19. Noise and vibration

19.1 Introduction

The assessment of the CoastConnect — Caloundra to Maroochydore public transport corridor requires consideration of potential noise and vibration impacts resulting from operation and construction of the project. Sensitive locations near the project corridor include residences, schools, health facilities, community facilities and recreational areas. The project entails improvements to bus stops and dedicated bus lanes along the corridor.

19.2 Methodology

This chapter forms a preliminary study to identify potential noise and vibration benefits, impacts and mitigation measures that may be associated with the project. A detailed analysis of the potential noise and vibration impacts from the corridor will be undertaken closer to construction phase of the project.

This desktop study included collection and analysis of field data in order to predict potential noise and vibration impacts from operation and construction of the bus corridor. Ambient noise monitoring of existing traffic noise levels was conducted at five locations along the corridor. A noise logger was located in each of the five main areas. The monitoring was conducted over four days, commencing Thursday, 7 May 2009 until Tuesday, 12 May 2009. Owing to periods of rain on Monday, 11 May 2009, this data was ignored. Therefore the noise monitoring results presented for each of the bus corridor sections is based on data obtained from Friday, 8 May to Sunday, 10 May 2009.

Noise measurements were conducted in general accordance with the Environmental Protection Agency Noise Measurement Manual. In the analysis, it has been assumed that the average of 15-minute samples would be equivalent to the average of 1-hour samples. As this is a preliminary assessment, with a detailed assessment to be performed at a later phase in the project, the following analysis has been conducted:

- description of existing environment
  - limited unattended and attended noise monitoring at five locations along the corridor.
- construction noise and vibration
  - evaluation of general construction noise and vibration impacts to highlight areas of risk with associated activities
  - identification of typical construction noise and vibration management strategies.
- operational traffic noise and vibration
  - evaluation of road traffic noise based on supplied traffic volumes
  - comparison of indicative predicted noise levels with planning noise levels in Environmental Protection Policy 1997.

At present there are no specific noise criteria applicable to busway (and bus priority) corridors. The *Environmental Protection Act 1994* (reprint 2009) excludes ordinary use of a busway from being an unlawful environmental nuisance. The Environmental Protection (Noise) Policy 1997 presented planning levels for traffic noise. The planning levels presented were as 63 dB(A) $L_{10\ 18h}$. Since publication of the Terms of Reference for this project, this policy has been superseded by the Environmental Protection (Noise) Policy 2008. The new policy does not present planning levels for traffic noise.

In the absence of any other legislative provisions, the Department of Transport and Main Roads Road Traffic Noise Management Code of Practice 2008 (DMR 2008) presents criteria for traffic noise that could be used for this project. The criteria for traffic noise are summarised in Table 19-1.

Table 19-1: DMR Code of Practice traffic noise criteria

Road type	Receiver type	Criteria
New road	Residence	63 dB(A) $L_{10\ 18h}$
	Health Community Building	55 dB(A) $L_{10\ 1h}$
	Park	63 dB(A) $L_{10\ 12h}$
Redeveloped road	Residence	68 dB(A) $L_{10\ 18h}$
	Health Community Building	63 dB(A) $L_{10\ 1h}$
	Park	63 dB(A) $L_{10\ 12h}$

As the department's 'new road' criteria are similar to the planning levels in the now superseded Environmental Protection (Noise) Policy 1997, the new road criteria of 63 dB(A) $L_{10\ 18h}$ has been adopted for this study. This is considered applicable as the bus corridor is located within general traffic lanes, or immediately adjacent to general traffic lanes and therefore the bus noise is likely to blend in with the general traffic noise.

19.3 Preliminary analysis

19.3.1 Existing situation

Sections 1 and 2 — Caloundra to Currimundi

Ambient noise monitoring was conducted at 49 Edmund Street. The logger was located 14 m from the road edge. The ambient noise in the area comprised traffic noise from Edmund Street and bird noise. Noise monitoring was conducted with a Rion NL-21 environmental noise logger, serial number 00276273. The instrument was calibrated prior to use and was found to be within 0.1 dB of the reference source post measurement.

Results from this noise monitoring station are included in Table 19-2 below. These measurements indicate that the ambient noise levels in Sections 1 and 2 are currently below the road traffic noise criterion.

Table 19-2: Noise monitoring at 49 Edmund Street

Acoustic descriptor	Traffic noise 6 am to 12 am	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am
$L_{10\ 18h}$, dB(A)	60	—	—	—
L10, dB(A)	—	62	57	48
Leq, dB(A)	—	59	53	48
L90, dB(A)	—	46	41	40

The noise monitoring data is presented graphically in Figure 19-1.

Sections 3 and 4 — Nicklin Way and Kawana Town Centre

Ambient noise monitoring was conducted at 630 Nicklin Way. The logger was located 10 metres from the nearest lane edge. Traffic noise from Nicklin Way is the dominant noise source in this area. Noise monitoring was conducted with a Rion NL-21 environmental noise logger, serial number 01043718. The instrument was calibrated prior to use and was found to be within 0.1 dB of the reference source post-measurement.

Results from this noise monitoring station are included in Table 19-3 below. These measurements indicate that the ambient noise levels in Sections 3 and 4 currently exceed the road traffic noise criterion.

Table 19-3: Noise monitoring at 630 Nicklin Way

Acoustic descriptor	Traffic noise 6 am to 12 am	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am
$L_{10\ 18h}$, dB(A)	73	—	—	—
L10, dB(A)	—	73	71	64
Leq, dB(A)	—	70	67	61
L90, dB(A)	—	61	53	44

The noise monitoring data is presented graphically in Figure 19-2.

Section 5 — Mooloolaba

Planning and delivery of this section is being lead by the Sunshine Coast Regional Council.

Section 6 — Alexandra Parade

Ambient noise monitoring was conducted at 274 Alexandra Parade. The logger was located 15 m from the nearest lane edge. Owing to equipment failure, the noise measurements were limited to almost two days of monitoring. The ambient noise in the area comprised traffic noise and noise from nearby surf. Noise monitoring was conducted with a Rion NL-21 environmental noise logger, serial number 00776884. The instrument was calibrated prior to use and was found to be within 0.1 dB of the reference source post-measurement.

Results from this noise monitoring station are included in Table 19-4 below. In this location the ambient noise was comprised of primarily traffic noise and noise from the surf. Although the noise levels in Section 6 are high, it was not possible to separate the traffic component of the monitored noise levels. These measurements indicate that the ambient noise levels in Section 6 are currently below the road traffic noise criterion.

Table 19-4: Noise monitoring at 274 Alexandra Parade

Acoustic descriptor	Traffic noise 6 am to 12 am	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am
$L_{10\ 18h}$, dB(A)	67	—	—	—
L_{10}, dB(A)	—	68	67	60
Leq, dB(A)	—	65	63	57
L_{90}, dB(A)	—	51	49	45

The noise monitoring data is presented graphically in Figure 19-3.

Section 7 — Maroochydore

Ambient noise monitoring was conducted at 2 Maroubra Street. The logger was located 12 m from the nearest lane edge. Owing to equipment failure, the noise measurements were limited to almost two days of monitoring. Traffic noise was the dominant noise source in this area. Noise monitoring was conducted with a Rion NL-21 environmental noise logger, serial number 00365350. The instrument was calibrated prior to use and was found to be within 0.2 dB of the reference source post-measurement.

Results from this noise monitoring station are included in Table 19-5 below. These measurements indicate that the ambient noise levels in Section 7 are currently below the road traffic noise criterion.

Table 19-5: Noise monitoring at 2 Maroubra Street

Acoustic descriptor	Traffic noise 6 am to 12 am	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am
$L_{10\ 18h}$, dB(A)	66	—	—	—
L10, dB(A)	—	67	65	59
Leq, dB(A)	—	64	62	56
L90, dB(A)	—	55	54	50

The noise monitoring data is presented graphically in Figure 19-4.

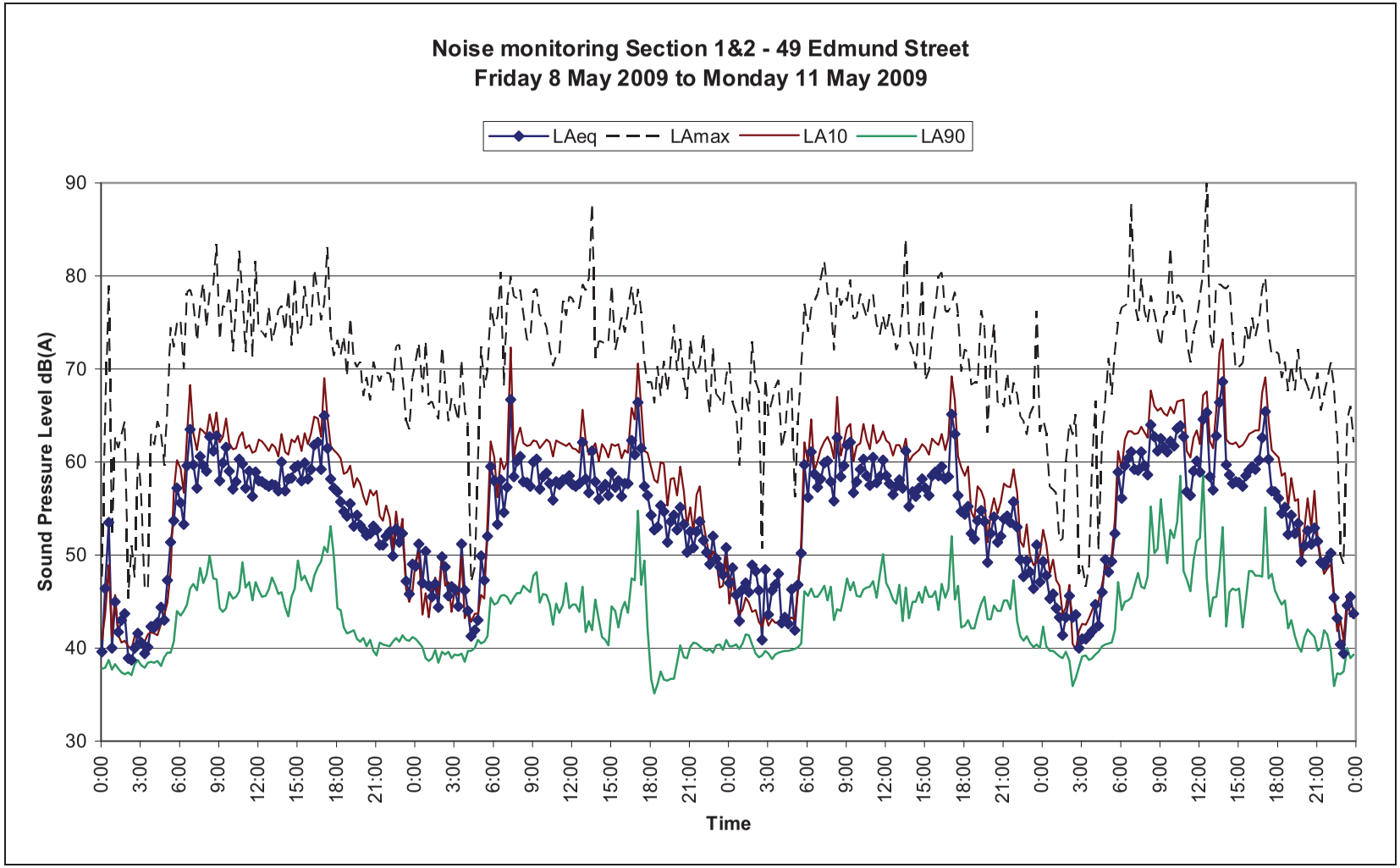

Figure 19-1: Noise monitoring at 49 Edmund Street

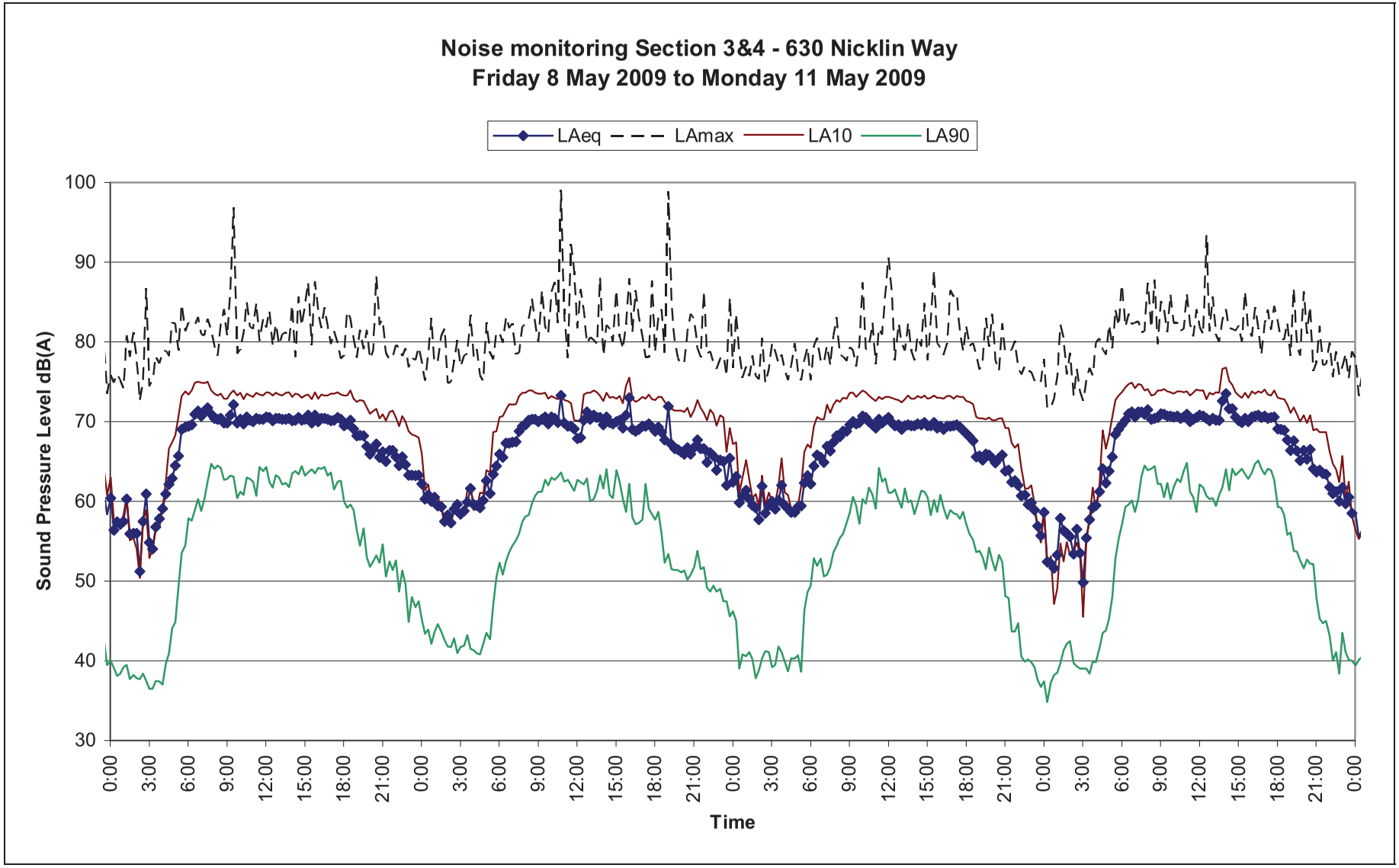

Figure 19-2: Noise monitoring at 630 Nicklin Way

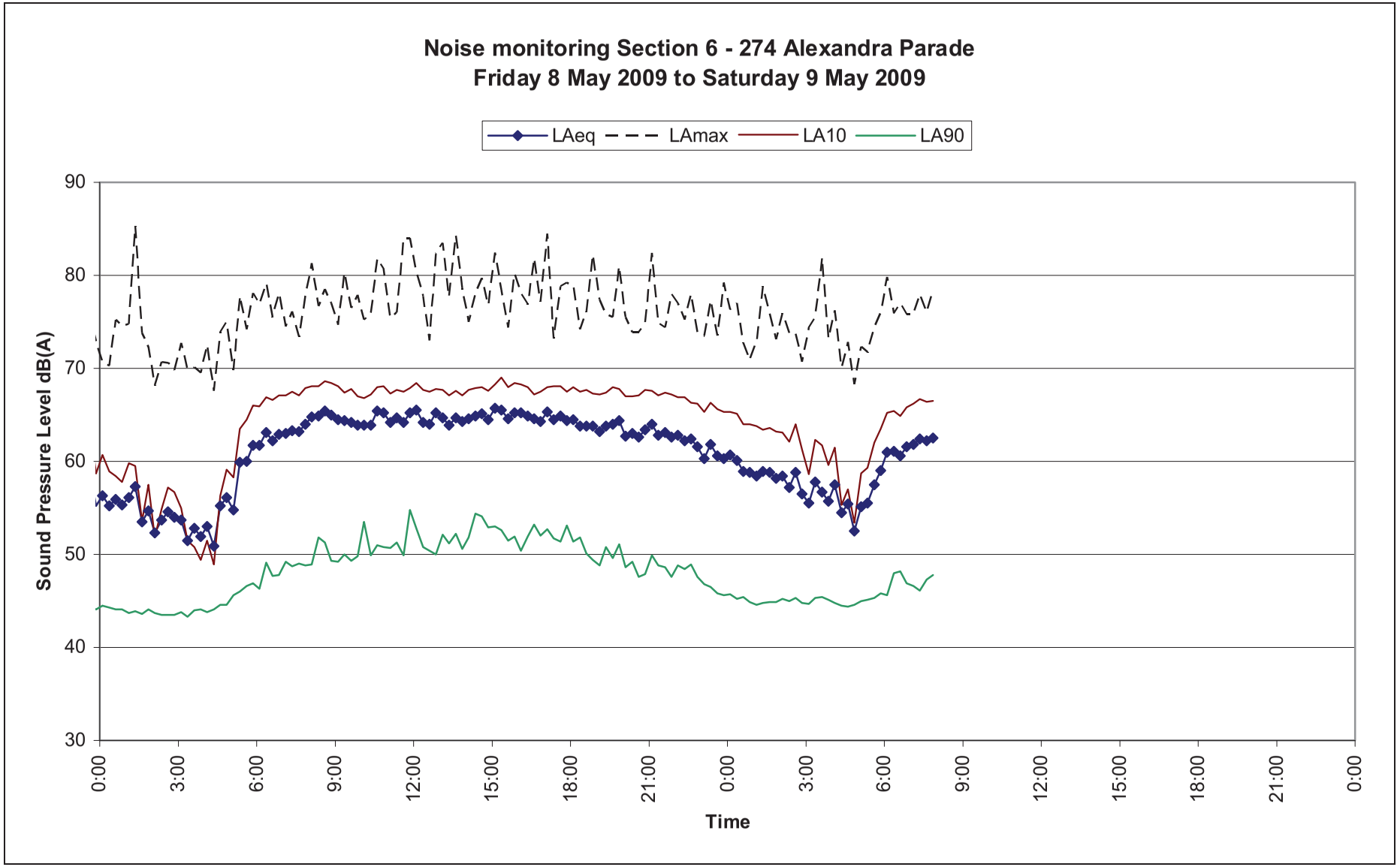

Figure 19-3: Noise monitoring at 274 Alexandra Parade

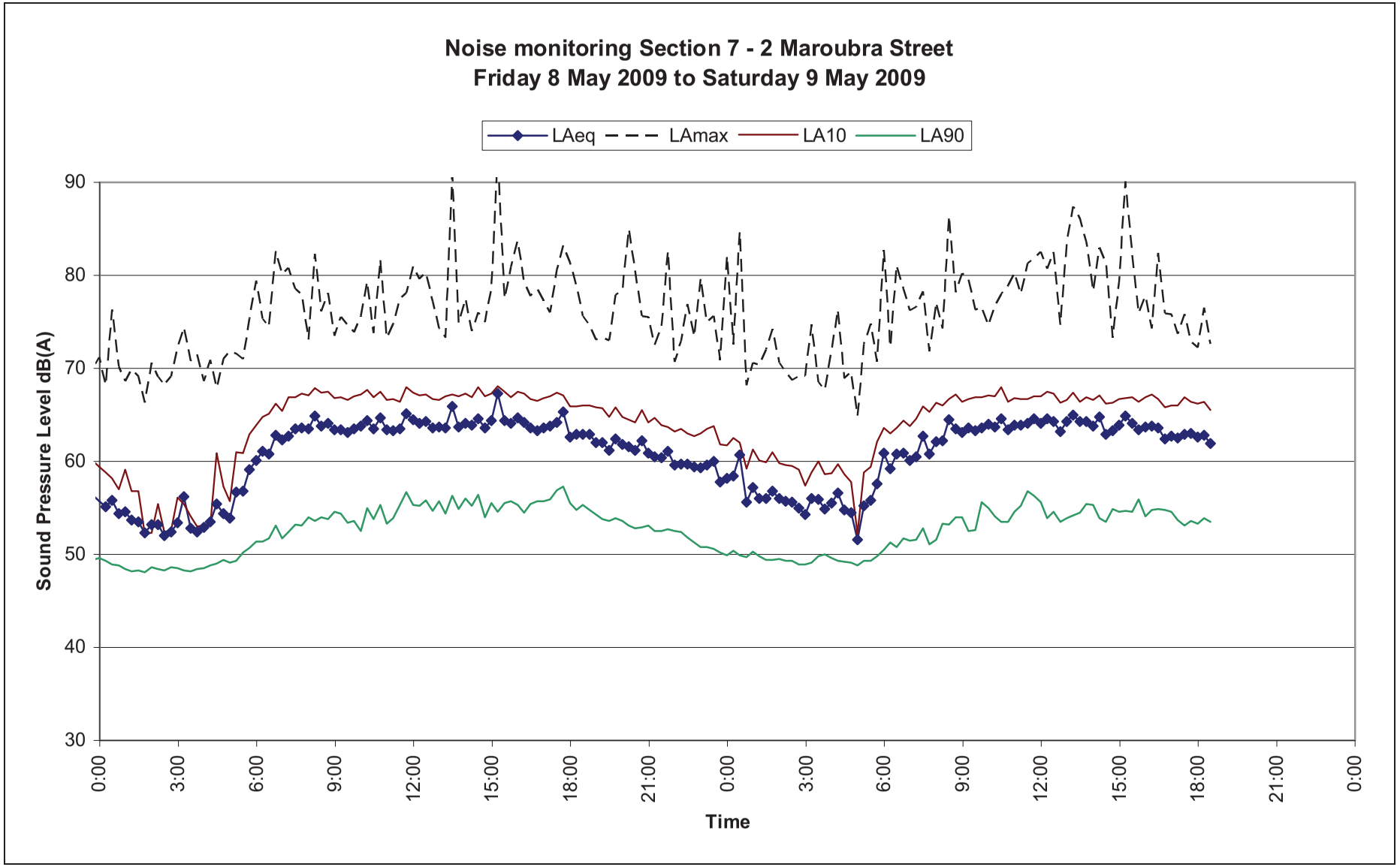

Figure 19-4: Noise monitoring at 2 Maroubra Street

19.3.2 Potential benefits, impacts and typical mitigation measures — Construction

Corridor-wide considerations

Potential impacts

Construction noise and vibration has the potential to cause annoyance at nearby residences. Typical construction noise levels have been predicted at several distances from various noise sources. The predicted noise levels are presented in Table 19-6.

Table 19-6: Typical construction noise levels

Noise source	Sound pressure level dB(A) Distance from source					
	10 m	25 m	50 m	100 m	150 m	200 m
Dump truck	86	78	72	66	62	60
Road truck	80	72	66	60	56	54
Crane	81	73	67	61	57	55
Excavator	88	80	74	68	64	62
Backhoe	88	80	74	68	64	62
Trencher	79	71	65	59	55	53
Driven piling	92	84	78	72	68	66
Bored piling	87	79	73	67	63	61
Concrete pump	77	69	63	57	53	51
Bulldozer	92	84	78	72	68	66
Scraper	90	82	76	70	66	64
Grader	88	80	74	68	64	62
Watercart	77	69	63	57	53	51
Compactor	92	84	78	72	68	66
Vibratory roller	74	66	60	54	50	48
Concrete paver	86	78	72	66	62	60
Concrete saw	94	86	80	74	70	68
Rock breaker	92	84	78	72	68	66
Jackhammer	86	78	72	66	62	60
Asphalt paver	86	78	72	66	62	60
Bitumen sprayer	78	70	64	58	54	52
Rock drill	96	88	82	76	72	70

Comparison of the above predicted noise levels with the ambient noise monitoring results in Tables 19-1 to Table 19-5 indicates that construction activities utilising the equipment presented are likely to be audible and potentially intrusive.

Based on the predicted noise levels, noise control measures are likely to be required for receivers in close proximity to construction sites. The vibration criteria for buildings are presented in Table 19-7. Typical construction vibration impacts have been predicted at several distances from various vibration sources (presented in Table 19-8).

Table 19-7: Vibration criteria

Criteria type	Location	Peak Particle Velocity (PPV) mm/s	Root Mean Square (RMS) mm/s
Human Annoyance (AS2670 Part2)	Residential day	4.0	0.20
	Residential night	0.2	0.14
	Commercial	8.0	0.40
	Critical (hospitals)	0.10	0.10
Cosmetic Damage to Buildings (DIN4150)	Residential	10	—
	Commercial	20	—
	Critical	3	—

Note- PPV is the maximum value of a vibration during a given interval, usually considered to be the maximum deviation of that vibration from the mean value.

RMS is the square root of the mean (average) of the vibration values squared

Table 19-8: Typical vibration impacts

Vibration source	Estimated peak particle vibration velocity (PPV) Distance from source mm/s		
	10 m	25 m	50 m
Dump truck	1.19	0.30	0.11
Road truck	1.98	0.50	0.18
Excavator	2.37	0.60	0.21
Backhoe	2.37	0.60	0.21
Trencher	1.19	0.30	0.11
Driven piling	11.86	3.00	1.06
Bored piling	2.37	0.60	0.21
Bulldozer	1.58	0.40	0.14
Scraper	1.19	0.30	0.11
Grader	1.19	0.30	0.11
Watercart	0.40	0.10	0.04
Compactor	3.56	0.90	0.32
Vibratory roller	3.56	0.90	0.32
Concrete paver	0.40	0.10	0.04
Rock breaker	1.19	0.30	0.11
Jackhammer	0.79	0.20	0.07
Asphalt paver	0.40	0.10	0.04
Rock drill	1.58	0.40	0.14

Comparison of the predicted vibration velocities in Table 19-8 with the criteria in Table 19-7 indicates that construction activities utilising the equipment presented are unlikely to exceed the criterion for cosmetic damage at distances greater than 25 m.

Based on the predicted noise levels and vibration impacts, noise and or vibration control measures are likely to be required for receivers in close proximity to construction sites and on haulage routes.

Typical mitigation measures

Construction noise and vibration management strategies may include a combination of administrative controls as well as physical mitigation controls. The following list of controls may be appropriate for certain activities and sites:

- administrative controls:
  - monitoring and measurement of noise and vibration impacts
  - the noisiest works such as pile boring, concrete pumping and jack hammering should be scheduled to be conducted during the day periods unless unavoidable. If possible, these works should be conducted between the hours of 9 am and 3 pm weekdays as receivers are generally least sensitive during this time period
  - duration of noisy works should be kept as short as possible
  - vehicles should be shut down when unattended on site or when likely to be left idling for an extended period of time
  - all vehicular movements to and from the site should only be made during the scheduled nominal working hours unless approval has been granted by the relevant authority
  - residents should be informed when night and evening works are scheduled to occur
  - workers should use hand-held radio transceivers to communicate across the work site rather than shouting.
- physical mitigation controls may include:
  - suitable mufflers fitted and maintained for all internal combustion type engines
  - all pneumatic tools operated near a residential area may be fitted with an effective silencer on their air exhaust port
  - equipment with the lowest noise rating should be used where work is conducted in a residential area of other noise sensitive location
  - all mechanical plant should be silenced by best practical means using current technology
  - noise suppression devices should be maintained to the manufacturer's specifications

- site buildings, access roads and plant should be positioned such that the minimum disturbance occurs to the locality as they can provide shielding between the site and residences
- noise barriers created between works and neighbouring residential receivers. To be effective the noise barriers should extend down to ground level and should block the line of sight between the source and receiver. The barrier should be located as close as is safe and practical to either the source or receivers
- partial or full enclosures may be constructed around noise emitting components of equipment.

Sections 1 and 2 — Caloundra to Currimundi

Potential impacts

Some construction activities resulting from improvements to bus stops are likely to be audible and may impact on residences. These activities are likely to result in a temporary increase in noise levels in the area. However, the improvement construction works are likely to be short term; therefore construction noise impacts may not be significant to residents.

Typical mitigation measures

The administrative and physical controls presented in the corridor-wide considerations would be appropriate for these construction activities.

Sections 3 and 4 — Nicklin Way and Kawana Town Centre

Potential impacts

The noise monitoring indicated that the ambient noise levels in these sections are already high owing to traffic on Nicklin Way. Certain construction activities are likely to be audible and may result in an increase in noise at nearby residences. It is possible that the traffic noise generated along Nicklin Way may aid in masking the noise of construction activities. This may be the case if the general traffic remains free-flowing during construction.

Typical mitigation measures

Residences along Nicklin Way are predominantly single storey; therefore shielding or screening of certain construction activities is likely to be an effective measure for reducing noise in these locations. Some residences already have existing fences fronting onto Nicklin Way. These may provide some shielding from construction activities thereby reducing the impacts at the residence.

The administrative and physical controls presented in the corridor-wide considerations would also be appropriate for these construction activities.

Section 5 — Mooloolaba

Planning and delivery of this section is being lead by the Sunshine Coast Regional Council.

Section 6 — Alexandra Headland

Potential impacts

This section of the corridor has predominantly multistorey residential and holiday apartments, which will overlook any construction activities along the road. Certain construction activities are likely to be audible and may result in an increase in noise at these residences.

Typical mitigation measures

The administrative and physical controls presented in the corridor-wide considerations would be appropriate for these construction activities. To be effective in reducing noise impacts at the residences on upper floors, any noise barriers or screens would need to be located close to the construction activity.

Section 7 — Maroochydore

Potential benefits

Aerodrome Road has a mostly non-residential frontage. These buildings may provide shielding for residences at the rear of these buildings.

Potential impacts

Certain construction activities are likely to be audible and may result in an increase in noise at nearby residences.

Typical mitigation measures

The administrative and physical controls presented in the corridor-wide considerations would be appropriate for these construction activities.

19.3.3 Potential benefits, impacts and typical mitigation measures — Operational

Corridor-wide considerations

Potential benefits

Generally, a decrease in the growth of general traffic volumes is forecast owing to the inclusion of the bus corridor. This may result in a decrease in traffic noise emissions.

Potential impacts

The combined traffic noise levels resulting from general traffic and the bus corridor may exceed the applicable traffic noise criteria, and therefore may be considered as generating an impact at residences.

Traffic noise levels have been predicted in year 2026 at several distances from the road lane edge. Traffic noise modelling was performed utilising the algorithms presented in Calculation of Road Traffic Noise (CoRTN).

Modelling details incorporate a 2.5 dB(A) façade correction, a -1.7 dB(A) CoRTN correction as specified in TMR CoP 2008, a dense graded asphalt road surface, and a flat ground model with a 50 % absorptive surface. Several situations were modelled as follows:

- general traffic noise levels for year 2026 without the CoastConnect corridor
- general traffic noise levels for year 2026 including the CoastConnect corridor
- traffic noise levels from the CoastConnect corridor only.

Typical mitigation measures

Mitigation measures that may be employed typically include the following:

- noise barriers (in some instances these may be impractical due to access requirements)
- road wearing surfaces options, such as:
  - open-graded asphalt (OGA) may reduce traffic noise emissions by 2 dB(A)
  - stone mastic asphalt (SMA) may reduce traffic noise emissions by 1 dB(A)
- speed control of buses
- improved traffic flow, allowing buses to reduce engine revving
- quieter operating buses.

Sections 1 and 2 — Caloundra to Currimundi

The traffic noise levels were predicted along Edmund Street as a representative location.

Table 19-9: Traffic noise predictions on Edmund Street

Situation	Predicted traffic noise levels, $L_{10\ 18h}$ dB(A)			
	10 m	20 m	40 m	60 m
General traffic without CoastConnect	64	62	59	56
General traffic with CoastConnect	64	62	59	56
CoastConnect only	59	58	56	54

The criterion of 63 dB(A) $L_{10\ 18h}$ is predicted to be achieved at 20 m from the edge of the road. However, most residences in these sections are approximately 10 m from the road lane edge, indicating potential exceedance of the noise criteria.

Potential benefits

With the inclusion of the bus corridor there is a 1 % decrease in traffic volumes.

Potential impacts

The 63 dB(A) $L_{10\ 18h}$ criterion is not predicted to be achieved closer than 20 m from the lane edge.

Typical mitigation measures

Typical mitigation measures have been presented in the corridor-wide considerations section.

Sections 3 and 4 — Nicklin Way and Kawana Town Centre

The traffic noise levels were predicted at three representative locations along Nicklin Way, near Pringa Street, near Palkana Drive, and near Jessica Boulevard.

Table 19-10: Traffic noise predictions on Nicklin Way near Pringa Street intersection

Situation	Predicted traffic noise levels, $L_{10\ 18h}$ dB(A)			
	10 m	20 m	40 m	60 m
General traffic without CoastConnect	75	72	69	67
General traffic with CoastConnect	75	72	69	66
CoastConnect only	60	58	56	54

Table 19-11: Traffic noise predictions on Nicklin Way near Palkana Drive intersection

Situation	Predicted traffic noise levels, $L_{10\ 18h}$ dB(A)			
	10 m	20 m	40 m	60 m
General traffic without CoastConnect	75	72	68	66
General traffic including CoastConnect	75	72	68	66
CoastConnect only	60	58	56	54

Table 19-12: Traffic noise predictions on Nicklin Way near Jessica Boulevard intersection

Situation	Predicted traffic noise levels, $L_{10\ 18h}$ dB(A)			
	10 m	20 m	40 m	60 m
General traffic without CoastConnect	76	72	69	67
General traffic including CoastConnect	76	73	69	67
CoastConnect only	60	58	56	54

As presented in Table 19-10 to Table 19-12, the traffic noise levels are predicted to be similar for the length of Nicklin Way in these sections. The predicted noise levels without the bus corridor already exceed the traffic noise criterion of 63 dB(A) $L_{10\ 18h}$.

With the inclusion of the bus corridor, the combined traffic noise levels are predicted to be similar to those without the bus corridor (an increase of 1 dB or less). In these sections, the bus corridor is located in dedicated bus lanes, therefore, the criteria of 63 dB(A) $L_{10\ 18h}$ may apply to the bus corridor only. Considering the bus lanes only, Table 19-10 to Table 19-12 indicate that the predicted noise levels at 10 metres from the dedicated bus lanes do not exceed the 63 dB(A) $L_{10\ 18h}$ criterion. Most residences in these sections are approximately 10 metres from the road lane edge.

Potential impacts

The total predicted traffic noise levels, including the bus corridor, exceeds the criterion of 63 dB(A) $L_{10\ 18h}$. However, noise from the bus corridor alone does not exceed the 63 dB(A) $L_{10\ 18h}$ criterion.

The total predicted traffic noise levels in these sections with the inclusion of the bus corridor are similar to those without the corridor. However, it is possible that the high existing traffic noise levels may provide masking of bus corridor noise. With the inclusion of the bus corridor there is a 2 % decrease in traffic volumes.

Typical mitigation measures

Typical mitigation measures have been presented in the corridor-wide considerations section.

Section 5 — Mooloolaba

Planning and delivery of this section is being lead by the Sunshine Coast Regional Council.

Section 6 — Alexandra Headland

The traffic noise levels were predicted along Alexandra Parade near Okinja Street, as a representative location in this section. The predicted noise levels are presented in Table 19-13.

Table 19-13: Traffic noise predictions on Alexandra Parade near Okinja Street intersection

Situation	Predicted traffic noise levels, $L_{10\ 18h}$ dB(A)			
	10 m	20 m	40 m	60 m
General traffic without CoastConnect	70	67	64	62
General traffic including CoastConnect	70	67	64	62
CoastConnect only	59	58	56	54

As presented in Table 19-13, the traffic noise levels are predicted to be similar for Alexandra Parade with or without the bus corridor in this section. The predicted noise levels without the bus corridor already exceed the traffic noise criterion of 63 dB(A) $L_{10\ 18h}$. With the inclusion of the bus corridor, the combined traffic noise levels are predicted to be similar to those without the bus corridor. Most residences in these sections are approximately 10 metres from the road lane edge.

Potential impacts

The predicted traffic noise levels, including the bus corridor, exceed the criterion of 63 dB(A) $L_{10\ 18h}$.

The predicted traffic noise levels in this section, with the inclusion of the bus corridor, are similar to those without the corridor. However, it is possible that the high existing traffic noise levels may provide some masking of bus corridor noise. With the inclusion of the bus corridor there is a slight decrease in traffic volumes of less than 1 %.

Typical mitigation measures

Typical mitigation measures have been presented in the corridor-wide considerations section.

Section 7 — Maroochydore

The traffic noise levels were predicted along Aerodrome Road near Maud Street, as a representative location in this section. The predicted noise levels are presented in Table 19-14.

Table 19-14: Traffic noise predictions on Aerodrome Road near Maud Street intersection

Situation	Predicted traffic noise levels, $L_{10\ 18h}$ dB(A)			
	10 m	20 m	40 m	60 m
General traffic without CoastConnect	71	68	65	63
General traffic including CoastConnect	71	68	65	63
CoastConnect only	59	58	56	54

As presented in Table 19-14, the traffic noise levels are predicted to be similar for Aerodrome Road with or without the bus corridor in this section. The predicted noise levels without the bus corridor already exceed the traffic noise criterion of 63 dB(A) $L_{10\ 18h}$. With the inclusion of the bus corridor, the combined traffic noise levels are predicted to be similar to those without the bus corridor. Most residences in these sections are approximately 10 metres of the road lane edge.

Potential impacts

The predicted traffic noise levels, including the bus corridor, exceed the criterion of 63 dB(A) $L_{10\ 18h}$.

The predicted total traffic noise levels in this section, with the inclusion of the bus corridor, are similar to those without the corridor. However, it is possible that the high existing traffic noise levels may provide some masking of bus corridor noise. With the inclusion of the bus corridor there is a 1 % decrease in traffic volumes.

Typical mitigation measures

Typical mitigation measures have been presented in the corridor-wide considerations section.

19.4 Future investigations

Further investigation will be required closer to construction to determine the existing or 'background' noise levels within the corridor. This will aid in determination of construction noise emission goals, and be used to confirm applicable operational bus corridor criteria.

Additionally, it is anticipated that a detailed noise assessment will be conducted including a review of up to date legislation regarding traffic noise criteria. This data will allow for an up-to-date noise assessment and management of the bus corridor noise impacts according to legislative requirements and guidelines current at the time of the future study.

19.5 References

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