{90} (evening period) and 39 dB(A) L_{90}, which were identified as being lower than the previously measured background levels at Location L2 (GHD 2016), which identified L_{90} background levels of 52 dB(A), 43 dB(A) and 42 dB(A) for day, evening and night time periods respectively. As a result, the adopted values for Logger A are more conservative for the purpose of this assessment. Attended measurements taken at Location A correlate with long term measurements (44-45 dB(A) L_{90}).

Historical data for Location L3 found that background levels representative of receivers (R3-R7) west of Butler Street are in the order of 42 dB(A), 47 dB(A) and 46 dB(A) L_{90} for day, evening and night time periods respectively GHD (2016). As a result it is considered suitable to adopt the background noise levels from Location A for these receivers, as the L_{90} values collected are lower over the evening and night time periods and therefore more conservative.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

4 Assessment Criteria

4.1 Operational Noise

The NSW Government's policy and guidelines for the assessment of industrial noise are presented in the *Noise Policy for Industry* (EPA, 2017). The NPI recommends intrusiveness criteria for residential receivers to address the potential for intrusive noise and amenity criteria to maintain acoustic amenity appropriate to the relevant land use category of the area. The criteria set in the NPI are non-mandatory, however it is emphasised that all reasonable and feasible measures should be implemented to attempt to achieve the criteria. Where the criteria are not met, additional considerations may apply.

Intrusiveness Noise Level – The $L_{Aeq,15min}$ noise level within the day (7.00am to 6.00pm, 8.00am to 6.00pm Sundays and Public Holidays), evening (6.00pm to 10.00pm) or night time (10.00pm to 7.00am, 10.00pm to 8.00am Sundays and Public Holidays) assessment periods should not exceed the Rating Background Level (RBL) within that period by more than 5 dB(A) when beyond a minimum threshold. The purpose of this noise goal is to minimise the likelihood of disturbance.

Amenity Noise Level – The maximum ambient L_{Aeq} noise level from industrial sources within the day, evening and night assessment periods should not exceed the "recommended amenity noise levels" published in the *Noise Policy for Industry* (EPA, 2017) and summarised in Table 4-1. Adjustments to the ANL apply where there is an existing industrial influence affecting sensitive receivers.

The ANL is dependent on the relevant receiver type and area category for the sensitive receiver. The purpose of this noise goal is to provide an upper limit to industry related noise emission and prevent industrial noise from creeping higher with each new successive industrial development.

For the purposes of this assessment, all residential receivers are considered to be within a suburban noise amenity area as the noise monitoring indicated the local environment is dominated by some traffic. With reference to the NPI the evening and night time levels could be characterised as urban, however for conservativeness the suburban amenity area will be applied.

Table 4-1. *Recommended L_{Aeq} Noise Levels from Industrial Noise Sources*

Type of Receiver	Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level dB(A) Acceptable
Residence	Suburban	Day	55
		Evening	45
		Night	40
Hotels, motels, holiday accommodation	Suburban	Day	60[1]
		Evening	50[1]
		Night	45[1]
Active recreation area (e.g. playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Note: This table is an extract of Table 2.2 of the NPI.

1. Note from the policy: 5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day.

It is noted that receiver R8 appears to be a commercial garage, but may comprise a residential dwelling, and has therefore been assessed as a residence for the purpose of this assessment.

The NPI includes provisions for noise that contains certain characteristics. The characteristics include tonality, impulsiveness, intermittency or dominant low frequency content. Where these characteristics are identified, an adjustment is made to the measured or predicted noise level.

The intrusive noise criteria are based on the default NPI background levels for Location A in Section 3.2.

No significant industrial noise influence was observed during observations on site and attended monitoring. The most stringent of the intrusive noise criteria and the amenity criteria was adopted as the proposal specific operational noise criteria for residential receivers. The proposed operational noise criteria are provided in Table 4-2.

Table 4-2. *Operational Noise Criteria*

Criteria Type	Receiver Type	Operational Noise Criteria, dB(A)		
		Day	Evening	Night
Intrusive	Residential	48 $L_{Aeq,15min}$	48 $L_{Aeq,15min}$	44 $L_{Aeq,15min}$
Amenity	Residential	55 $L_{Aeq, period}$	45 $L_{Aeq, period}$	40 $L_{Aeq, period}$
$L_{Aeq, period}$	Hotel	60	50	45
$L_{Aeq,period}$	Restaurant / Commercial	65	65	65
$L_{Aeq,15min}$	Railway Station	65	65	65
$L_{Aeq,period}$	Recreational Area	55	55	55

Notes: 1. Day (7.00am-6.00pm Monday to Saturday and 8.00am-6.00pm Sundays and Public Holidays), Evening (6.00pm-10.00pm), Night (10.00pm-7.00am, unless preceding a Sunday or Public Holiday).

4.2 Sleep Disturbance

The *Noise Policy for Industry* (EPA, 2017) states that *"the potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages."*

This document presents the following limits for sleep disturbance impacts prior to triggering the need for a detailed maximum noise level event assessment. These limits are applied to the night time noise levels from the subject development at the nearest residential location:

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

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Thus for the proposal the sleep disturbance criterion for residential receivers would be $L_{Aeq,15min}$ 44 dB(A) and L_{AFmax} 54 dB(A).

4.3 Operational Traffic

Criteria for the assessment of road traffic noise are set out in the Road Noise Policy (RNP) (DECC 2011).

Traffic associated with the proposal would generally be associated with traffic accessing the interchange from Butler Street. This assessment has assumed Butler Road had been upgraded as a result of the bypass.

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

For existing residences affected by additional traffic on existing roads generated by land use developments, the criteria, applicable at 1m from the façade, are shown in Table 4-3.

Table 4-3. *Road Traffic Noise Criteria, $L_{Aeq(period)}$, dB(A)*

Type of development	Day 7.00 am to 10.00 pm	Night 10.00 pm to 7.00 am
Existing residence affected by additional traffic on arterial roads generated by land use developments	60 $L_{eq(15hr)}$	55 $L_{eq(9hr)}$
Existing residence affected by additional traffic on local roads generated by land use developments	55 $L_{eq(1hr)}$	50 $L_{eq(1hr)}$

Proprietary information for SMEC only. Property of Pacific Environment Limited.

5 Noise and Vibration Assessment

5.1 Operational Noise

The operational assessment has considered the activities associated with the typical operation of the bus interchange based on buses, coaches, cars and taxis accessing the interchange area. Impacts at nearby receivers were assessed via predictive modelling and compared to relevant criteria. The proposal has been assessed in isolation and cumulatively with the Byron Bay Bypass, which is anticipated to be completed in Q1 2020.

5.1.1 Modelling methodology

Noise modelling has been undertaken using the *ISO 9613 Acoustics – Attenuation of sound during propagation* outdoors (ISO, 1996) algorithm, as implemented within the CadnaA 4.5 acoustic modelling package. The noise modelling takes into consideration the sound power level of the proposed site operations, activities and equipment, and applies adjustments for attenuation from geometric spreading, acoustic shielding from intervening ground topography, ground effect, meteorological effects and atmospheric absorption.

Impacts were assessed based on 24 hour operations of the proposal. Meteorological conditions were not considered due to the close proximity of the proposal to affected receivers.

5.1.2 Site layout and equipment

The locations of plant and equipment have been determined based on the key proposal elements as provided in Appendix B.

Ongoing operational noise impacts would generally be associated with vehicles accessing the proposal including buses/ coaches and light vehicles such as cars and taxis. The vehicles would access the proposal from the west via Butler Street, via a roundabout to be constructed as part of the Bypass, and access the turning circle. No carparking spaces have been provided therefore the impacts of carparking (doors slamming, etc) have not been included in this assessment. Vehicle impacts on public roads are considered separately.

Noise from amenities and facilities have been assumed based on the site layout provided in Appendix B. It has been assumed that the amenities building will be fitted with ventilation fans and exhausts.

The noise contribution of patrons is anticipated to be significantly less than vehicular traffic noise impact and therefore these impacts have been excluded from the assessment.

Vehicle and equipment sound power information was sourced from Pacific Environment's sound power database. The sound powers used are presented in Table 5-1.

Table 5-1: *Vehicle and Plant Sound Power Levels*

Equipment	SWL dB(A) L_{Aeq}
Buses and coaches (<30 km/h)	100
Bus (idle)	90
Cars and taxis (<30 km/h)	80
Bus air release	110

Proprietary information for SMEC only. Property of Pacific Environment Limited.

	Amenities exhaust fan / ventilation fan	77

Notes: 1. Sourced from Pacific Environment's sound power database.

5.1.3 Interchange traffic volumes

Current traffic flows through the existing bus infrastructure were sourced from the *Byron Bay – Bus Bay Capacity Assessment – Review of Scheduled Services and Capacity Assessment* (D. Innis, April 2018). These volumes have been used to determine estimate the access to the future interchange.

Based on the information provided, the interchange would generally be operational from 4am to midnight. A summary of the average overall flows for a typical weekday, Saturday and Sunday is presented in Table 5-2.

Table 5-2: *Existing Vehicle Flows (Buses)*

Period	Average Vehicles per day	Peak vehicles per hour
Weekday	121	10 buses accessing the site between 4 pm and 5 pm
Saturday	60	9 per hour between 8 pm to 9 pm
Sunday	30	5 per hour between 5 pm and 6 pm

Source: *Byron Bay – Bus Bay Capacity Assessment – Review of Scheduled Services and Capacity Assessment* (D. Innis, April 2018).

Based on the above volumes, the highest volumes of traffic throughput are experienced on weekdays. Based on these periods, peak hour flows and average volumes have been adopted for the modelling.

Table 5-3: *Vehicle Flows based on Weekday Volumes*

Flow (vehicles)	Peak flows per hour (Day)	Peak flows per hour (Eve)	Peak flows per hour (Night)
Peak per hour	10 buses (4pm-5pm)	9 buses (8pm-9pm)	6 buses (10pm-11pm)
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10pm to 7am)
Total vehicle movements per period	83	27	11

1. Day (7.00am-6.00pm Monday to Saturday and 8.00am-6.00pm Sundays and Public Holidays), Evening (6.00pm-10.00pm), Night (10.00pm-7.00am, unless preceding a Sunday or Public Holiday).

Source: *Byron Bay – Bus Bay Capacity Assessment – Review of Scheduled Services and Capacity Assessment* (D. Innis, April 2018).

Based on the above data, weekday flows have been used for the assessment.

5.1.4 Modelled Scenarios

Four modelling scenarios were developed to quantify anticipated noise levels at sensitive receivers, as follows:

- Scenario 1a considered peak hour operations from the proposal only, with all vehicle movements occurring during one peak hour period;
- Scenario 1b considered the average vehicle movements over the day and night time periods.
- Scenario 2a considered peak hour operations from the proposal only with the Bypass;

Proprietary information for SMEC only. Property of Pacific Environment Limited.

- Scenario 2b considered the average vehicle movements over the day and night time periods.

The assumptions provided are as follows:

- 10 peak hour bus movements per peak hour period (equating to 3 bus movements per 15 minute period);
- A nominal assumption of 10 light vehicle movements (taxis or cars) were incorporated to account for kiss and ride movements / drop-offs / pickups in any 15 minute period;
- Existing light vehicle movements from adjacent residences has not been considered as part of this assessment.
- Modelling has assumed vehicle speed of 30 km/h for the assessment, however it is likely that the operations will involve speeds closer to 20 km/h.

Scenario 1 assumptions were developed based on maximum peak hour traffic movements and overall traffic movements during each operational period, based on information provided by Sydney Trains. The scenarios considered are presented in Table 5-4.

Table 5-4: *Scenario 1 Assumptions*

Period	Peak Vehicle Movements		Average Movements per Period	
	Buses per 15 minute period	Cars and taxis drop offs per 15 minute period	Buses per period	Cars and taxis drop offs per period
Day	3	10	83	40
Evening	2	10	27	40
Night	2	10	11	40
Sleep disturbance	2	10	-	-

1. Day (7.00am-6.00pm Monday to Saturday and 8.00am-6.00pm Sundays and Public Holidays), Evening (6.00pm-10.00pm), Night (10.00pm-7.00am, unless preceding a Sunday or Public Holiday).

An assessment of sleep disturbance has been completed based on the occurrence and emergence of night time noise levels associated with bus air brake release. Based on the schedule traffic information, it is anticipated that night time use of the proposal will be limited to before midnight and after 4 am. Further, the fleets involved include a number of vans, which do not generate air brake noise events.

5.2 Operational Noise Levels

5.2.1 Scenario 1 - Proposal Only

Predicted noise levels at the nearest sensitive receivers are presented in Table 5-5 for Scenario 1 (peak hour) operations and Table 5-6 for Scenario 1 (average movements over day, evening and night periods).

For peak hour movements, noise levels are predicted to comply with relevant criteria for the day and evening periods at the majority of affected receivers. Minor exceedances (up to 2 dB) are predicted at R5 during day and night time periods. Noise levels for operational scenarios

Proprietary information for SMEC only. Property of Pacific Environment Limited.

are predicted to comply with relevant criteria for day, evening and night time periods for all other receivers for peak hour movements.

Average noise levels over the day and evening periods are expected to comply with relevant criteria at all affected receivers. Predicted noise levels for the proposal are predicted to comply with criteria at all potentially affected non-residential receivers.

Major contributors are generally associated with bus idling within the proposal. As a result of these findings, noise management and mitigation measures are recommended as outlined in Section 6.

Noise contours for the day and night time periods are presented in Figure 5-1 and Figure 5-2.

Table 5-5: *Scenario 1a - Predicted Peak Operational Noise Levels, $L_{eq\ 15min}$ dB(A)*

ID	Criteria			Predicted Noise Level, $L_{Aeq,\ 15min}$		
	Day	Evening	Night	Day	Evening	Night
R1	48	48	44	40	38	36
R2	48	48	44	40	38	36
R3	60	50	45	46	44	41
R4	48	48	44	48	45	43
R5	48	48	44	**50**	48	**45**
R6	48	48	44	48	45	43
R7	48	48	44	47	44	41
R8	48	48	44	47	44	41
R9	60	50	45	41	39	36
R10	48	48	44	36	33	30

1. Day (7.00am-6.00pm Monday to Saturday and 8.00am-6.00pm Sundays and Public Holidays), Evening (6.00pm-10.00pm), Night (10.00pm-7.00am, unless preceding a Sunday or Public Holiday).
2. Receivers R11-R18 are commercial receivers and as such are not assessed against the intrusive noise criteria.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Table 5-6: *Scenario 1b - Predicted Average Operational Noise Levels, $L_{eq\ period}$ dB(A)*

ID	Criteria			Predicted Noise Level, $L_{Aeq,\ period}$		
	Day	Evening	Night	Day	Evening	Night
R1	55	45	40	37	35	30
R2	55	45	40	37	35	30
R3	60	50	45	42	40	35
R4	55	45	40	44	42	37
R5	55	45	40	46	44	39
R6	55	45	40	44	42	37
R7	55	45	40	42	40	36
R8	55	45	40	42	40	36
R9	55	45	40	37	35	31
R10	60	50	45	31	29	25
R11	60	50	45	34	31	27
R12	65	65	65	38	36	31
R13	65	65	65	40	38	33
R14	65	65	65	51	49	45
R15	65	65	65	52	49	45
R16	65	65	65	36	33	29
R17	65	65	65	37	35	31
R18	55	55	55	39	37	33

1. Day (7.00am-6.00pm Monday to Saturday and 8.00am-6.00pm Sundays and Public Holidays), Evening (6.00pm-10.00pm), Night (10.00pm-7.00am, unless preceding a Sunday or Public Holiday).

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Figure 5-1: *Noise Contours for the Proposal only (Scenarios 1b)– Daytime*

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Figure 5-2: *Noise Contours for the Proposal only (Scenarios 1b)- Nighttime*

5.2.2 Scenario 2 – Proposal and Bypass (Cumulative)

Based on the predictions from the Bypass (GHD 2016), impacts as a result of the interchange and Bypass operations can be considered. The Bypass operational noise impacts resulted in several affected residences on Butler Street being identified as qualifying for mitigation. Further, Renzo Tonin and Associates (2017) identified that 23 residences qualify for mitigation, generally architectural treatment.

It is of note that operational road noise levels are generally discussed in terms of daytime period ($L_{eq15hour}$) noise levels and night time period ($L_{eq,9hour}$) noise levels during the night time period, however comparison can be made to provide a relative assessment of the proposal's impact on the nearest receivers. For the purpose of comparison, $L_{Aeq,\ period}$ noise levels have been compared to the $L_{Aeq,\ period}$ noise predictions from Table 5-6.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Table 5-7: *Scenario 2 - Predicted Operational Noise Levels (Project with Bypass), dB(A)*

ID	Criteria, $L_{Aeq, 15min}$[1]			Predicted Noise Level, $L_{Aeq, period}$[2]			Predicted Operational Road Noise Level, $L_{Aeq, period}$[3]	
	Day	Evening	Night	Day	Evening	Night	Day[3]	Night [3]
R1	55	45	40	37	35	30	57	54
R7	55	45	40	42	40	36	54	51
R10	55	45	40	31	29	25	61	58
R11	55	45	40	34	31	27	59	57

1. Day (7.00am-6.00pm Monday to Saturday and 8.00am-6.00pm Sundays and Public Holidays), Evening (6.00pm-10.00pm), Night (10.00pm-7.00am, unless preceding a Sunday or Public Holiday).
2. Levels sourced from $L_{Aeq, period}$ predictions from Table 5-6).
3. Operational road noise values sourced from GHD (2016), based on opening year 2018 traffic predictions.

Comparison of the predicted impacts of the interchange and the Bypass indicate that while the interchange in isolation may generate a noticeable noise impact at the nearest receivers, the impacts are likely to be negligible compared to the influence of the future Byron Bay Bypass on Butler Street. Predicted noise impacts from the proposal are at least 10 dB lower than the equivalent noise impact from the Bypass once it is operational, therefore impacts will be almost negligible in comparison.

Furthermore, the Condition 24 of the DA for the Bypass (10.2016.77.1) outlines 23 properties to be considered for mitigation as a result of operational noise impacts. These receivers were investigated further by Renzo Tonin and Associates in its Expert Report to the Land and Environment Court (2017). The below receivers affected by impacts from the bus interchange would therefore already benefit from architectural treatment as part of the Bypass.

Table 5-8: *Receivers identified for Mitigation as part of Byron Bay Bypass*

Receiver ID[1]	Address	Receiver Type
R5	58 Butler St	Residential dwelling
R6	56 Butler St	Residential dwelling
R7	54 Butler St	Residential dwelling

Source: Development Application 10.2016.77.1

Note: 1. ID from Section 2.5.

5.2.3 Sleep Disturbance

Sleep disturbance events can potentially be caused by short high level noise events from operations.

Based on typical activities, noise levels of L_{Amax} 110 dB(A) has been assumed to represent typical maximum noise level events from peak noise events such as a bus air brake release. L_{Amax} noise levels were predicted based on instantaneous maximum noise levels, and an

Proprietary information for SMEC only. Property of Pacific Environment Limited.

average 15 minute noise level was determined based on a 10 seconds of events per period. It is understood that some of the vehicle types are vans, which do not typically have air brakes.

The predicted maximum noise level results at the most sensitive residential receivers are presented in Table 5-9. Results were predicted below the sleep disturbance criteria for the majority of receivers, with exceedances over the $L_{eq,15min}$ limit up to 2 dB at receivers R4 and R5, and up to 4 dB above criteria at R5. Levels are predicted to remain below the L_{max} criteria for all receivers.

Table 5-9: *Scenario 1 - Predicted L_{Amax} Noise Levels at Residential Receivers*

ID	Criteria		Predicted Noise Level	
	$L_{Aeq,15min}$	L_{max}	$L_{Aeq,15min}$[1]	L_{max}
R1	44	54	36	39
R2	44	54	37	39
R3	44	54	43	45
R4	44	54	**46**	47
R5	44	54	**48**	50
R6	44	54	**46**	48
R7	44	54	44	46
R8	44	54	44	46
R9	44	54	39	41
R10	44	54	33	35
R11	44	54	35	37

1. Day (7.00am-6.00pm Monday to Saturday and 8.00am-6.00pm Sundays and Public Holidays), Evening (6.00pm-10.00pm), Night (10.00pm-7.00am, unless preceding a Sunday or Public Holiday).

Maximum noise levels are predicted to exceed sleep disturbance criteria at the nearest receivers on Butler Street (R4, R5, R6). It is noted that the number of maximum noise level events has been estimated assuming on event per vehicle during the worst case hour, which is unlikely and can be managed using operational controls as discussed in Section 6. Additionally, maximum noise level events from the Byron Bay Bypass have not been considered in the designation of criteria and are likely to influence maximum noise level events at the nearest receivers. A detailed sleep disturbance assessment was not completed for the Byron Bay Bypass, therefore impacts cannot be compared for the purpose of this instance. Noise mitigation measures are discussed in Section 6.

5.3 Road Noise

This section assesses noise impacts from additional traffic noise generated from project operation. This assessment assesses the proposal in isolation (Scenario 1) the proposal and Byron Bay Bypass (Scenario 2).

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Calculations were made to estimate the impact of additional proposal-related traffic on local roads using the Calculation of Road Traffic Noise (CoRTN).

Access to the proposal via the public road network would be via Butler Street. Based on the traffic assessment, approximately 10 bus movements would occur per worst case peak hour period. During a typical weekday, 110 buses are anticipated during the daytime period (7 am to 10 pm), and 11 buses over the night time period (10 pm to 7am). Based on the assumptions made in the operational noise assessment (Section 5.1.3), 10 car movements (or 40 cars per hour) taxis/ kiss and ride movements have been assessed for a worst case peak hour.

Traffic flow data have been sourced from the Bypass noise assessment (GHD 2016) for Butler Street for the proposal only (Scenario 1) and with the Byron Bay Bypass (Scenario 2).

Assessments of traffic on Butler Street have been made based on peak hour traffic volumes.

Traffic volumes on Butler Street were sourced for the portion of Butler Street adjacent potentially affected receivers, as summarised in Table 5-11: and Table 5-11. Day night splits were not available from the GHD report (2016).

Table 5-10: *Scenario 1- Predicted Daily Traffic Volumes on Butler Street - Bypass – No Build*

Street	2018
Butler Street	2160

Source: GHD (2016).

Table 5-11: *Scenario 2 - Predicted Daily Traffic Volumes on Butler Street – Bypass - Build*

Street	2018
Butler Street north[1]	5400
HV %	5%

Source: GHD (2016).

Note 1: Traffic volumes on Butler Street have been divided at Burns Street into 'north' and 'south'. 'North' is representative of the most affected residences for this assessment.

An assessment of the peak hour traffic volumes has been made based on the peak hour flows alone.

5.3.1 Scenario 1 - Proposal Only

Assuming a worst case scenario, with all vehicles occurring within a 1 hour period during the day and night, a scenario of road noise impact was completed at the nearest receivers on Butler Street, located approximately 15 m from the roadside. Results are presented in Table 5-12 and Table 5-14 for Butler Street residences.

Table 5-12: *Scenario 1 Predicted (Worst Case) Operational Traffic Impacts on Sub arterial Roads- Day*

Receiver ID	Distance to receiver, m	Noise Level L_{Aeq15h} Day, dB(A)			
		Criteria, L_{Aeq15h}	Pre Proposal	Post Proposal	Change
Butler Street	15	60	55.1	57.1	1.9

Note: Day (7.00am – 10.00pm), night (10.00pm – 7.00am).

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Table 5-13: *Scenario 1 Predicted (Worst Case) Operational Traffic Impacts on Sub arterial Roads - Night*

Receiver ID	Distance to receiver, m	Noise Level L_{Aeq9h} Night, dB(A)			
		Criteria, L_{Aeq9h}	Pre Proposal	Post Proposal	Change
Butler Street	15	55	55.1	55.7	0.6

Note: Day (7.00am – 10.00pm), night (10.00pm – 7.00am).

Operational road traffic noise levels are predicted to result in a small increase in received noise levels at residences on Butler Street during the day period due to the increases in heavy vehicle percentages; however the relative change is less than 2 dB based on noise levels without the proposal.

5.2.2 Scenario 2 - Proposal and Bypass (Cumulative)

Assuming a scenario with all vehicles occurring within a 1 hour period during the day and night, an assessment of road noise impact was completed at the nearest receivers on Butler Street, located approximately 15 m from the roadside. Results are presented in Table 5-14 and Table 5-15 for Butler Street residences. The results for Butler Street are expected to be conservative, as heavy vehicles including buses would already be accounted for in the Byron Bay Bypass traffic volumes.

Table 5-14: *Scenario 2 Predicted (Worst Case) Operational Traffic Impacts on Sub arterial Roads- Day*

Receiver ID	Distance to receiver, m	Noise Level L_{Aeq15h} Day, dB(A)			
		Criteria, L_{Aeq15h}	Pre Proposal	Post Proposal	Change
Butler Street	15	60	59.1	60.8	1.7

Note: Day (7.00am – 10.00pm), night (10.00pm – 7.00am).

Table 5-15: *Scenario 2 Predicted (Worst Case) Operational Traffic Impacts on Sub arterial Roads - Night*

Receiver ID	Distance to receiver, m	Noise Level L_{Aeq9h} Night, dB(A)			
		Criteria, L_{Aeq9h}	Pre Proposal	Post Proposal	Change
Butler Street	15	55	59.1	59.5	0.4

Note: Day (7.00am – 10.00pm), night (10.00pm – 7.00am).

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Operational road traffic noise levels are predicted to result in a small increase in received noise levels at residences on Butler Street during the day period due to the increases in heavy vehicle percentages; however the relative change is less than 2 dB based on noise levels without the proposal.

5.4 Vibration

Noticeable vibration can occur where heavy vehicles travel at speed over damaged pavement or road joints and a receiver is within several metres of the source. Due to the separation distance between the bus interchange and receivers and expected operational speeds, perceptible vibration is not expected and have not be considered further.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

6 Noise Management and Mitigation Measures

6.1 Operational Noise

Operational noise levels are expected to result in minor exceedances of noise criteria by up to 2 dB at the nearest Butler Street the whole day, therefore night time peak hour volumes are likely to be less than reported. During average traffic conditions, noise levels are predicted to comply with all criteria at all affected sensitive receivers.

Major noise contributors were identified as bus movement and idling. Impacts are considered conservative as vehicles moving within the interchange are likely to be operating at lower speeds than assessed (30km/h), and kiss and ride / taxi movements have been conservatively estimated.

Consideration of the cumulative impacts with the Byron Bay Bypass indicates that noise levels will be negligible compared to the influence of the future Byron Bay Bypass on Butler Street.

Additionally, a sleep disturbance assessment indicated the site has the potential to generate sleep disturbance events at the nearest residences, in the event of air brake release during night time periods. It is understood that some of the vehicle types are more typical of a van, therefore impacts of compression braking as presented in this section is likely to be conservative.

As the exceedances of noise criteria at receiver R5 are limited to peak hours only, it is considered that impacts may be managed via operational management measures to limit potential speed-related noise impacts and limit the occurrence of maximum noise level events. It is recommended that the following measures be included as part of the operational management plan for the site:

- Signage to bus drivers and vehicular patrons to minimise noise during sensitive night time periods.
- Posted speed limits within the interchange to minimise high engine revving.

Further, it is noted that receiver R5 has been identified as qualifying for mitigation as a result of the Byron Bay Bypass (Renzo Tonin and Associates, 2017). In the event the Bypass goes ahead, it is recommended that during project delivery, architectural treatments recommended for dwellings affected by the Byron Bay Bypass be confirmed, as these would be of benefit to the receiver as a result of this proposal.

6.2 Statement of Compliance

The assessment of noise impacts from the proposed Byron Bay Bus Interchange indicates that for average vehicle movements over the day, evening and night time periods, noise levels will comply with relevant criteria at all affected residential and non-residential receivers.

Assuming peak hour movements, being the worst-case hour over the site's weekday operations, estimated to be represented by flows between 4pm and 5pm, noise levels are predicted to comply with noise amenity criteria for the day and evening periods at the majority of affected receivers. Noise levels are expected to result in minor exceedances of the intrusive

Proprietary information for SMEC only. Property of Pacific Environment Limited.

noise criteria by up to 2 dB at the nearest residence on Butler Street for day and night time periods.

As the exceedances of noise criteria at receiver R5 are limited to peak hours only, it is considered that impacts may be managed via operational management measures to limit potential speed-related noise impacts and limit the occurrence of maximum noise level events.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

7 Conclusion

This report presents the operational noise and vibration assessment for the proposed operation of the Byron Bay Bus Interchange.

The assessment has considered existing noise levels and terrain effects in the prediction and assessment of noise levels, and has been completed with consideration to NSW EPA guidelines, assessment methods and relevant noise standards.

The results of this assessment have found that operational noise impacts associated with the proposal only (Scenario 1) are expected to result in exceedances of noise criteria of up to 2 dB at the nearest residence (receiver R5) on Butler Street during peak hour movements. During average traffic conditions, noise levels are predicted to comply with all criteria at all affected sensitive receivers.

Consideration of the cumulative impacts with the Byron Bay Bypass (Scenario 2) indicates that noise levels will be negligible compared to the influence of the future Byron Bay Bypass on Butler Street. It is anticipated that noise levels from the operation of the interchange will be masked by operational road noise from the Bypass, which, is proposed to be operational prior to the opening of the interchange.

A sleep disturbance assessment indicated the site has the potential to generate sleep disturbance events at the nearest residences, in the event of air brake release usage during night time periods. It is anticipated that these impacts can be effectively managed by implementation of the measures outlined in this report. Further, these impacts are likely to be masked by the operation of the proposed Bypass,.

Receiver R5 (58 Butler Street) has been identified as qualifying for mitigation as a result of the Byron Bay Bypass (Renzo Tonin and Associates, 2017). In the event the Bypass goes ahead, it is recommended that during project delivery, architectural treatments recommended for dwellings affected by the Byron Bay Bypass be confirmed, as these would be of benefit to the receiver as a result of this proposal.

Road noise impacts from traffic movements during operation of the proposal were found to be below relevant road noise criteria for receivers on Butler Street.

In order to manage noise impacts at the nearest affected receivers, a number of mitigation and management measures have been recommended for the operation of the proposal.

Due to the distances between sources and receivers, and no significant vibration sources during operations, operational vibration has not been considered as part of this assessment.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

8 References

Australian Standard, 1997, *AS1055.1 Acoustics – Description and measurement of environmental noise.*

Bureau of Meteorology (BoM) (2017). *Climate Data Online.* Accessed from 4th to 28th September 2017.

Byron Shire Council Development Application 10.2016.77.1.

CONCAWE Report No. 4/81, Manning C.J., 1981, *The propagation of noise from petroleum and petrochemical complexes to neighbouring communities.*

DEC 2004 *Assessing Vibration, A Technical Guideline*

DECCW, 201. Road Noise Policy (RNP)

D. Innis, April 2018. Byron *Bay – Bus Bay Capacity Assessment – Review of Scheduled Services and Capacity Assessment*

EPA 2017 *Noise Policy for Industry*

GHD (January 2016). *Byron Shire Council Byron Bay Bypass Environmental Impact Statement (22/17484).*

International Standard, *ISO 9613 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation*.

NSW Environmental Protection Authority (2000), *Industrial Noise Policy* (INP).

Renzo Tonin 29 March 2017. Butler Street Community Network Incorporated V Northern Region. Joint Regional Planning Panel & Ors L&Ec Proceedings 2016/22777|5 Byron Bay Bypass Expert Report.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Appendix A

Glossary of Terms

Proprietary information for SMEC only. Property of Pacific Environment Limited.

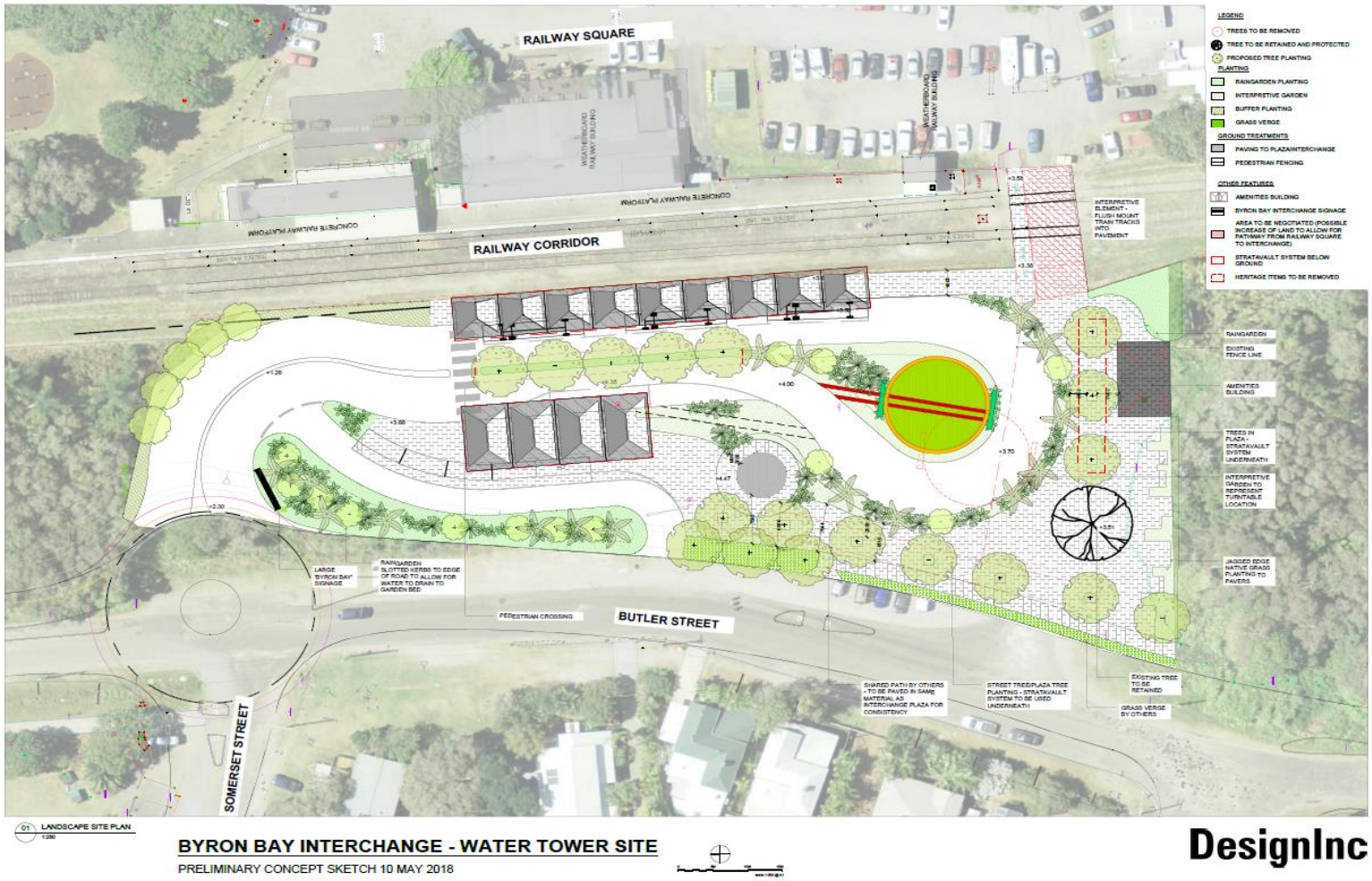
Term	Description
Adverse weather	Weather conditions that affect noise measurements (wind, rain and temperature inversions) that occur at a particular site for a significant period of time. The maximum wind speed allowed during acoustics measurements is 5m/s. No rain is allowed.
Ambient noise	The all-encompassing noise environment at a given location, comprising sources in the near and far field.
Assessment period	The period in a day over which assessments are made.
A-weighting	Adjustment made to a noise level based on international standards. Approximates a human's hearing response to frequency at lower sound levels.
Background noise	Background noise is the term used to describe the underlying level of noise present in an area, measured in the absence of any extraneous noise. Typically when measured with a sound level meter is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period ($L_{A90,T}$).
dB	Decibel, the logarithmic ratio of a given sound pressure to a reference pressure.
dB(A)	A-weighted decibels.
Free-field	A sound field where the effects of reflection are negligible in the region of interest.
Frequency	The number of cycles per unit of time. It is measured with cycles per second (cps) or the interchangeable Hertz (Hz). Frequency can be associated as a synonymous to pitch.
Intermittent noise	Level that drops to the background noise level several times during the period of observation.
Heavy vehicle	A truck or other vehicle with either two or three axles, two groups or three or more axles, more than two groups.
Light vehicle	Passenger vehicles (cars, vans, utilities, motorcycles etc.).
$L_{A1,T}$	The noise level exceeded for 1% of the time period, T.
$L_{A10,T}$	The noise level exceeded for 10% of the time period, T.
$L_{A90,T}$	The noise level exceeded for 90% of the time period, T. Commonly referred to as the background noise level.
$L_{Aeq,T}$	The equivalent average noise level of the time period, T. It represents in a single number, the energy of the actual fluctuating noise level over the period.
$L_{Amax,T}$	The maximum noise level measured during the period, T.
RBL	Rating Background Level. The background noise level as defined by the NSW Industrial Noise Policy (EPA, 2000). It is calculated by the taking the median value of the lowest 10th percentile L_{A90} measurements in any day, evening or night period.
Sound Pressure Level (SPL)	Is the difference between the pressure produced by a sound wave and the barometric (ambient) pressure at the same point in space. Typically expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Levels (Lw)	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power. Typically associated with noise sources.

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Appendix B

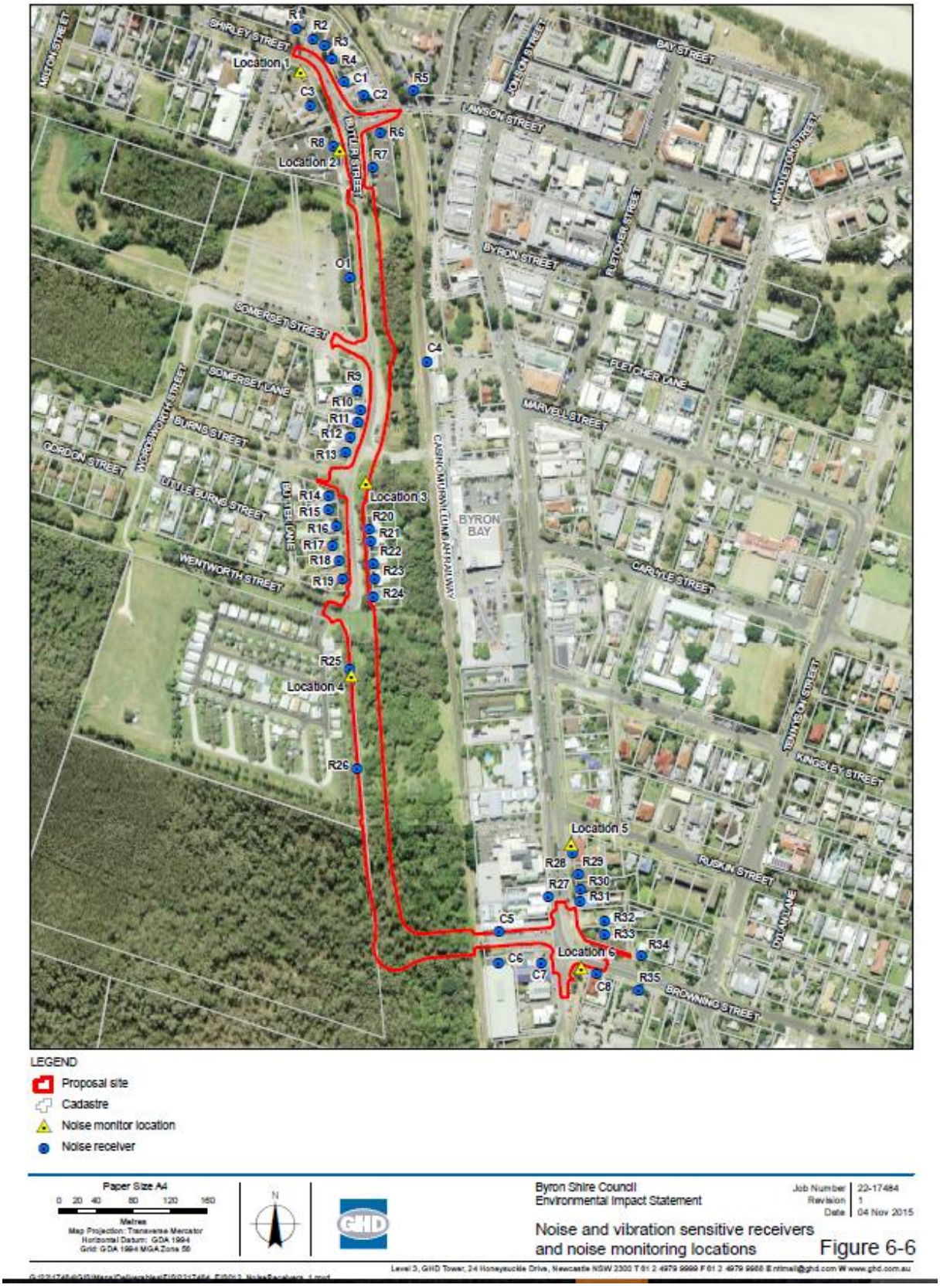
Concept Design for Project and Byron Bay Bypass Alignment

Proprietary information for SMEC only. Property of Pacific Environment Limited.



Source: SMEC 2018

Proprietary information for SMEC only. Property of Pacific Environment Limited.



Source: GHD (2016)

Proprietary information for SMEC only. Property of Pacific Environment Limited.

Appendix C

Daily Logger Graphs

Proprietary information for SMEC only. Property of Pacific Environment Limited.

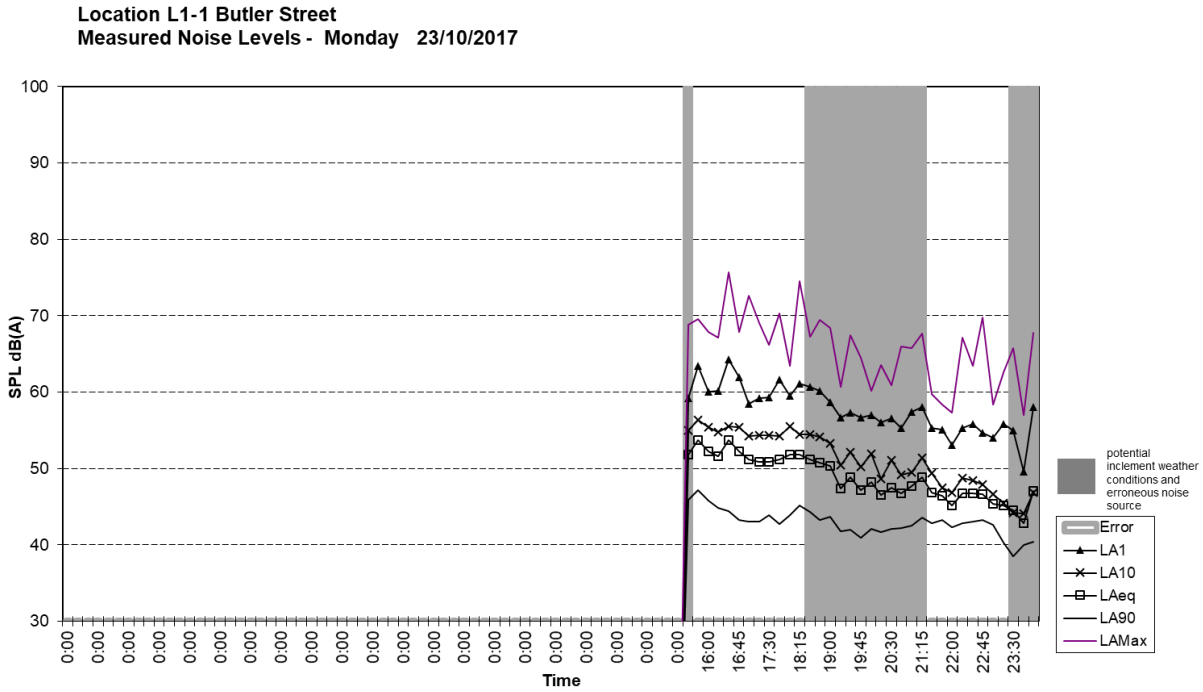
Noise Logger Position (A)

NTI Audio XL2 logger kit PELNOISE06 S/N A2A-06272-E0

Table C-1: L1 Monitoring Summary

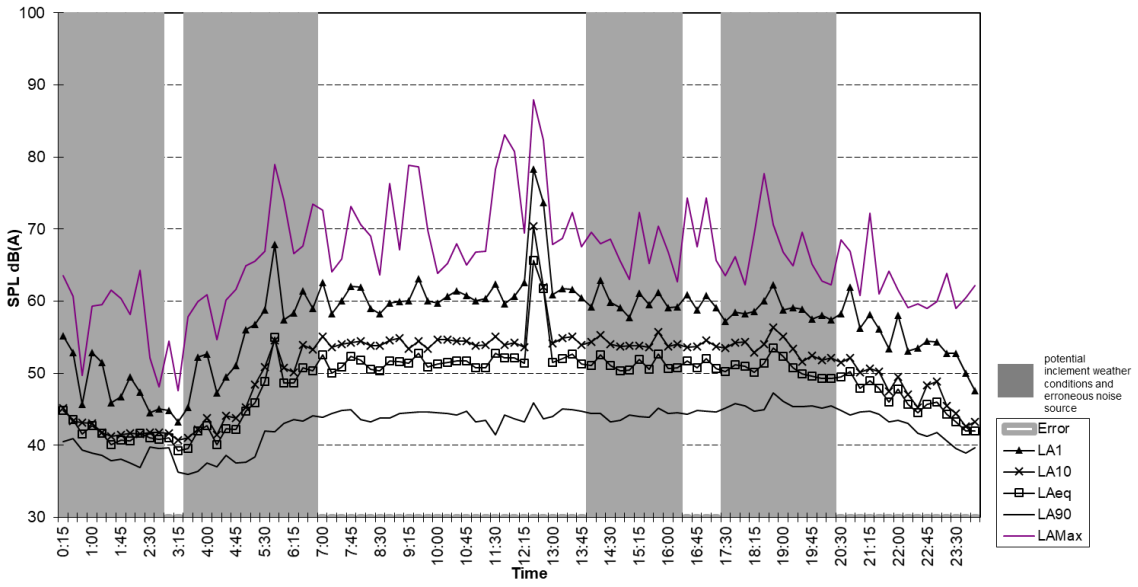
Date	Measured Noise Level, dB(A)								
	L_{10}			L_{90}			L_{eq}		
	D	E	N	D	E	N	D	E	N
23/10/2017	56	53	49	43	42	41	52	48	46
24/10/2017	55	52	49	43	43	39	55	49	46
25/10/2017	63	-	54	43	-	37	56	-	48
26/10/2017	56	53	55	49	47	41	53	64	49
27/10/2017	55	54	56	44	43	40	52	50	49
28/10/2017	55	52	53	41	46	36	52	50	47
29/10/2017	54	-	52	40	-	32	50	-	50
30/10/2017	54	-	57	45	-	37	52	-	52
31/10/2017	-	-	48	-	-	40	-	-	45

Note: Logger failed after 2nd August 2016 due to adverse weather conditions.

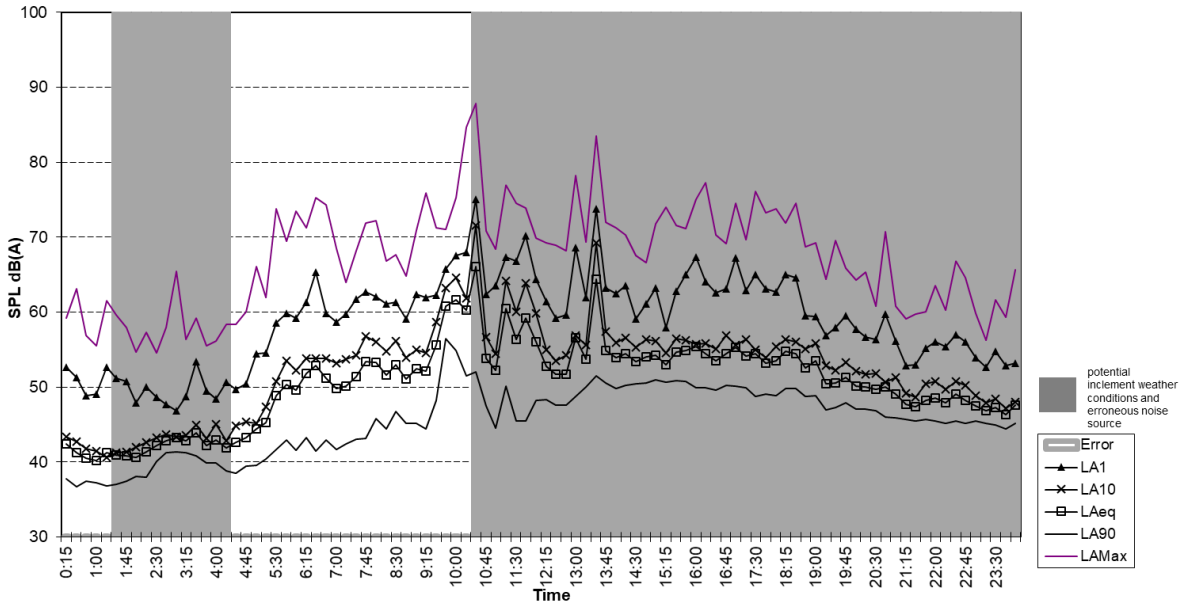


Proprietary information for SMEC only. Property of Pacific Environment Limited.

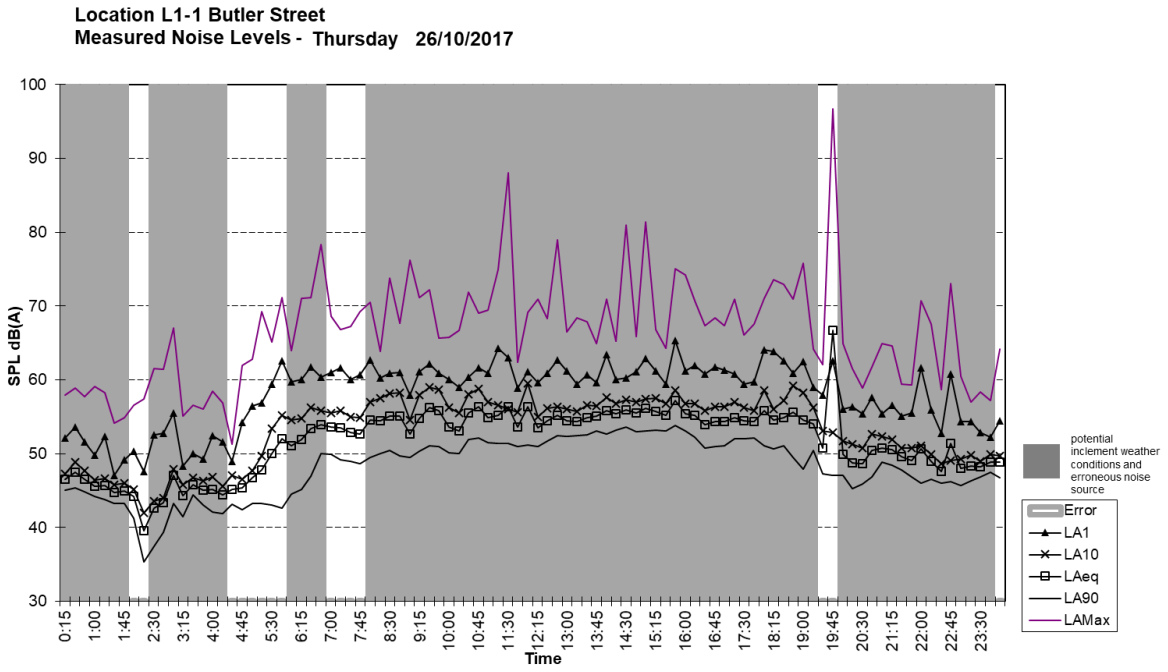
Location L1-1 Butler Street
Measured Noise Levels - Tuesday 24/10/2017

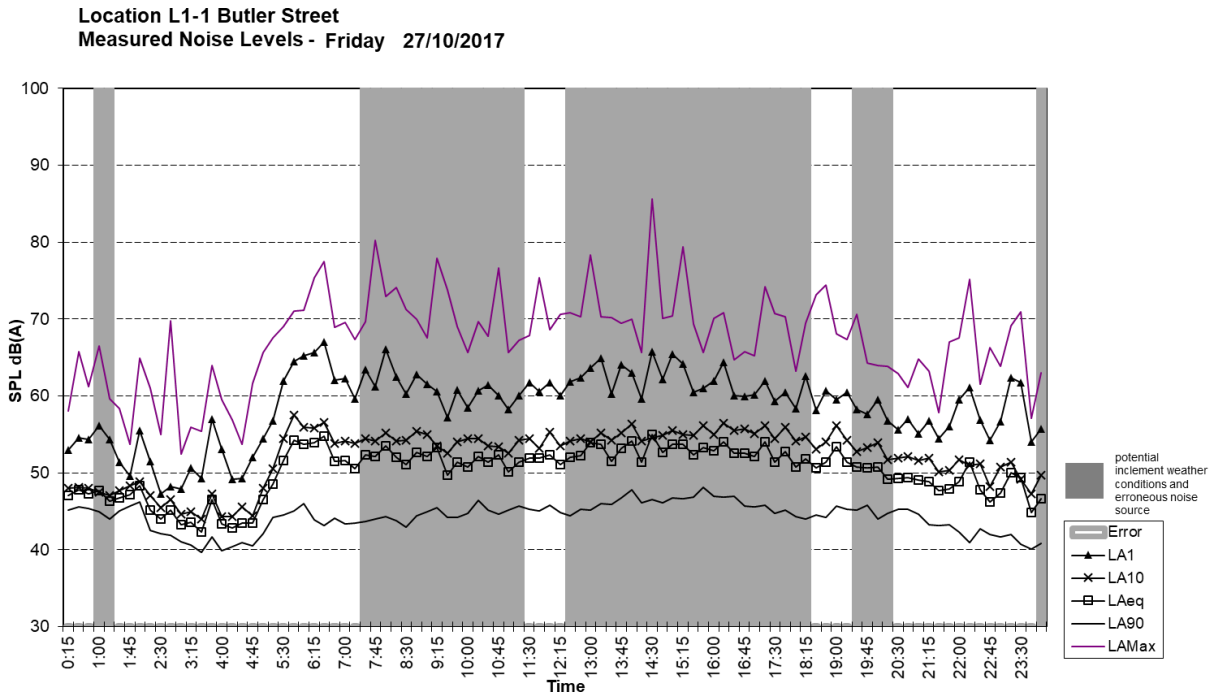


Location L1-1 Butler Street
Measured Noise Levels - Wednesday 25/10/2017

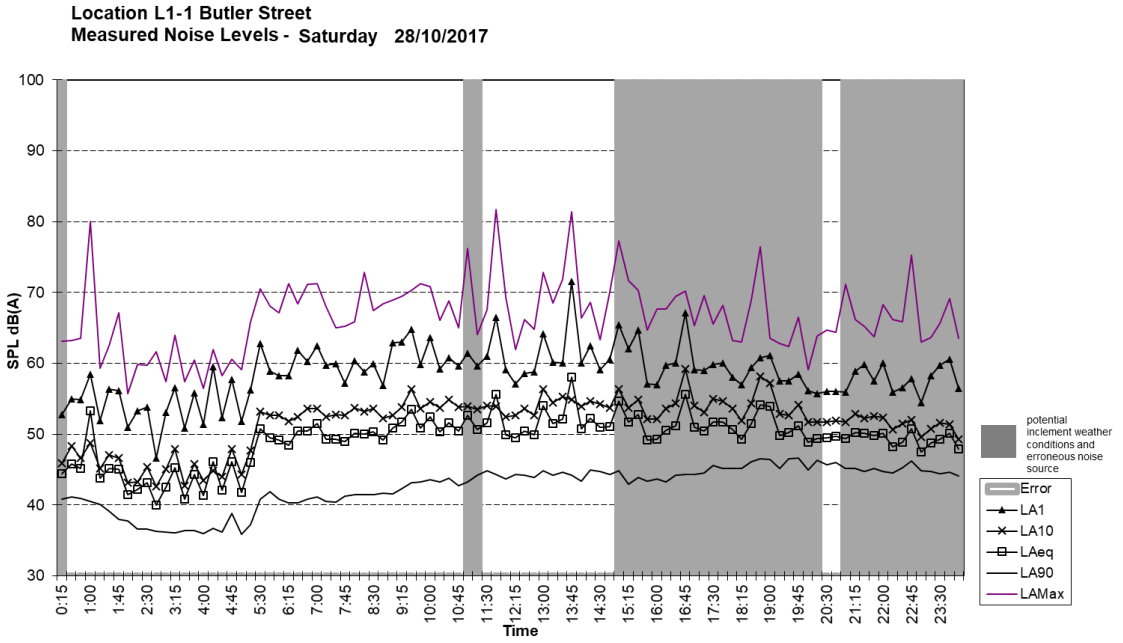


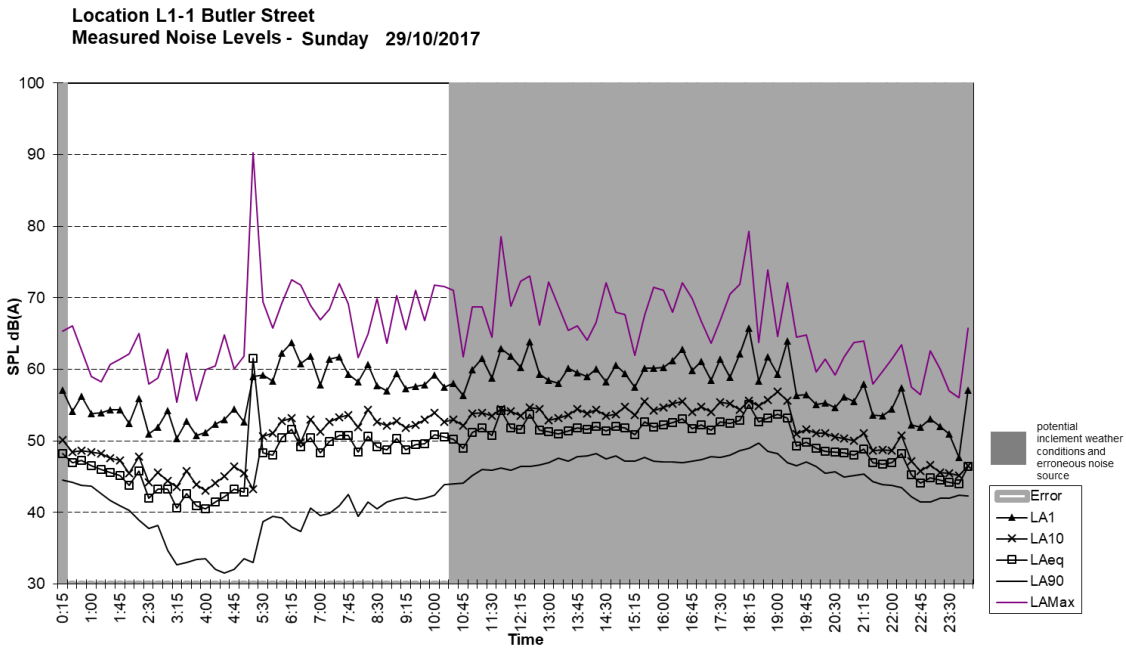
Proprietary information for SMEC only. Property of Pacific Environment Limited.



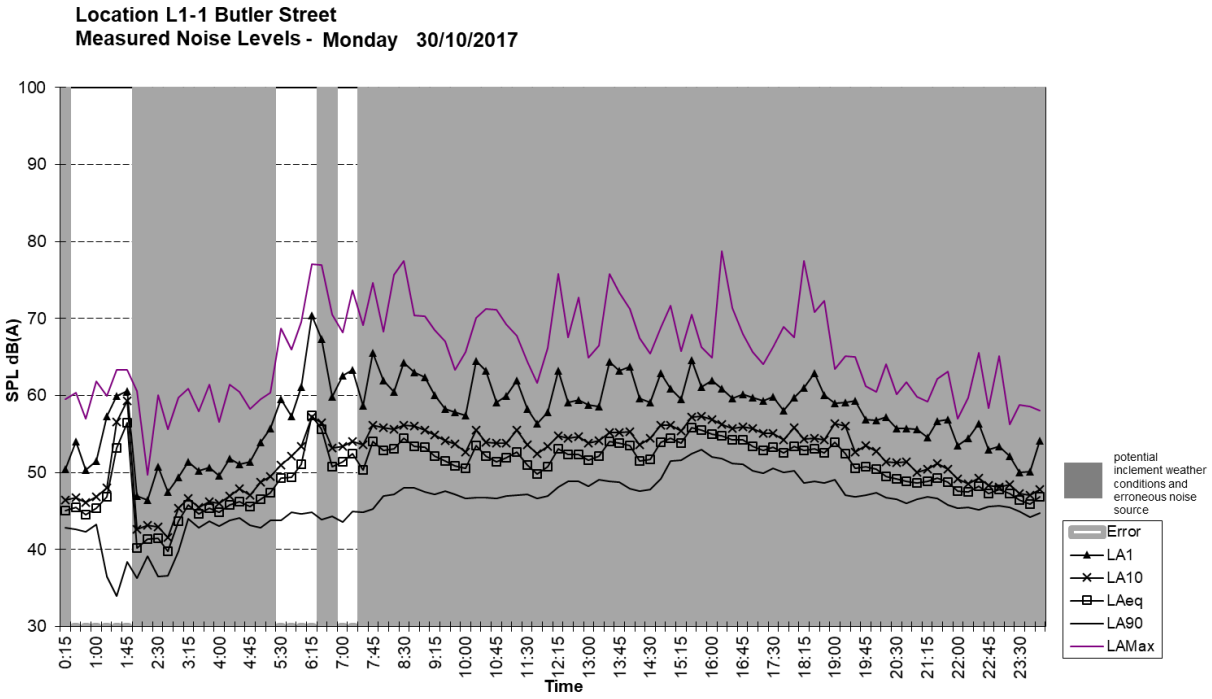


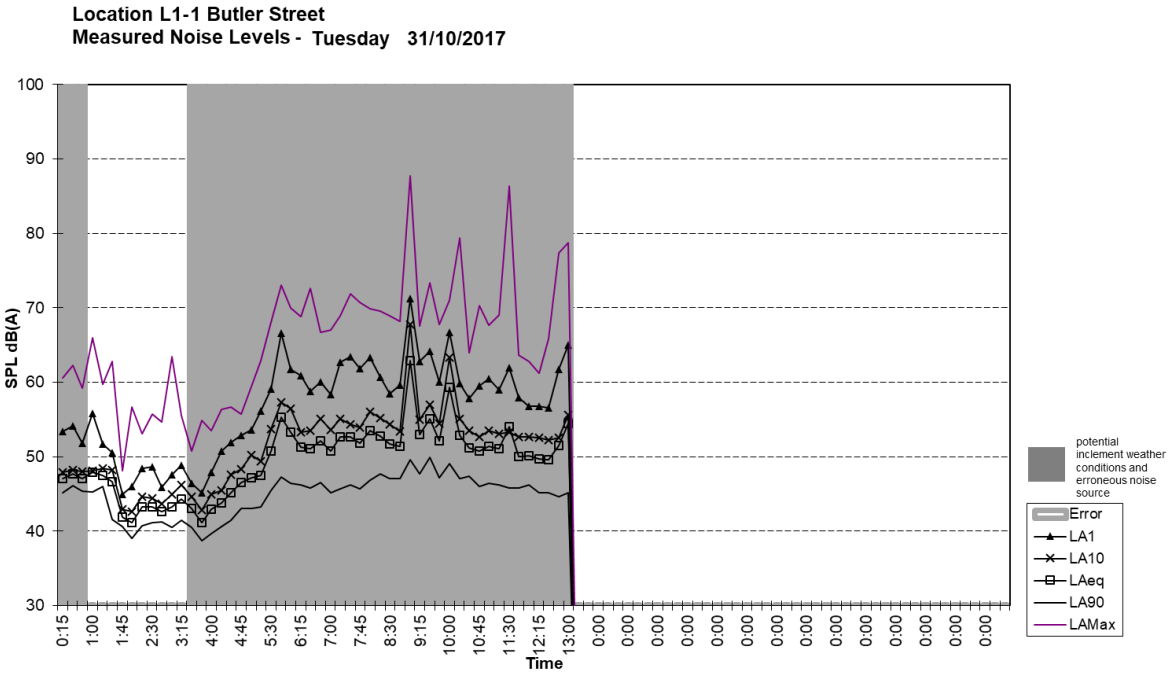
Proprietary information for SMEC only. Property of Pacific Environment Limited.





Proprietary information for SMEC only. Property of Pacific Environment Limited.





Proprietary information for SMEC only. Property of Pacific Environment Limited.