Australian Government

NSW GOVERNMENT

Coffs Harbour Bypass

Amendment Report

Volume 2A. Appendices A & B (Main report, sub-appendices A-F)

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Appendix A

Supplementary traffic and transport assessment

Transport for New South Wales

Coffs Harbour Bypass Amendment Report

Appendix A Supplementary Traffic and Transport Assessment

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1 Introduction

1.1 Overview

Transport for New South Wales (TfNSW) is seeking approval for the Coffs Harbour Bypass (the project). The approval is being sought under Division 5.2 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) as Critical State Significant Infrastructure (CSSI).

The project includes a 12 km bypass of Coffs Harbour from south of Englands Road to Korora Hill in the north and a 2 km upgrade of the existing highway between Korora Hill and Sapphire. The project would provide a four-lane divided highway that bypasses Coffs Harbour, passing through the North Boambee Valley, Roberts Hill and then traversing the foothills of the Coffs Harbour basin to the west and north to Korora Hill.

The key features of the project include:

- Four-lane divided highway from south of Englands Road roundabout to the dual carriageway highway at Sapphire
- Bypass of the Coffs Harbour urban area from south of Englands Road intersection to Korora Hill
- Upgrade of the existing Pacific Highway between Korora Hill and the dual carriageway highway at Sapphire
- Grade-separated interchanges at Englands Road, Coramba Road and Korora Hill
- A one-way local access road along the western side of the project between the southern tie-in and Englands Road, connecting properties to the road network via Englands Road
- A new service road, located east of the project, connecting Solitary Islands Way with James Small Drive and the existing Pacific Highway near Bruxner Park Road
- Three tunnels through ridges at Roberts Hill (around 190 metres long), Shephards Lane (around 360 metres long), and Gatelys Road (around 450 metres long)
- Structures to pass over local roads and creeks as well as a bridge over the North Coast Railway
- A series of cuttings and embankments along the project
- Tie-ins and modifications to the local road network to enable local road connections across and around the alignment
- Pedestrian and cycling facilities, including a shared path along the service road tying into the existing shared path on Solitary Islands Way, and a new

pedestrian bridge to replace the existing Luke Bowen footbridge with the name being retained

- Relocation of the Kororo Public School bus interchange
- Noise attenuation, including low noise pavement, noise barriers and at-property treatments as required
- Fauna crossing structures including glider poles, underpasses and fencing
- Ancillary work to facilitate construction and operation of the project, including:
  - Adjustment, relocation and/or protection of utilities and services
  - New or adjusted property accesses as required
  - Operational water quality measures and retention basins
  - Temporary construction facilities and work including compound and stockpile sites, concrete/asphalt batching plant, sedimentation basins and access roads (if required).

1.2 Design changes

The environmental impact statement (EIS) was exhibited by the Department of Planning, Industry and Environment (DPIE) for 47 days from 11 September 2019 to 27 October 2019. TfNSW has amended several aspects of the project as exhibited in the EIS. These changes have been developed in response to:

- Consultation with the community and landowners during the EIS public exhibition period
- Submissions received during the EIS public exhibition period
- Continued development and refinement of the concept design and consultation with government agencies
- Consultation with the community, landowners and stakeholder groups during the design changes display period (27 November 2019 to 13 December 2019).

The proposed design changes are:

- Englands Road interchange
- North Boambee Valley vertical alignment
- Coramba Road bus stop
- Coffs Creek flood mitigation
- Korora Hill interchange
- Kororo Public School bus interchange and Luke Bowen footbridge
- Pine Brush Creek and Williams Creek realignment
- Water quality basins.

The proposed construction changes are:

- Additional blasting
- New and revised ancillary sites
- Revised traffic management
- Construction sediment basins.

A concept design has been developed for the project, incorporating the design and construction changes identified above, and is referred to as the amended design.

1.3 Purpose of this report

A traffic and transport assessment was prepared in support of the EIS for the project (refer to *Traffic and Transport Assessment,* Arup 2019). The purpose of the assessment was to address the Secretary's Environmental Assessment Requirements (SEARs) for the project's construction and operation relevant to traffic and transport.

Following exhibition of the EIS, receipt of submissions and further consultation with community and stakeholders, several design and construction changes have been made to the project.

This supplementary traffic and transport assessment has been prepared to assess the impacts of the design and construction changes for the project. This supplementary assessment only includes information that has changed since the EIS was prepared and should be read in conjunction with the *Traffic and Transport Assessment* (Arup 2019).

The design changes relevant to this supplementary traffic and transport assessment include:

- Englands Road interchange
- Coramba Road bus stop
- Korora Hill interchange
- Kororo Public School bus interchange and Luke Bowen footbridge.

The construction changes relevant to this supplementary traffic and transport assessment include:

- New and revised ancillary sites
- Revised traffic management.

This report provides:

- Network changes (Chapter 2) - a brief description of the proposed design changes to the project impacting road operation and performance
- Operational assessment (Chapter 3) - an assessment of the change in traffic, transport and road safety impacts which are anticipated to occur from the operation of the project associated with the proposed design changes outlined in Chapter 2

- Construction assessment (Chapter 4) - an assessment of the change in construction traffic impacts associated with the proposed changes to construction activities for the project.

1.3.1 EIS Traffic and transport assessment report

The following table provides a brief description of the chapters within the *Traffic and Transport Assessment* (Arup 2019) submitted as part of the EIS, and a description of how these have been addressed as part of this supplementary report.

EIS traffic and transport assessment	Supplementary traffic and transport assessment
Chapter 2 Existing traffic and transport operations Outlined the existing traffic and transport features and conditions relevant to the areas modelled and provided the regional and local context within which the assessment has been undertaken.	No change. The existing traffic and transport facilities and features addressed in this supplementary analysis are as per that previously reported in the *Traffic and Transport Assessmen*t (Arup 2019).
Chapter 3 Existing road performance Established the existing traffic performance of the road network. Results from traffic surveys and assessment of existing traffic performance were summarised in this chapter.	No change. The proposed design changes since the issue of the EIS do not impact the existing road performance results previously reported in the *Traffic and Transport Assessmen*t (Arup 2019).
Chapter 4 Traffic modelling and forecasting Provided details of the traffic modelling and forecasting approach which has been adopted for the project operational performance assessment. Traffic modelling for the project was carried out using a three-tiered approach with a regional strategic model being used to provide forecast traffic demands for the modelled area (detailed in Sections 4.1 to 4.5 of the *Traffic and Transport Assessment*, Arup 2019). This approach included: • Strategic modelling (Coffs Harbour Strategic Transport Model CHSTM) to strategically assess the project options and forecast traffic demand for future years with and without the project • Mesoscopic modelling (Coffs Harbour Traffic Model CHTM) to assign traffic demands to the road network to provide predictions of traffic volumes and delays on various links and turns • Detailed intersection and interchange performance was assessed using both microscopic (Aimsun) and detailed intersection (SIDRA) modelling tools.	There has been no change to the traffic modelling process described in the *Traffic and Transport Assessmen*t (Arup 2019). The CHTM and subsequent detailed intersection and interchange models have been updated to represent the proposed design changes for the project. *[Refer to Chapter 2 of this report]* There are subsequent changes to the operational performance of the road network because of the proposed design changes. *[Refer to Chapter 3 of this report]*

EIS traffic and transport assessment	Supplementary traffic and transport assessment
Chapter 5 Assessment of operational impacts Provided an assessment of the resulting traffic, transport and road safety impacts which are anticipated to occur from the operation of the project.	This amendment report includes updates to the operational performance of the road network based on assessment of the proposed design changes. *[Refer to Chapter 3 of this report]*
Chapter 6 Assessment of construction impacts Provided an assessment of the resulting transport-related impacts which are anticipated to occur during construction of the project.	This amendment report includes updates to the performance of the road network during construction based on updates to the construction methodology. *[Refer Chapter 4 of this report]*
Chapter 7 Management of traffic and transport impacts Provided management and mitigation measures anticipated to be implemented to mitigate construction and operational traffic impacts from the project.	The proposed management and mitigation measures are consistent with those previously reported in the *Traffic and Transport Assessmen*t (Arup 2019). The additional environmental management measures for traffic and transport are provided in Chapter 6, Revised environmental management measures in the Amendment Report

2 Design and construction changes

The proposed design changes relevant to this supplementary traffic and transport assessment are presented in Figure 1and described in this section have been modelled within the Coffs Harbour Traffic Model (CHTM) with the new results presented in Chapter 3 of this supplementary report.

2.1 Design changes

2.1.1 Englands Road interchange

The EIS design and the amended design for the Englands Road interchange are shown on Figure 2. The key changes to the Englands Road interchange compared with the EIS design include:

- A revised alignment for northbound exit ramp and the new one-way local access road, located on the west side of the project, to reduce impacts on the Coffs Coast Resource Recovery Park
- A large roundabout under the project carriageways to provide a connection between Englands Road, Isles Drive, the northbound entry ramp and the southbound exit ramp. The roundabout would replace the traffic lights along Englands Road on either side of the project proposed in the EIS.

2.1.2 Coramba Road school bus stop

The EIS design and the amended design for the Coramba Road bus stop are shown on Figure 3. The key changes to the Coramba Road bus stop compared with the EIS design include:

- A new school bus stop on the north side of Coramba Road and about 50 metres east of Spagnolos Road. The new school bus stop would include capacity for four 12.5 metre long buses
- A bus shelter
- A shared user path to connect Spagnolos Road with the new school bus stop on Coramba Road
- A cul-de-sac would be provided at the Coramba Road end of Spagnolos Road to provide an informal area for pick-up and drop-off, off Coramba Road.

Legend

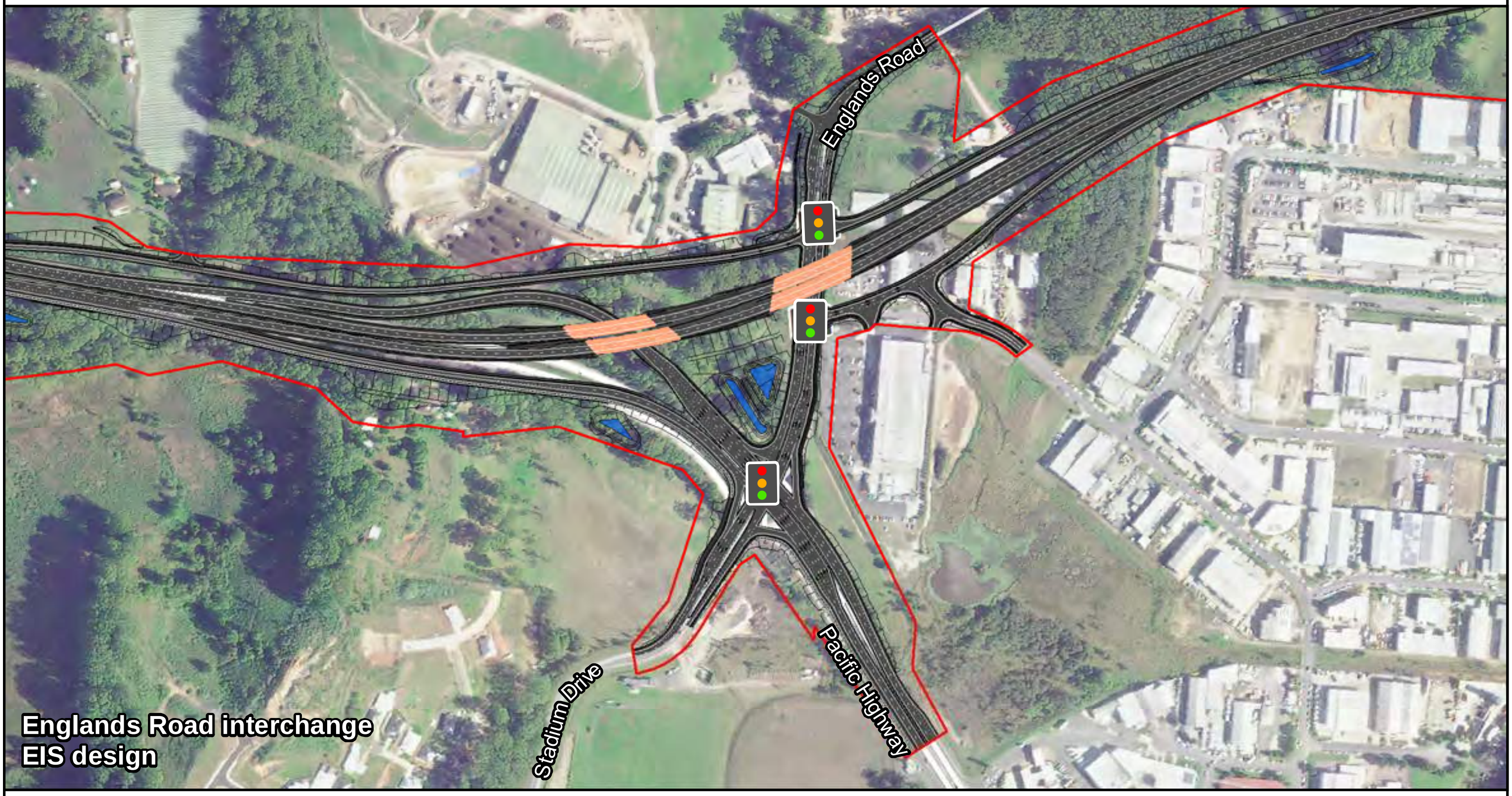
Construction footprint
Alignment
North Coast Railway
Watercourse

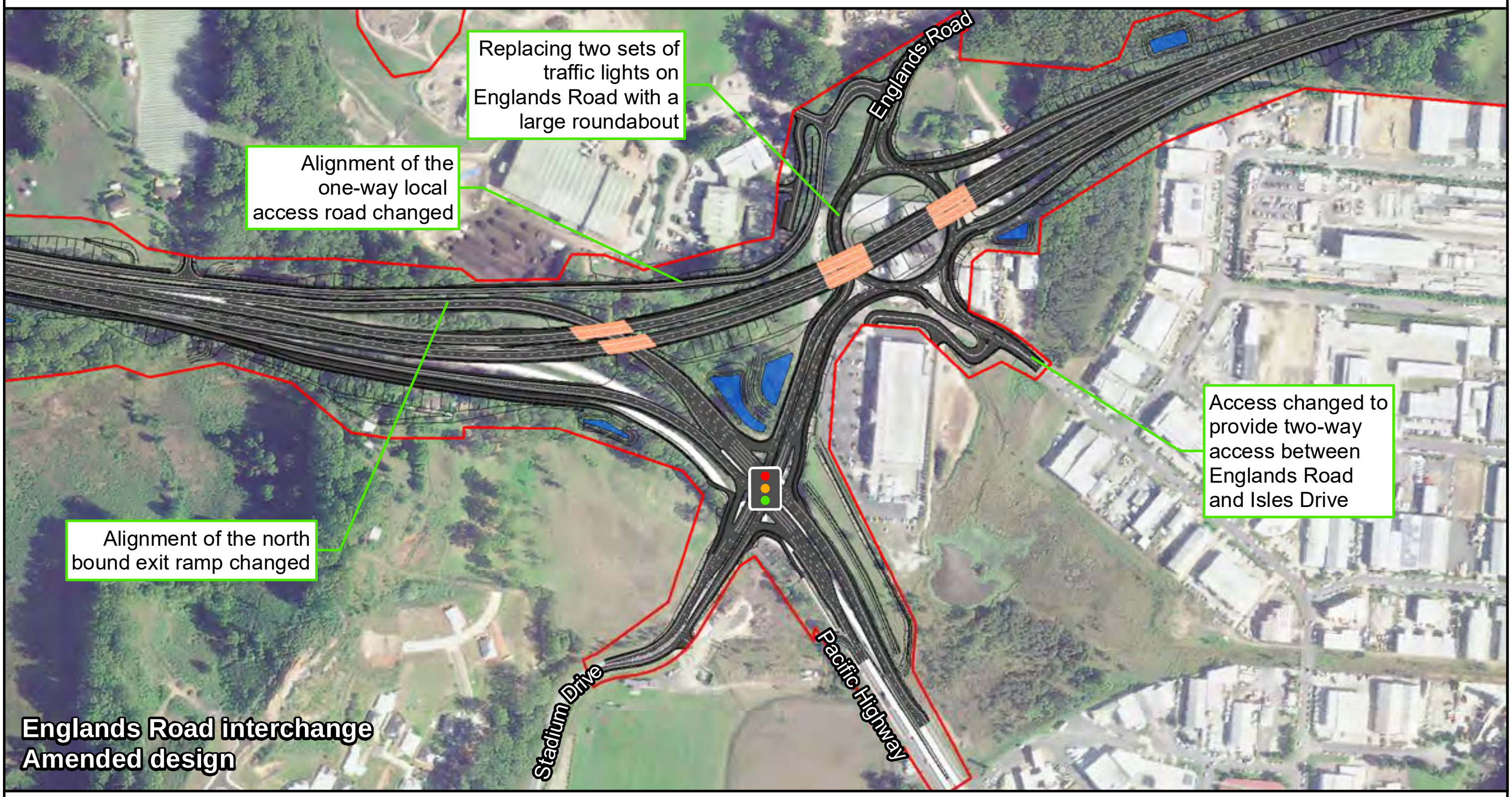
Major design changes

1. Englands Road interchange
2. Coramba Road bus stop
3. Korora Hill interchange
4. Kororo Public School bus interchange and Luke Bowen footbridge

Coffs Harbour Bypass
Project overview - major design changes
Figure 1

0 0.5 1 1.5 km
N
Scale @A4: 1:50,000
GDA 1994 MGA Zone 56



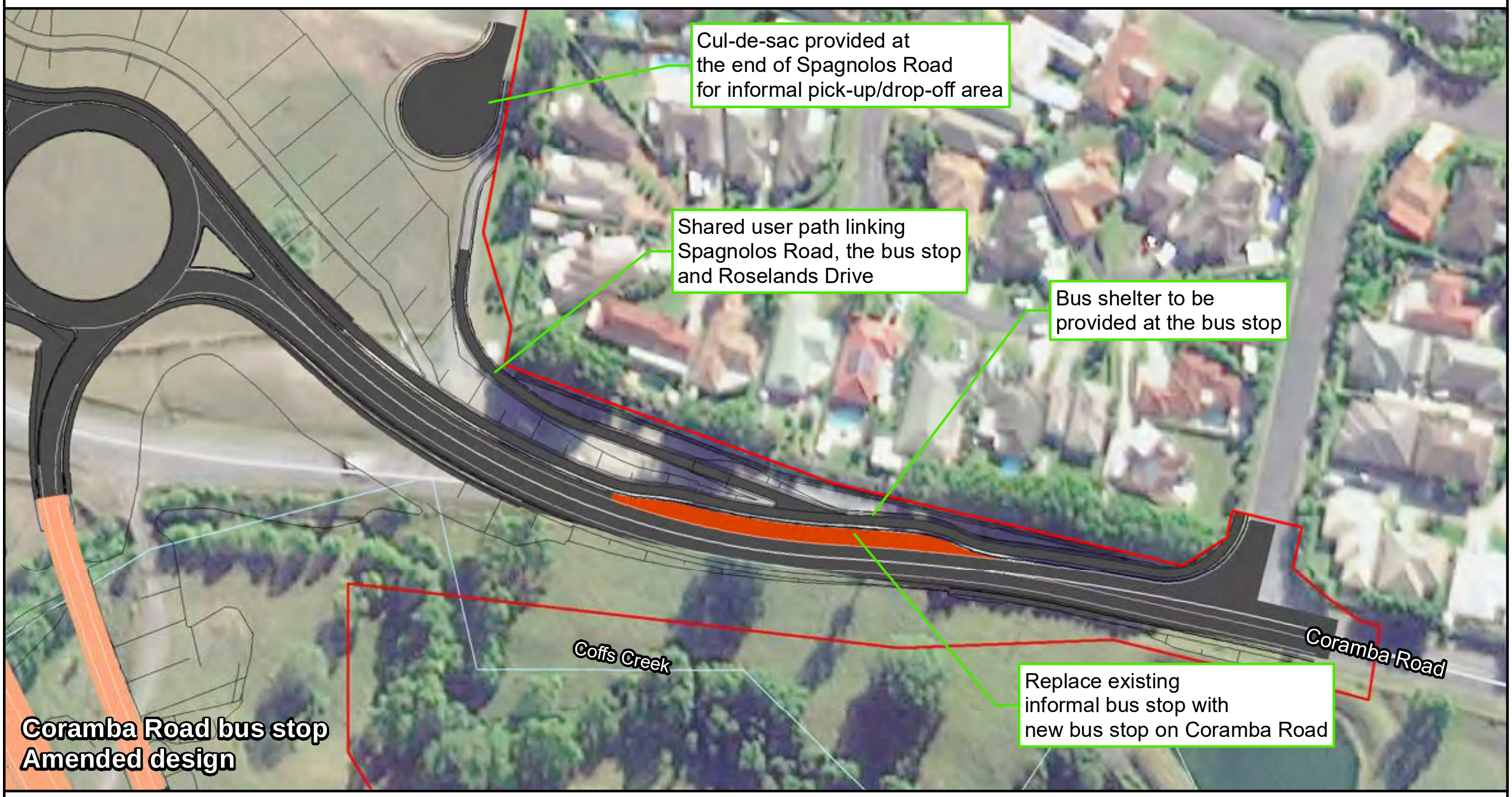


Legend

- Construction footprint
- Pavement
- Bridge
- Tunnel
- Permanent Basin
- North Coast Railway
- Watercourse
- Signalised intersection

Coffs Harbour Bypass
Englands Road interchange
Figure 2

0 0.08 0.16 0.24 km
Scale @A4: 1:8,000
GDA 1994 MGA Zone 56
N



Legend

- Construction footprint
- Pavement
- Bridge
- Tunnel
- Permanent Basin
- North Coast Railway
- Watercourse
- Signalised intersection
- Bus stop/bays

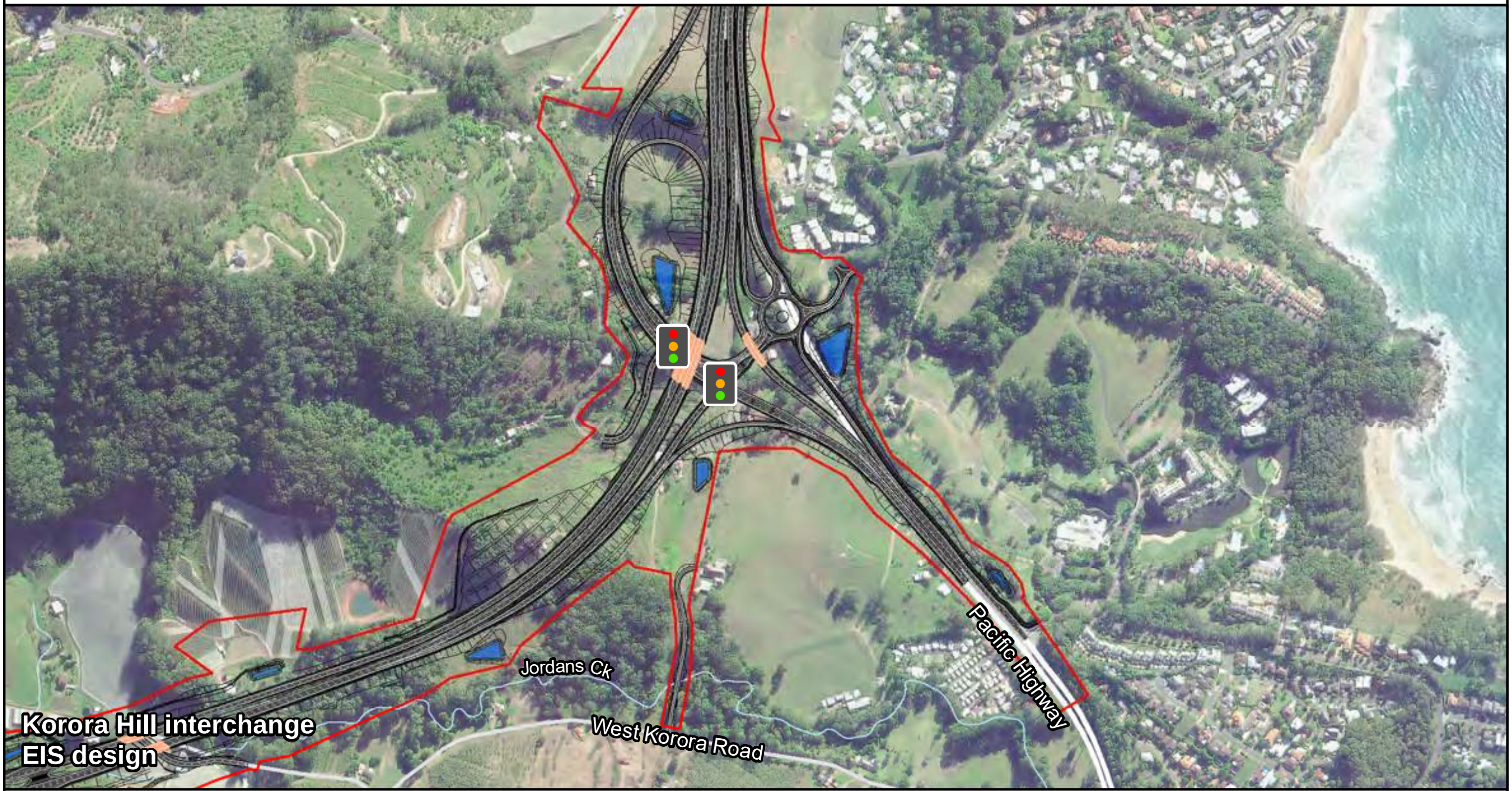
Coffs Harbour Bypass
Coramba Road bus stop
Figure 3

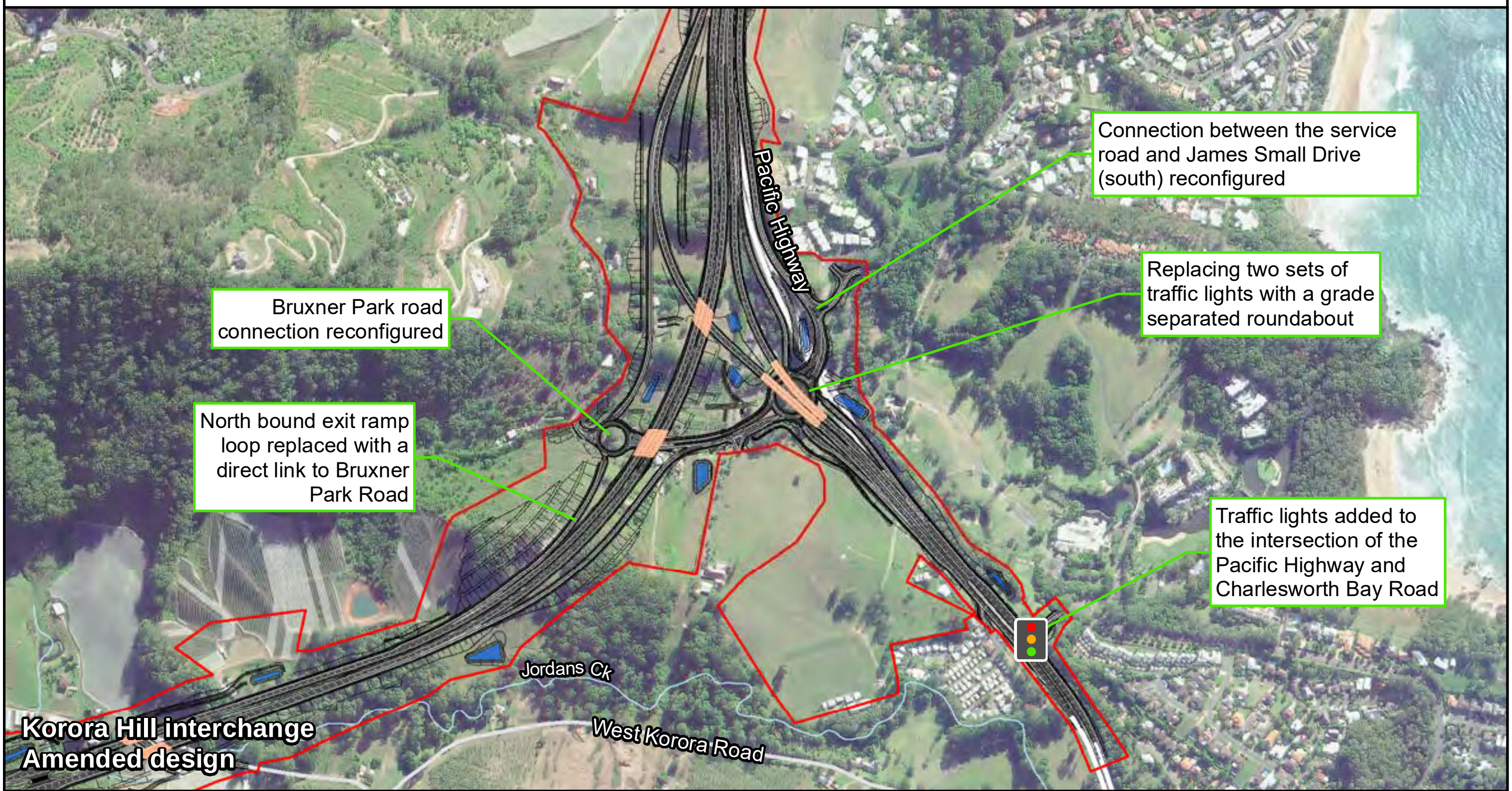
0 0.02 0.04 0.06 km
Scale @A4: 1:2,000
GDA 1994 MGA Zone 56
N

2.1.3 Korora Hill interchange

The EIS design and the amended design for the Korora Hill interchange are shown on Figure 4. The key changes to the Korora Hill interchange compared with the EIS design include:

- A southbound exit ramp from the project to the existing Pacific Highway via a bridge over a new roundabout at the intersection of Bruxner Park Road, the service road and slip lanes to and from the existing Pacific Highway. A left slip lane would be provided from the southbound exit ramp to provide access to James Small Drive, the service road and Bruxner Park Road
- A northbound entry ramp from the existing Pacific Highway to the project via a bridge over a roundabout at the intersection of Bruxner Park Road, the service road and slip lanes to and from the existing Pacific Highway. The northbound entry ramp would pass beneath the project
- A northbound exit ramp from the project to Bruxner Park Road. A new roundabout would be provided at the intersection of the exit ramp and Bruxner Park Road
- A bridge would carry the project over Bruxner Park Road. Property accesses would be retained for existing properties south of Bruxner Park Road between the project and the existing highway
- A southbound entry ramp from Bruxner Park Road to the project
- A new roundabout would be provided below the northbound entry ramp and the southbound exit ramp to provide access between Bruxner Park Road, the service Road, James Small Drive (via the service road), and the existing Pacific Highway and replace two sets of traffic lights
- James Small Drive (south) would join the service road via a T-intersection
- Traffic signals would be provided at the intersection of the existing Pacific Highway and Charlesworth Bay Road to provide safe access for traffic from Charlesworth Bay Road travelling north.





Legend

- Construction footprint
- Pavement
- Bridge
- Tunnel
- Permanent Basin
- North Coast Railway
- Watercourse
- Signalised intersection

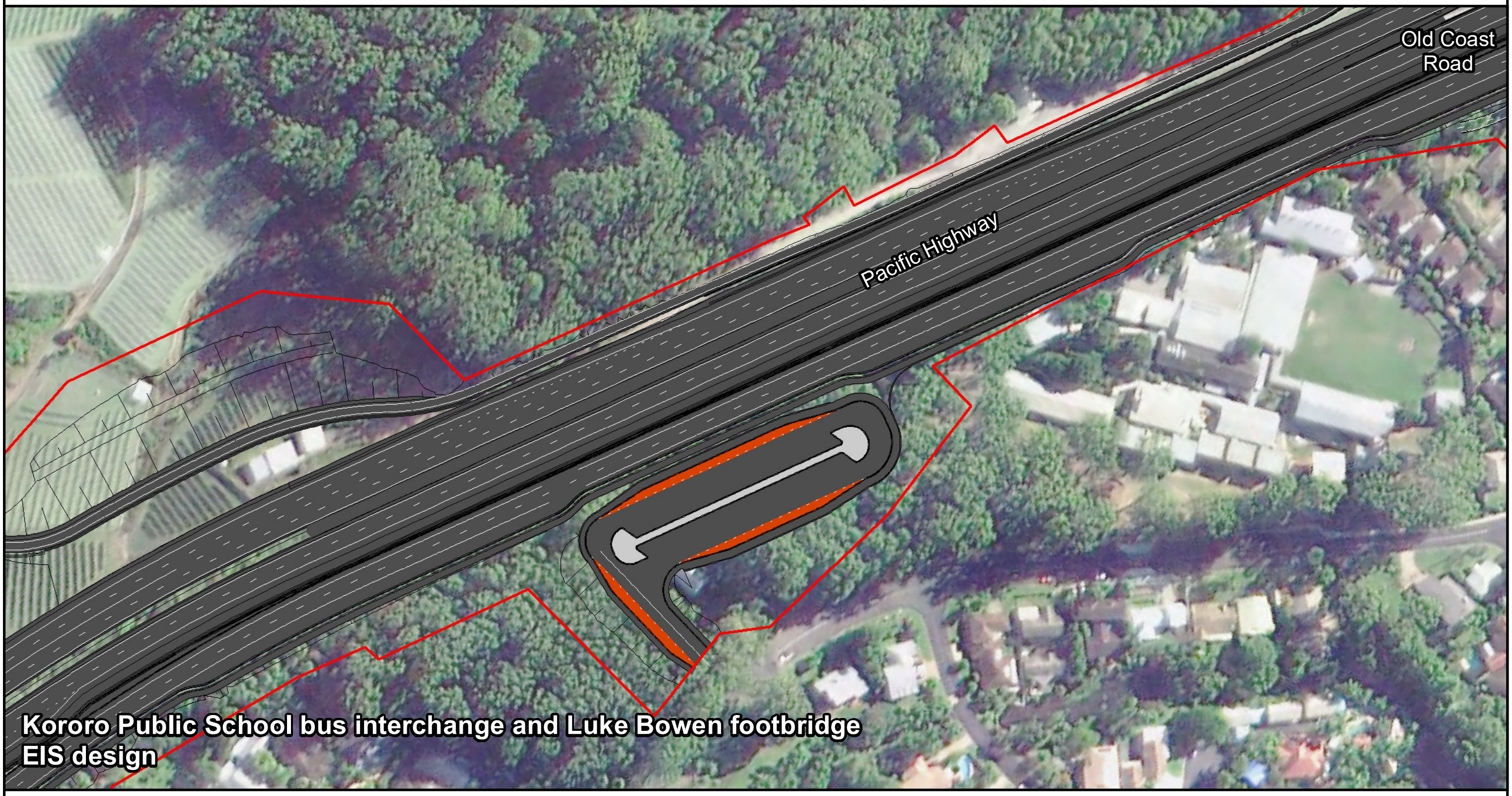
Coffs Harbour Bypass
Korora Hill interchange
Figure 4

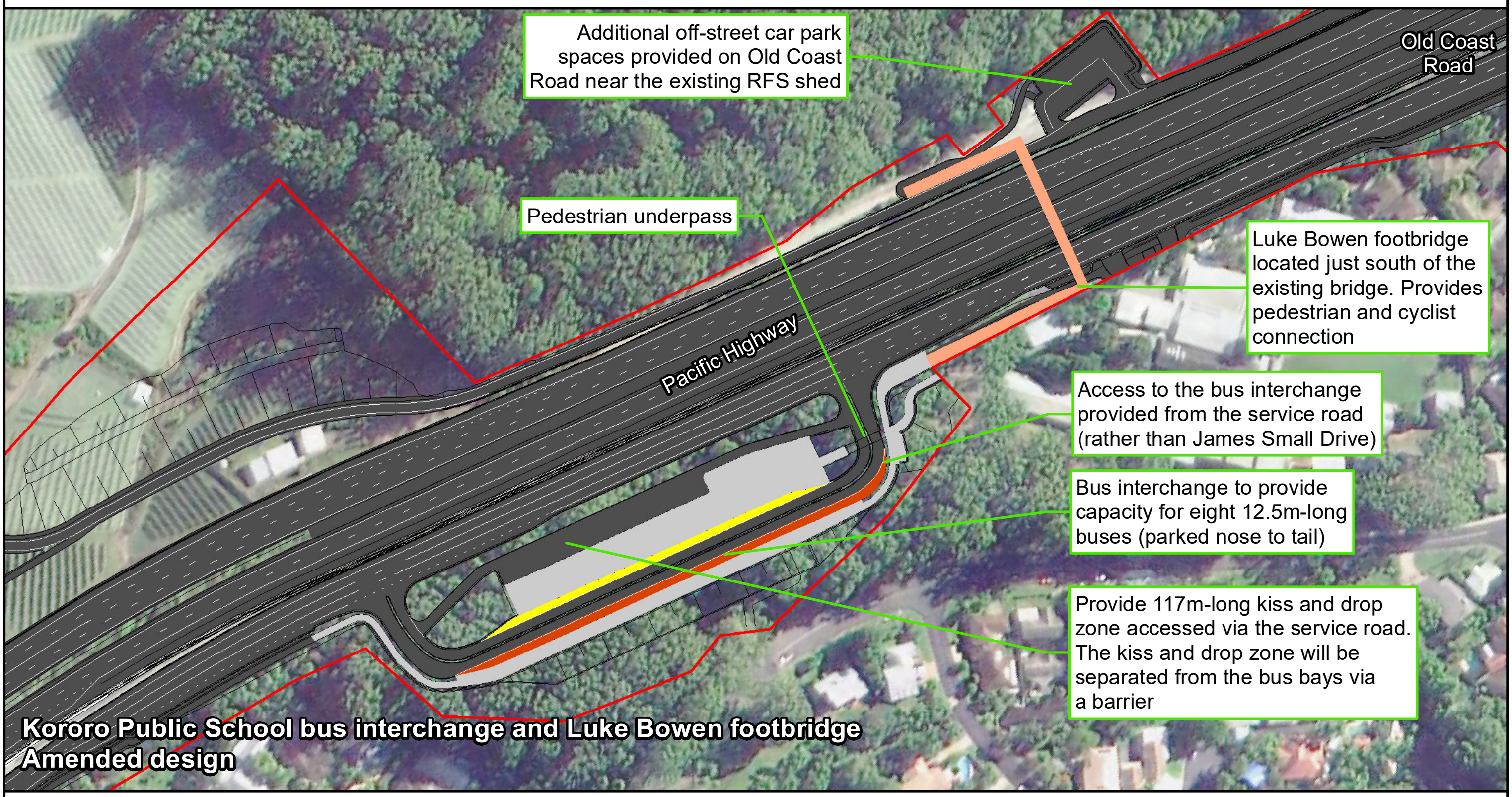
0 0.1 0.2 0.3 km
Scale @A4: 1:12,500
GDA 1994 MGA Zone 56
N

2.1.4 Kororo Public School bus interchange and Luke Bowen footbridge

The EIS design and the amended design for the Kororo Public School bus interchange and Luke Bowen footbridge are shown on Figure 5. The key changes to the Kororo Public School bus interchange and Luke Bowen footbridge compared with the EIS design include:

- The existing bus interchange located near Kororo Nature Reserve would be relocated to just south of Kororo Public School with access provided via the service road
- The bus interchange would have capacity for eight 12.5 metre long buses (parked nose to tail) with bus shelters provided adjacent to the bus bays
- The bus interchange would include capacity for 30 staff car park spaces
- A 117-metre-long ‘kiss-and-drop’ zone would be provided within the bus interchange, accessed via the service road. The ‘kiss-and-drop’ zone would be separated from the bus bays via a barrier
- The Luke Bowen footbridge would be replaced with a new pedestrian bridge over the project located just south of the existing bridge. The new bridge would retain the name Luke Bowen footbridge. This bridge would provide a pedestrian and cyclist connection between Old Coast Road and the proposed service road next to Kororo Public School
- Additional off-street short-term and long-term car park spaces would be provided on Old Coast Road near the existing Solitary Rural Fire Services (RFS) shed, formalising the existing informal car parking in this area
- The existing Solitary RFS shed would would be directly impacted to accommodate the additional car park spaces and the new footbridge location. TfNSW have commenced consultation with RFS Mid North Coast Team and identified a location near Korora Hill interchange for a new shed and facilities on TfNSW owned property (within construction ancillary facility site 3B). The new shed and facilities are proposed to be constructed as part of the project and would be undertaken as a pre-construction activity.





Legend

- Construction footprint
- Pavement
- Bridge
- Tunnel
- Permanent Basin
- North Coast Railway
- Watercourse
- Signalised intersection
- Bus stop/bays
- Kiss and drop area
- Pavement and landscape areas

Coffs Harbour Bypass
Kororo Public School bus interchange and Luke Bowen footbridge
Figure 5

0 0.03 0.06 0.09 km
Scale @A4: 1:3,000
GDA 1994 MGA Zone 56
N

2.2 Construction changes

Changes to the proposed approach to construction of the project relevant to the traffic and transport assessment include:

- Changes to the location of use of construction ancillary facilities. Four new construction ancillary facilities and two amended construction ancillary facilities would be needed to build the project:
  - Construction Zone 1: New construction ancillary sites in construction zone 1 include site 1A and site 1J, and the boundary of site 1C has been amended to accommodate the proposed design changes for the Englands Road interchange. New and amended construction ancillary sites in this construction zone would be accessed via Englands Road
  - Construction Zone 3: To accommodate the proposed design changes, new ancillary sites in construction zone 3 (site 3A and site 3F) have been included, the boundary of site 3D has been amended and site 3C has been removed.
    The new ancillary site 3A and the amended site 3D will be accessed via Bruxner Park Road.
    New ancillary site 3F is proposed to be accessed via the existing Pacific Highway.
- Changes to construction traffic management and access include:
  - Two new construction access roads would be needed for the project – Buchanans Road and Gatelys Road
  - Use of Russ Hammond Close would be required temporary access for existing traffic associated with the Kororo Public School and Korora School Road.

All other elements for the construction of the project are consistent with the details provided in Chapter 6 of the EIS.

3 Assessment of operational impacts

This section provides an assessment of the resulting traffic, transport and road safety impacts which are anticipated to occur from the operation of the amended design.

3.1 Assessment methodology

The purpose of the EIS traffic and transport assessment was to address the SEARs for the project's operation relevant to traffic and transport. The same methodology for the assessment used for the EIS was adopted for the traffic and transport assessment of the proposed design changes. Computer-based transport modelling based on a three-tiered modelling approach was used to assess changes in traffic as a result of the project. This included:

- A regional strategic model (CHSTM) used to forecast future traffic demand/growth and redistribution for the wider region with and without the project. There was no change to this model for the assessment of the proposed design changes
- A detailed project specific mesoscopic model (CHTM) using Aimsun Next (Aimsun) software to assess the future traffic performance with and without the project. This model was updated to include the proposed design changes for the project outlined in Section 2
- A detailed intersection model – microscopic simulation using Aimsun and detailed intersection assessment using the SIDRA Intersection program to determine operational demand of interchanges and performance of intersections. These models were updated to include the proposed design changes for the project outlined in Section 2.

3.2 Traffic volumes on the project

The design changes modelled in the CHTM have resulted in minor changes in the overall traffic volumes on the project over the design horizon, previously reported in Section 5.3 of the *Traffic and Transport Assessment* (Arup 2019).

3.2.1 EIS results

The forecast daily traffic volumes for the project report in the EIS showed that:

- The section of the project south of Coramba Road is expected to carry more vehicles than the northern section
- The proportion of heavy vehicles is expected to remain relatively static between 2024 and 2044 for both sections, with a slight increase on the northern section
- Overall traffic volumes on the project are anticipated to increase at a rate of approximately 1.0 per cent per annum from 2024 to 2044.

3.2.2 Design changes

The forecast daily traffic volumes for the amended design and the EIS design for the 2024, 2034 and 2044 design years are summarised in Table 1. These volumes reflect the redistribution of traffic demand to the project during its operational phase.

Table 1 Forecast daily weekday volumes (two-way) for the project (source: CHTM)

Location	Model	Two-way daily average volume [vpd (% HV)]		
		2024	2034	2044
Project, south of Coramba Road	Amended design	24,700 (13%)	27,800 (13%)	29,000 (14%)
	EIS design	23,400 (14%)	26,400 (14%)	27,900 (14%)
Project, north of Coramba Road	Amended design	19,700 (15%)	22,900 (14%)	24,200 (15%)
	EIS design	19,300 (15%)	22,300 (15%)	24,000 (16%)

The forecast traffic volumes for the amended design continue to demonstrate similar overall traffic patterns as reported in the EIS.

However, with the proposed design changes, daily traffic volumes are on the bypass are shown to increase when compared to the EIS design. This is primarily because of the proposed design changes at the Englands Road interchange where the two signalised intersections are replaced with a roundabout. This results in reduced travel times for traffic accessing the bypass compared to the EIS design and which increases the attractiveness of using the bypass.

The increased attractiveness associated with accessing the project at the southern end results in increased traffic volumes for the full length of the bypass when compared to the EIS design. The proposed design changes at the Korora Hill interchange will improve traffic flow and reduce delays for most movements, except for those motorists travelling from south of Korora Hill interchange and entering the project to travel southbound on the bypass. As such the overall increase in traffic demand on the bypass is slightly lessened on the northern section with some motorists travelling to/from the catchment located in the vicinity of Bray Street predicted to find it more attractive to access the project through the Coramba Road interchange instead of the Korora Hill interchange.

It should be noted that actual driver behaviour and route choice once the project is operational may be different to model predictions. As such, as part of environmental management measure TT11, a review of the operational network performance will be carried out to confirm impacts of the project on the surrounding road network.

3.3 Traffic impacts on the existing road network

The proposed design changes modelled in the CHTM have resulted in changes in the overall traffic impacts on the project over the design horizon when compared with results from the EIS, which were previously reported in Section 5.4 of the *Traffic and Transport Assessment* (Arup 2019).

3.3.1 EIS results

A comparison of traffic volumes with and without the project and changes to traffic patterns on existing roads was carried out for future traffic conditions and is presented in Section 5.4 of the *Traffic and Transport Assessment* (Arup 2019).

Once constructed, the project would redistribute traffic to the Coffs Harbour bypass from the north-south movements on the Pacific Highway and Hogbin Drive. Additionally, east-west movements on key local roads, including Coramba Road and Bray Street may be redistributed to the Coffs Harbour Bypass because of better traffic conditions along the new route.

Some of the key findings reported for the opening year (2024) conditions include:

- The project is expected to substantially decrease traffic volumes on the Pacific Highway south of Albany Street (just south of the CBD) by 12,600 vpd, which is a 40 per cent decrease
- The project is expected to substantially decrease traffic volumes on the Pacific Highway north of Orlando Street (just north of the CBD) by 10,000 vpd, which is a 23 per cent decrease
- The project is expected to substantially reduce traffic volumes on the Pacific Highway south of Bruxner Park Road by 9,200 vpd, which is a 24 per cent decrease
- The project is expected to increase traffic volumes on Englands Road between the bypass and the existing Pacific Highway by 1,600 vpd, which is an 18 per cent increase and is due to traffic using this short section of Englands Road to access the bypass
- The project is expected to increase traffic at the southern end of James Small Drive by around 1,900 vpd, which is a 48 per cent increase.

  It is noted however, that the EIS design model did not include the proposed pick-up / drop off bays and parallel parking spaces on the service road. Instead, all traffic was modelled to access the Kororo Public School via James Small Drive. This resulted in an overestimation of traffic demands on James Small Drive being reported in the EIS.

3.3.2 Amended design results

The comparison of predicted traffic volumes with and without the project, for both the EIS and the amended design is presented in Table 2.

Table 2 Forecast daily volumes (two-way)

Location	Model	2024 daily volumes			2034 daily volumes			2044 daily volumes		
		Without project	With project	Change	Without project	With project	Change	Without project	With project	Change
Project										
South of Coramba Road	Amended design	-	24,700	24,700	-	27,800	27,800	-	29,000	29,000
	EIS design		23,400	23,400		26,400	26,400		27,900	27,900
North of Coramba Road	Amended design	-	19,700	19,700	-	22,900	22,900	-	24,200	24,200
	EIS design		19,300	19,300		22,300	22,300		24,000	24,000
Existing Pacific Highway										
South of Englands Road	Amended design	34,700	38,100	3,400	37,400	42,800	5,400	40,400	45,600	5,200
	EIS design		38,600	3,900		43,100	5,700		45,800	5,400
South of Albany St (south of CBD)	Amended design	31,700	18,100	-13,600	33,300	19,500	-13,800	33,500	19,900	-13,600
	EIS design		19,100	-12,600		20,400	-12,900		20,600	-12,900
North of Orlando St (north of CBD)	Amended design	43,900	33,100	-10,800	47,300	35,100	-12,200	49,900	37,400	-12,500
	EIS design		33,900	-10,000		35,900	-11,400		38,000	-11,900
South of Bruxner Park Road	Amended design	38,000	32,800	-5,200	42,600	36,100	-6,500-	45,900	38,800	-7,100
	EIS design*		32,500*	-5,500		36,000*	6,600		39,200*	-6,700
Local and regional road network										
Hogbin Drive (north of Park Beach Road)	Amended design	9,300	6,700	-2,600	11,300	7,800	-3,500	10,000	8,000	-2,000
	EIS design		6,600	-2,700		7,800	-3,500		8,100	-1,900
Hogbin Drive (north of Harbour Drive)	Amended design	18,300	13,100	-5,200	19,500	14,000	-5,500	19,200	14,300	-4,900
	EIS design		13,100	-5,200		13,900	-5,600		14,300	-4,900

Location	Model	2024 daily volumes			2034 daily volumes			2044 daily volumes		
		Without project	With project	Change	Without project	With project	Change	Without project	With project	Change
Hogbin Dive (north of Stadium Drive)	Amended design	29,900	20,300	-9,600	32,700	20,800	-11,900	33,100	22,100	-11,000
	EIS design		20,700	-9,200		20,900	-11,800		22,500	-10,600
Stadium Drive (east of Pacific Highway)	Amended design	11,700	11,000	-700	12,800	12,200	-600	15,000	13,000	-2,000
	EIS design		10,700	-1,000		11,900	-900		12,700	-2,300
Englands Road (west of Pacific Highway)	Amended design	8,700	12,500	3,800	11,600	15,100	3,500	12,500	16,800	4,300
	EIS design		10,300	1,600		13,000	1,400		14,300	1,800
Isles Drive (west of Pacific Highway)[1]	Amended design	6,000	4,100	-1,900	6,100	4,600	-1,500	6,500	4,300	-2,200
	EIS design		5,000	-1,000		5,500	-600		5,400	-1,100
Bray Street (east of Joyce Street)	Amended design	9,800	7,500	-2,300	10,500	7,600	-2,900	11,300	7,700	-3,600
	EIS design		7,400	-2,400		7,300	-3,200		7,500	-3,800
Coramba Road (Robin Street to Shephards Lane)	Amended design	11,300	9,600	-1,700	12,000	10,100	-1,900	12,700	10,900	-1,800
	EIS design		9,500	-1,800		10,000	-2,000		10,700	-2,000
Coramba Road (Shephards Lane to Bypass)	Amended design	8,300	9,400	1,100	8,600	10,200	1,600	9,000	11,000	2,000
	EIS design		8,900	600		9,600	1,000		10,500	1,500
Coramba Road (west of Bypass)	Amended design	6,800	6,700	-100	7,000	7,000	-	7,100	7,000	-100
	EIS design		6,800	-		7,000	-		7,100	-
Bennetts Road (west of Coramba Road)	Amended design	400	400	-	500	500	-	500	500	-
	EIS design		400	-		500	-		500	-
James Small Drive south (east of Pacific Highway)	Amended design	4,000	3,600	-400	4,200	3,900	-300	5,100	4,700	-400
	EIS design		5,900	1,900		6,200	2,000		7,500	2,400

[1] Noted that daily traffic volumes on Isles Drive not previously reported in the EIS.

Location	Model	2024 daily volumes			2034 daily volumes			2044 daily volumes		
		Without project	With project	Change	Without project	With project	Change	Without project	With project	Change
Bruxner Park Road (west of Pacific Highway)	Amended Design	1,200	1,200	-	1,600	1,600	-	1,800	1,800	-
	EIS Design		1,200	-		1,600	-		1,800	-

* The traffic volumes outputs previously reported in the EIS for the Existing Pacific Highway south of Bruxner Park Road had values of 28,800 vpd, 31,500 vpd and 34,500 vpd for the With Project scenario at 2024, 2034 and 2044 respectively. These previous volumes were incorrect as they did not include southbound traffic volumes from Bruxner Park Road and from the bypass northbound at this location. These values have been updated in the above table to ensure all two-way volumes south of the interchange are being reported.

Traffic impacts of the amended design

Daily traffic volumes for the amended design are predicted to decrease in comparison to the 'without project' case volumes at the locations listed below. These findings are consistent with the EIS design.

- Pacific Highway between Englands Road and Bruxner Park Road
- Hogbin Drive
- Stadium Drive
- Isles Drive
- Bray Street
- Coramba Road east of Shephards Lane.

Isles Drive was not previously reported in the EIS. As shown in Table 2, traffic volumes on Isles Drive (west of the Pacific Highway) are predicted to decrease with the introduction of the bypass. This is anticipated to be because of a reduction in the number of vehicles that previously used Isles Drive to travel between Englands Road and the Pacific Highway and a diversion of traffic accessing Isles Drive from the bypass instead of the existing Pacific Highway.

Localised increases in daily traffic volumes at the Pacific Highway (south of Englands Road), Englands Road and Coramba Road (west of Shephards Lane) are predicted. This is consistent with the EIS and reflects a shift in traffic routes associated with access to the new bypass.

Daily traffic volumes 'without project' and 'with project' with the amended design for 2024 are presented in Figure 6.

Changes in traffic impacts on the existing road network compared with the EIS

The predicted daily traffic volumes for the amended design are generally similar to the EIS design with small differences across the network caused by changes in the level of delay experienced at the Englands Road and Korora Hill interchanges. However, some areas of the network are predicted to experience traffic volumes greater changes than 5% compared to the EIS design and these are discussed further below.

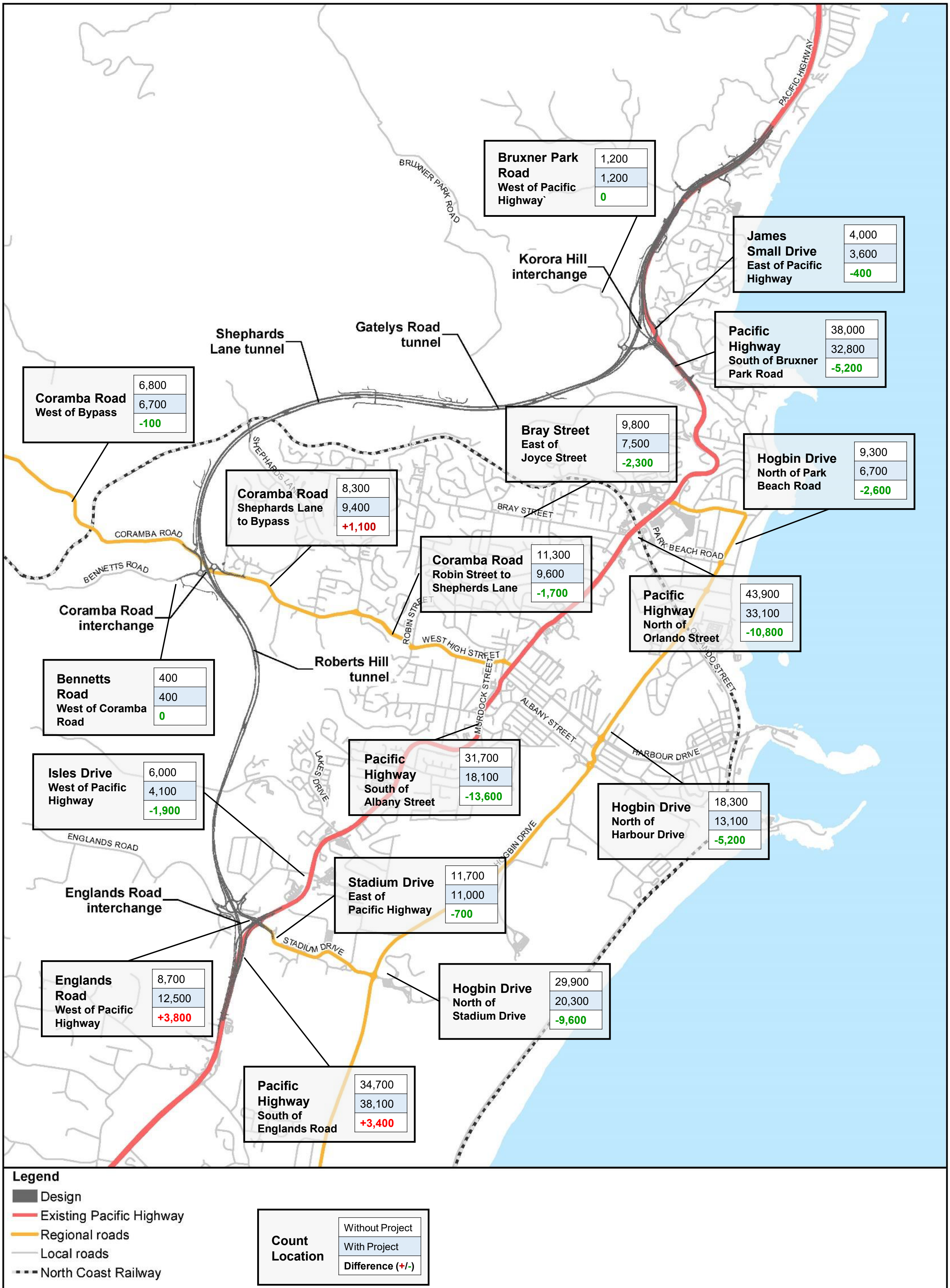
The proposed design changes improve access to Isles Drive from the Englands Road interchange. With this improved access, analysis was undertaken to identify whether Isles Drive would be used by motorists rather than the Pacific Highway, particularly when accessing the Coffs Harbour Health District. The assessment demonstrates that while this may be an attractive route during the morning peak period, the proposed design changes result in an overall reduction of daily trips on Isles Drive when compared to the EIS. The proposed design changes decrease delays for traffic travelling through the interchange, reducing the attractiveness of Isles Drive as an alternative route to the existing Pacific Highway.

It should be noted that actual driver behaviour and route choice during operation may be different to model predictions. As such, as part of environmental management measure TT11 a review of the operational network performance will be carried out to confirm impacts of the project on the surrounding road network.

The proposed design changes at the Englands Road interchange result in reduced travel time to access the bypass because of the replacement of two signalised intersections with a single large roundabout. The amended design also provides right-turn access into Isles Drive from Englands Road, which wasn't available in the EIS design. These changes mean the predicted volumes on Englands Road between the bypass and the existing Pacific Highway would increase by an additional 2,200 vpd (up to 3,800 vpd), when compared to the EIS results. This section of Englands Road is only about 200 metres in length and the interchange has been designed to accommodate this increase in traffic volume in the amended design.

Predicted traffic volumes on Coramba Road between Shephards Lane and the project have increased by 600 vehicles per day to a total increase of 1100 vehicles per day, compared with an increase of 500 vehicles per day reported in the EIS. As discussed in Section 3.2.2, the proposed design changes at the Korora Hill interchange will improve traffic flow and reduce delays for most movements, excepting those motorists entering the project southbound from the Pacific Highway south of the interchange. As such the overall increase in traffic demand on the bypass is slightly lessened on the northern section. Some motorists travelling to/from the catchment located near Bray Street are predicted to find it more attractive to access the project through the Coramba Road interchange instead of the Korora Hill interchange. This results in the predicted further increase in traffic volumes on Coramba Road between Shephards Lane and the project.

Traffic volumes on the southern section of James Small Drive are shown in Table 2 to reduce in comparison to the EIS design. As previously detailed in Section 3.3.1, the EIS overestimated the increase of traffic demands at the southern end of James Small Drive. This was because the EIS model did not include the proposed parking and pick-up / drop off opportunities on the service road and instead modelled all traffic accessing Kororo Public School via James Small Drive. The amended design model has been corrected to ensure traffic accessing the Kororo Public School can do so by either James Small Drive or the service road. As such, the revised modelling approach combined with the improvements associated with the amended design results in a reported decrease of 2,300 vpd at the southern end of James Small Drive when compared to the EIS.



Coffs Harbour Bypass
Traffic impacts on existing road network in 2024 for the amended design
Figure 6

3.4 Network performance

The proposed design changes modelled in the CHTM have resulted in minor changes in the overall network performance of the study area with and without the project over the design horizon, previously reported in Section 5.5 of the *Traffic and Transport Assessment* (Arup 2019).

3.4.1 EIS results

The CHTM was used to assess the impact of the project on the overall performance of the road network. Road network performance was measured with reference to:

- Total travel time: measure of the total travel time of all vehicles on the network during the modelled peak periods
- Total distance travelled: measure of the total distance travelled by all vehicles in the network during the modelled peak periods
- Average speed: recorded for all traffic in the network over the modelled peak periods
- Travel time savings for traffic going through Coffs Harbour on the Pacific Highway.

The network-wide performance statistics indicated that the project would have the following impacts:

- An increase in network-wide average travel speeds by 18 per cent at 2044 for all vehicles. This is expected because of the 110 km/h posted speed on the bypass, and the reduction of traffic congestion along routes through Coffs Harbour
- Heavy vehicles gain a larger overall increase in average speed as these vehicles mainly use the highway network and therefore gain a larger overall benefit per vehicle once shifted to the free-flow bypass. This is reflected in the results by the considerable increase in network-wide average travel speeds of 42 per cent to 58 per cent at 2044 for heavy vehicles
- The without project predictions show that average travel times along the existing Pacific Highway were expected to increase from around 21 minutes in 2024 to 29 minutes by 2044 during the morning peak
- By 2044, travel time savings of up to 20 minutes when travelling southbound along the Pacific Highway during the morning peak period were expected compared to without project. This travel time saving reflected the higher posted speed limit and free-flow conditions of the project
- The results also demonstrated little change in travel times between the opening year (2024) and the 20-year design horizon (2044) indicating that the project will operate with free-flow conditions (ie without congestion) over the entire design duration.

3.4.2 Design changes results

The network performance with and without the project based on the amended design modelled has resulted in changes to the predicted network wide total travel time, distance travelled and average speeds over the design horizon.

Total network travel time

The predicted network wide change in total travel time is presented in Table 3 for both the amended design and EIS design.

Table 3 Predicted network wide change in total travel time

Scenario	Model	Total travel time (hours)					
		2024 AM	PM	2034 AM	PM	2044 AM	PM
Without project	Base	3,427	3,116	4,008	3,659	4,607	4,152
With project	Amended design	2,981	2,747	3,205	3,102	3,503	3,273
	EIS design	2,995	2,794	3,240	3,141	3,554	3,336
Difference	Amended design	-446	-370	-804	-557	-1104	-879
	EIS design	-432	-322	-768	-518	-1053	-816
Travel time savings (hours per day)*	Amended design	-4,479		-7,472		-10,885	
	EIS design	-4,142		-7,059		-10,262	

* The total travel time savings per day are calculated by taking the difference between the base case and project case and converting the morning and afternoon peak hour total (extracted from the CHTM) to a daily equivalent using expansion factors determined using the strategic model (CHSTM) outputs.

The results demonstrate that the project with the proposed design changes will continue to result in significant network wide improvements in total travel time. Across each of the modelled years, the proposed amended design demonstrates greater daily travel time savings than that reported for the EIS model. As discussed in Section 3.2.2 this is because of improved attractiveness of the bypass because of reduced delays at the Englands Road interchange. By improving the attractiveness of the bypass, demands and delays on the existing Pacific Highway are further reduced.

Total network distance travelled

The total distance travelled predicted for each design year during the morning and afternoon peak hours is presented in Table 4 for both the amended design and EIS design.

Table 4 Predicted network wide change in total distance travelled

Scenario	Model	Total distance travelled (km)					
		2024 AM	PM	2034 AM	PM	2044 AM	PM
Without project	Base	141,665	136,461	152,709	151,250	160,679	159,041

Scenario	Model	Total distance travelled (km)					
		2024		2034		2044	
		AM	PM	AM	PM	AM	PM
With project	Amended design	150,487	142,631	163,925	159,756	175,925	168,998
	EIS design	150,333	142,804	163,758	159,831	176,030	169,310
Difference	Amended design	8,822	6,170	11,216	8,505	15,246	9,957
	EIS design	8,667	6,343	11,049	8,581	15,351	10,269
Change in distance travelled (km per day)*	Amended design	76,158		100,183		128,031	
	EIS design	76,253		99,722		130,150	

* The total change in distance travelled has been calculated by converting morning and afternoon peak hour totals (extracted from the CHTM) to a daily equivalent by using expansion factors determined using the strategic model (CHSTM) outputs.

The results demonstrate that the total network distance travelled for the amended design is consistent with the EIS findings where the introduction of the bypass will result in increased distances travelled on the modelled road network. This is because of the bypass providing a longer but faster alternative to travelling on the existing Pacific Highway through Coffs Harbour.

Average network speed

The average network speed results for the amended design and the EIS design are presented in Table 5 for the 2024, 2034 and 2044 design years during the morning and afternoon peak periods.

Table 5 Predicted network wide change in average speed

Scenario	Vehicle type	Model	Average speed (km/h)					
			2024		2034		2044	
			AM	PM	AM	PM	AM	PM
Without project	All	Base	41	42	40	41	38	39
	Heavy	Base	46	48	43	46	43	45
With project	All	Amended design	46	47	46	47	46	47
		EIS design	46	47	46	46	45	46
	Heavy	Amended design	59	69	58	72	62	72
		EIS design	59	69	57	71	61	71
Difference	All	Amended design	**5**	**5**	**7**	**6**	**8**	**8**
		EIS design	**5**	**5**	**6**	**5**	**7**	**7**
	Heavy	Amended design	**13**	**21**	**15**	**26**	**19**	**27**
		EIS design	**13**	**21**	**14**	**25**	**18**	**26**

The results demonstrate the project with the proposed design changes will continue to result in significant network wide improvements in average travel speeds, consistent with the results from the EIS design. There are some minor improvements for the amended design model compared to the EIS design model. This is because of increased traffic volumes using the bypass resulting from improved attractiveness of the bypass with the proposed design changes.

Travel time for through traffic

Table 6 presents the travel time savings for traffic going through Coffs Harbour calculated from the updated CHTM for the amended design and the EIS design.

Table 6 Predicted travel time for vehicles passing through Coffs Harbour

Scenario	Direction	Model	Travel times (minutes)					
			2024 AM	PM	2034 AM	PM	2044 AM	PM
Without project	Southbound	Base	21.0	19.3	20.7	20.7	29.2	21.8
	Northbound		19.6	19.6	20.5	21.4	20.4	23.7
With project	Southbound	Amended design	8.5	8.5	8.5	8.6	8.6	8.6
		EIS design	8.5	8.6	8.6	8.6	8.6	8.6
	Northbound	Amended design	8.3	8.4	8.3	8.5	8.4	8.5
		EIS design	8.3	8.4	8.4	8.5	8.4	8.5
Travel time savings	Southbound	Amended design	12.5	10.8	12.2	12.1	20.6	13.2
		EIS design	12.5	10.7	12.1	12.1	20.6	13.2
	Northbound	Amended design	11.3	11.2	12.2	12.9	12.0	15.2
		EIS design	11.3	11.2	12.1	12.9	11.9	15.2

As per the EIS, the travel time savings for road users travelling through Coffs Harbour continue to be significant with the introduction of the project, with travel time savings reflecting the higher posted speed limit and free-flow conditions of the project.

When compared to the EIS, the predicted travel time results from the CHTM for the amended design changes are essentially the same with some values changing slightly.

VEHSIM travel time assessment

As part of the amended design, the vertical alignment of the bypass has been lowered through the North Boambee Valley floodplain and through the Englands Road interchange. The proposed changes to the vertical alignment of the project were assessed by ARRB, on behalf of TfNSW, in terms of travel time for both light and heavy vehicles separately. Overall, the assessment carried out by ARRB demonstrated travel time savings of up to 20 to 35 seconds for heavy vehicles for the amended design when compared to the EIS design, with no significant change for light vehicles.

3.5 Intersection performance

The proposed design changes modelled in the CHTM have resulted in minor improvements to intersection performance of the study area with the project over the design horizon, previously reported in Section 5.6 of the *Traffic and Transport Assessment* (Arup 2019).

3.5.1 EIS results

Interchanges and intersections were designed to provide a minimum level of service (LOS) C in accordance with the Pacific Highway Upgrade Guidelines. At LOS C, the operation, speed and flows are still considered stable, however conditions are becoming critical with motorists anticipated to expect some tension on the road.

The method for determining the critical level of service for intersections is dependent on the type of intersection control:

- For signalised intersections, the critical level of service is equal to level of service averaged over all movements
- For roundabouts and priority-controlled intersections, the critical level of service is as per the worst turning movement at the intersection.

A summary of the 2044 interchange and intersection performance results are provided in Table 7.

Based on the EIS modelled layout, the analysis demonstrated the proposed project intersection arrangements at each interchange and along the service road would meet the traffic and transport objectives for the project and the intersections would operate at an acceptable level of service over the 20-year design horizon.

As shown in Table 7, the Pacific Highway / Charlesworth Bay Road intersection (not previously reported in the EIS report), was predicted to operate above acceptable limits during the 2044 design year with LOS F. This was because of the delays incurred by vehicles egressing Charlesworth Bay Road and turning right into Charlesworth Bay Road from Pacific Highway (south).

Table 7 Summary of 2044 intersection level of service (LOS)

Intersection	Model	Control	Overall LOS		Worst Movement LOS^		Critical LOS
			AM	PM	AM	PM	
Englands Road Interchange							
Englands Road / Isles Drive / Bypass	Amended design	Roundabout	B	B	B	B	B
Englands Road / Bypass Southbound Off-Ramp	EIS design	Signals	A	B	B	B	B
Isles Drive / Bypass Southbound Off-Ramp	EIS design	Priority	A	A	A	A	A
Englands Road / Bypass On-Ramp / Property Access Road	EIS design	Signals	A	B	D	D	B
Pacific Highway / Englands Rd / Stadium Drive	Amended design	Signals	C	C	D	F	C
	EIS design	Signals	C	C	D	D	C
Pacific Highway / Isles Drive	Amended design	Signals	C	B	F	D	C
	EIS design	Signals	D	C	F	E	D
Coramba Road Interchange							
Coramba Road (east) roundabout	Amended design	Roundabout	A	A	B	A	B
	EIS design	Roundabout	A	A	B	A	B
Coramba Road (west) roundabout	Amended design	Roundabout	A	A	A	A	A
	EIS design	Roundabout	A	A	A	A	A
Coramba Road NW priority	Amended design	Priority	-	-	A	A	A
	EIS design	Priority	-	-	A	A	A
Korora Hill Interchange							
Korora Hill (west) roundabout	Amended design	Roundabout	C	C	C	C	C
Service Road roundabout	Amended design	Roundabout	B	A	B	A	B
Service Road / James Small Drive (south)	Amended design	Priority	-	-	C	A	C
Korora Hill (west) signals	EIS design	Signals	B	B	D	E	B
Korora Hill (east) signals	EIS design	Signals	A	B	D	E	B
James Small Drive roundabout	EIS design	Roundabout	A	A	B	B	B

Intersection	Model	Control	Overall LOS		Worst Movement LOS^		Critical LOS
			AM	PM	AM	PM	
Pacific Highway / Charlesworth Bay Road**	Amended design	Signals	A	A	F	E	A
	EIS design	Priority	-	-	F	F	F
Service Road							
Service Road / James Small Drive North	Amended design	Roundabout	A	A	A	A	A
	EIS design	Roundabout	-	-	A	A	A
Service Road / Opal Boulevard	Amended design	Priority	-	-	B	A	B
	EIS design	Priority	-	-	A	A	B*
Service Road / Seaview Close	Amended design	Priority	-	-	A	A	A
	EIS design	Priority	-	-	A	A	A
Service Road / Underpass	Amended design	Priority	-	-	A	A	A
	EIS design	Priority	-	-	A	A	A
Service Road / Solitary Island Way	Amended design	Priority	-	-	A	A	A
	EIS design	Priority	-	-	A	A	A

* Value incorrectly reported in the *Traffic and Transport Assessment* (Arup 2019) as LOS A

** Noted that intersection performance of the priority-controlled Pacific Highway / Charlesworth Bay Road not previously reported in the EIS

^ The intersection analysis considers every movement at an intersection and assigns a level of service to each movement (e.g. southbound through movement). The worst movement level of service is the level of service for the movement with the lowest level of service.

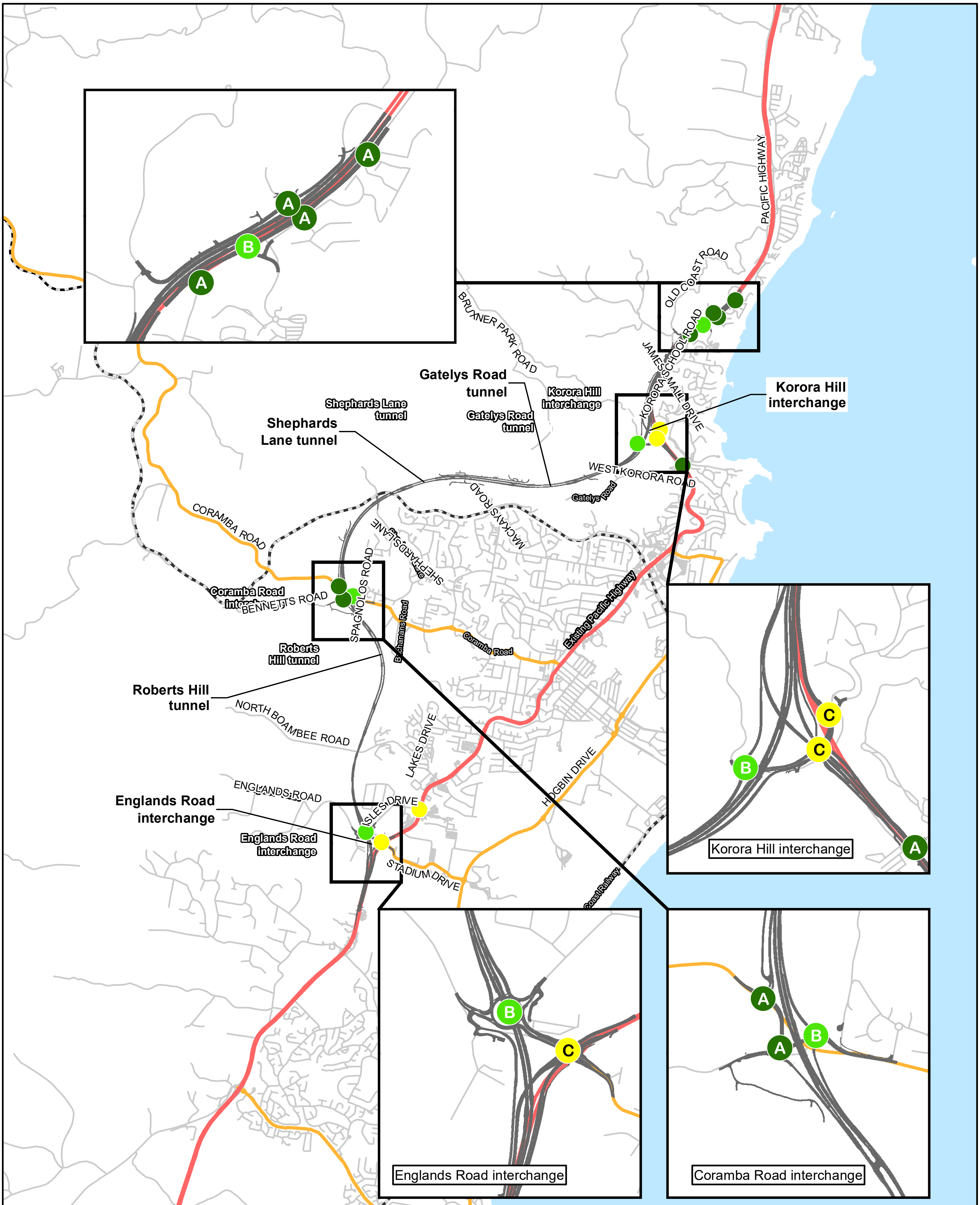
3.5.2 Amended design results

An assessment of the project's intersection operational performance was completed considering predicted traffic redistribution because of the project. The arrangement of each of the amended design interchanges modelled is described in Section 2.

The project will continue to remove all existing at-grade intersections along the Pacific Highway between the Korora Hill and Sapphire interchanges, with roads that currently connect directly to the Pacific Highway instead being connected onto a service road that runs parallel to the highway.

A full summary of the amended design 2044 traffic analysis results is shown in Table 7, Figure 7 and the amended / new intersection performance results are summarised below:

- The Englands Road interchange would continue to operate within acceptable limits with a critical level of service of B at the proposed roundabout
- Improved operation at the Pacific Highway / Isles Drive intersection as compared to the EIS reflecting the reduced demands on both the Pacific Highway and Isles Drive with the proposed design changes (as shown in Table 2).
- The amended design includes proposed design changes to the intersection control and approach arrangements at the Korora Hill interchange. The resulting design however has been demonstrated to continue to operate within acceptable limits with the eastern roundabout operating at level of service C, and the western roundabout operating at level of service B. Additionally, the James Small Drive (south) / service road roundabout is anticipated to operate at level of service C (i.e. within acceptable limits of operation over the design horizon)
- The signalised Pacific Highway / Charlesworth Bay Road intersection is anticipated to operate with a critical level of service of A at 2044. By upgrading to signalised control (previously remaining priority-controlled with the EIS design), all movements are controlled, thus improving the overall operation of the intersection. As discussed previously, the minor movements opposing the through traffic on the Pacific Highway were incurring significant delays resulting in a LOS F with the EIS design.
- The service road / Opal Boulevard Road intersection is anticipated to continue to operate at level of service B at 2044. This was incorrectly reported in the *Traffic and Transport Assessment* (Arup 2019) to be operating at level of service A (rather than level of service B) with the project and as such no change in the modelling results of this intersection are expected with the proposed design changes.



Legend

- Design
- Existing Pacific Highway
- Regional roads
- Local roads
- North Coast Railway

Critical level of service

- A
- B
- C

0 0.75 1.5 2.25 km
N
Scale @A4: 1:74,367
GDA 1994 MGA Zone 56

Coffs Harbour Bypass
Intersection performance for amended design
Figure 7

3.6 Road safety

3.6.1 EIS design

There are various elements of the project, as documented in the Section 5.7 of the *Traffic and Transport Assessment* (Arup 2019), which would have a positive impact on road safety. These road safety improvements include:

- Reduction of traffic volumes on the Pacific Highway resulting in a decrease in rear-end type crashes
- Removal of at-grade intersections along the Pacific Highway and introduction of grade-separated interchanges
- Upgrading the Pacific Highway / Englands Road roundabout to a signalised intersection to aid with congestion and minimising rollover incidents at the intersection
- Removal of the school bus interchange from the Pacific Highway.

Changes to the road environment as a result of the EIS design that would potentially have an adverse impact on road safety for some users, including the proposed Kororo Public School bus interchange layout and its potential for conflict between users; and the localised marginal increase in traffic volumes on Coramba Road on approach to the bypass potentially increasing the exposure rate for the opportunity of crashes to occur.

3.6.2 Design changes

The road safety benefits arising from the introduction of the EIS design will continue to be evident for the amended design. With the proposed design changes, additional road safety improvements are anticipated including:

- Improve the safety of the school bus stop by increasing the space between the bus stop and the proposed roundabout on Coramba Road, east of the project
- By upgrading the Pacific Highway / Charlesworth Bay Road intersection to signalised control, motorists entering / exiting Charlesworth Bay Road have dedicated phases and are no longer required to wait for a gap in the Pacific Highway stream of traffic. This reduces delays significantly for these turning movements, and minimises likelihood of conflict between through and turning traffic
- The provision of traffic lights at the intersection of the existing Pacific Highway and Charlesworth Bay Road allows for the provision of signalised pedestrian/cycle crossings of the existing Pacific Highway, improving road safety for pedestrian and cyclists crossing the existing highway
- The design changes of the proposed Kororo Public School bus interchange separate bus and private vehicle movements. Parking manoeuvres are now separated from bus movements. This separation between users improves the operational safety of the facility as compared to the EIS design

- The proposed design changes at the Kororo Public School bus interchange relocates access to the interchange from James Small Drive to the service road. This design change minimises the need for buses to use James Small Drive, therefore reducing the risk of bus-to-passenger vehicle conflicts occurring on James Small Drive when compared to the EIS design
- The proposed design changes at the Kororo Public School bus interchange include provision of a pedestrian underpass to allow grade separated access to the school from the new car park (refer to Figure 5 for the location of the underpass). This separates vulnerable road users from bus and passenger car movements removing the risk of vehicle / pedestrian conflict at this location
- The proposed design changes incorporate the formalisation and provision of 24 off-street car park spaces provided on the western property access road near the existing Solitary Rural Fire Services shed. By providing a sealed and line-marked car park, vehicle manoeuvres are more predictable as they enter / exit the parking area and each individual space. This minimises the risk of vehicle-vehicle low speed collisions in this area
- Pedestrian access to the car park on the western property access road is to be provided along the full length of the property access road to Old Coast Road, and between the car park and Luke Bowen footbridge. The path provides pedestrians a designated place in the road corridor, separated from vehicles. This predictability of movements and separation from vehicles, minimises the risk of vulnerable road users being struck by vehicles. Additionally, the provision of a new formalised path should minimise the risk of slips, trips and falls for pedestrians as they access the Kororo Public School.

There may be changes in some localised road safety impacts as a result of the amended design, as detailed below:

- The pedestrian underpass proposed as part of the Kororo Public School bus interchange may result in personal safety concerns. A CPTED analysis to address this is detailed in the Supplementary Urban Design, Landscape Character and Visual Impact Assessment Report (Arup 2020) and TfNSW will continue to consult with Kororo Public School during detailed design.

3.7 Crash assessment

The existing Pacific Highway through Coffs Harbour is subject to a large number of crashes with 259 recorded over the period from 2014 to 2018. The locations of each of these recorded crashes are presented in Figure 8.

Coffs Harbour Bypass
Road crash data on the existing Pacific Highway (2014-2018)
Figure 8

3.7.1 EIS design

As part of the EIS, an assessment was carried out to forecast the potential reduction in crashes on the Pacific Highway resulting from the operation of the project. The assessment was reported in Section 5.7.1 of the *Traffic and Transport Assessment* (Arup 2019) and included analysis of the existing Pacific Highway and the main project alignment.

The assessment analysed the existing Pacific Highway in three segments:

- Segment 1: Pacific Highway between the bypass interchange at Korora Hill and the northern tie-in at Sapphire
- Segment 2: Pacific Highway from (and including) the Englands Road interchange to Korora Hill interchange
- Segment 3: Pacific Highway between Englands Road and the southern tie-in at Boambee.

The EIS crash rate analysis demonstrated:

- The section of the Pacific Highway north of Englands Road (Segment 2) has a crash rate (without the project) of 39 per 100 million vehicle kilometres travelled (mvkt). With the project, the crash rate remains the same, however the total number of crashes would be less because of the decrease in traffic volumes on the link
- The section of the Pacific Highway north of Korora Hill (Segment 1) has an existing crash rate (without the project) of 18.3 per 100 mvkt. With the project, the crash rate is predicted to reduce to 12.5 per 100 mvkt
- It is predicted the proposed bypass would demonstrate a crash rate of 12.5 per 100 mvkt, which is consistent with expectations for new highways constructed to a motorway standard
- The introduction of the bypass results in a reduction of 14 crashes on the Pacific Highway
- The analysis demonstrates that although a reduction of two crashes is forecast at 2044, the project attracts an additional 11,281 vpd to the road network assessed (ie Segments 1, 2 and 3 of the Pacific Highway and the project) because of a redistribution of traffic from key local roads to the project ie north-south movements on Hogbin Drive and east-west movements on Stadium Drive and Bray Street.

3.7.2 Design changes

The predicted reduction in the number of crashes for the amended project in comparison to the without project scenario is summarised in Table 8.

Table 8 Comparison of predicted crashes for the with and without project scenarios

Road element	Number of crashes in 2024			Number of crashes in 2044		
	Without project	With amended project	Change	Without project	With amended project	Change
Segment 1	6	4	-2	7	4	-3
Segment 2	49	36	-13	53	40	-13
Segment 3	2	2	0	2	2	0
Bypass	-	10	10	0	12	12
Total	**57**	**52**	**-5**	**62**	**58**	**-4**

The revised crash rate analysis demonstrated a reduction of 16 crashes on the Pacific Highway (Segments 1, 2 and 3) in year 2044, compared to a reduction of 14 reported in the EIS. Overall, it the assessment demonstrated a reduction of four crashes (previously a reduction of two crashes in the EIS reporting) forecast at 2044. The change in relation to the EIS design is due to a reduction in traffic volumes on the existing Pacific Highway.

Coramba Road

Crash assessment has been undertaken for Coramba Road based on historic 2014 to 2018 crash history data sourced from the Centre for Road Safety, NSW Government. The crash locations for the five year period between 2014 and 2018 are shown in Figure 9 analysis demonstrates the following:

- West of the project, 16 crashes were recorded between 2014 and 2018. The resulting crash rate for this section of Coramba Road is 40.4 crashes per 100 million vehicle kilometres travelled (mkvt). The proposed design changes are anticipated to result in negligible difference in daily volumes along this portion of Coramba Road. As such, when compared to the EIS, it is expected that there would be no change in the predicted number of crashes
- Between the project and Shephards Lane, a total of three crashes were recorded between 2014 and 2018. Of these, one of those crashes is within the construction footprint at the intersection of Bennetts Road and Coramba Road, which would be upgraded as part of the project
- The proposed design changes are anticipated to result in a localised increase in traffic volumes on Coramba Road of 500 vehicles per day. Given the low crash history in this section of Coramba Road, the existing crash rate at this location is 12.6 crashes per 100mvkm. The predicted increase in demands therefore result in less than 0.1 increase to the anticipated number of crashes on Coramba Road between Shephards Land and the project
- East of Shephards Lane, a total of 16 crashes were recorded between 2014 and 2018. Within this section of Coramba Road, daily traffic demands are predicted to increase by 100 and 200 vehicles per day at the 2024 and 2044 design years respectively. Given the existing crash rate on this section of Coramba Road, the minor increase in demands results in less than 0.1 increase at 2044 as compared to the EIS.

Based on the existing crash rates on Coramba Road, the analysis demonstrates less than a 0.1 increase in the number of crashes on Coramba Road is anticipated as a result of the proposed design changes and the associated shifts in traffic demand. As shown, the predicted localised increase in traffic volumes on Coramba Road to the east of the project, does not result in a significant increase in the predicted number of crashes, given that the increased traffic volumes occur on the section of Coramba Road with a low crash history.

3.8 Public transport

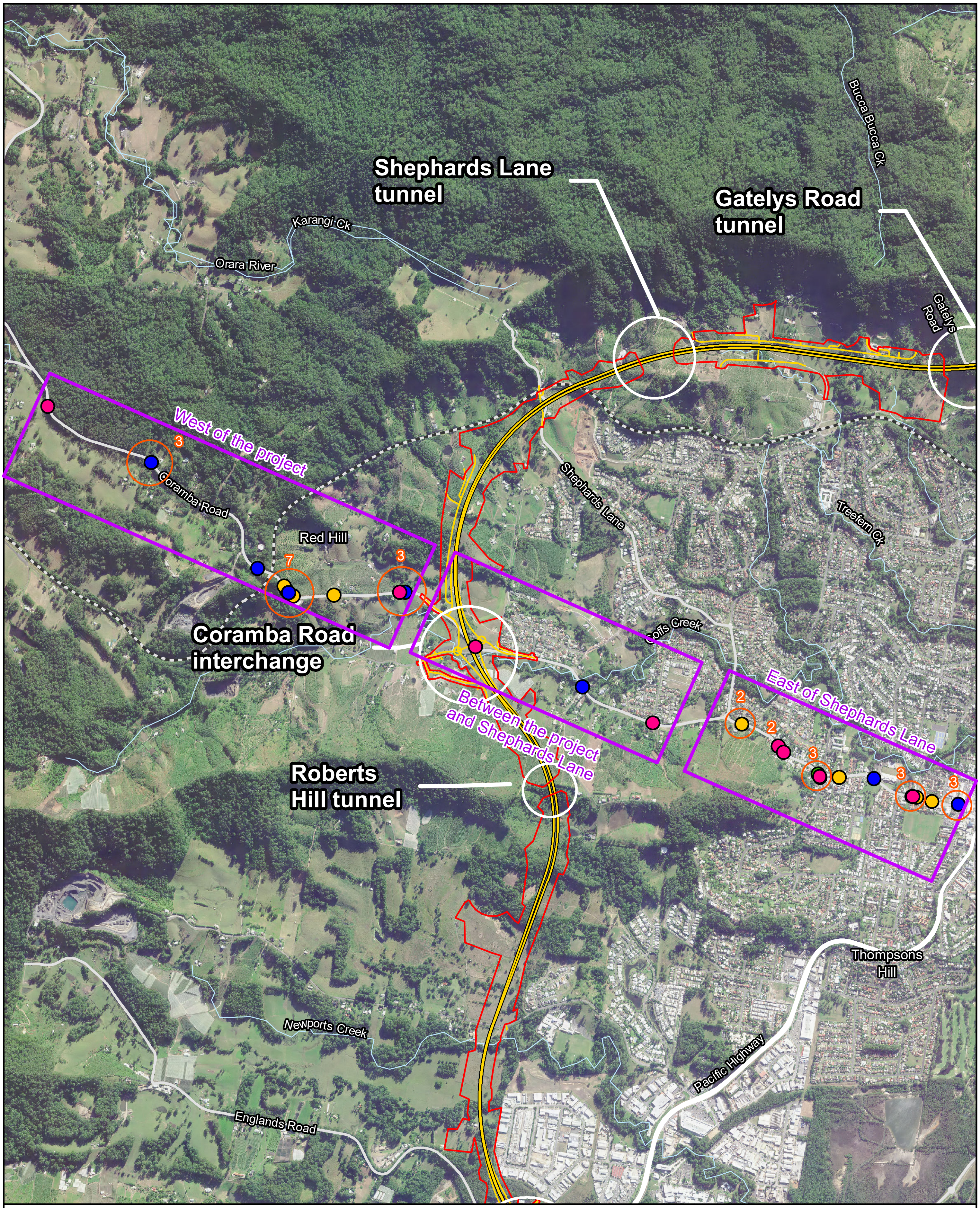
The proposed design changes for the Coramba Road school bus stop and the Kororo Public School bus interchange are expected to improve the school bus facilities when compared with the EIS design.

The proposed design changes to the school bus stop on Coramba Road near Spagnolos Road are anticipated to:

- Increase the capacity of the proposed school bus stop to enable four buses to stop at one time, to meet the expected peak demand for buses using the Coramba Road school bus stop.

The proposed design changes to the Kororo Public School bus interchange are anticipated to:

- Provide access to the bus interchange from the service road instead of James Small Drive, avoiding the need for buses to travel on the narrower James Small Drive to access the bus interchange
- Provide greater separation between buses and passenger vehicles using the bus interchange
- Allow all buses to line up nose-to-tail at one location when students are interchanging. Previously, in the EIS design the bus set down and layover areas were separated into three different locations. This design change minimises walking distance for students when interchanging and minimises the risk of students ‘cutting’ through the staff car park to reach their bus. This therefore reduces the likelihood of pedestrian-vehicle collisions within the facility
- Physically restrict students accessing the bus interchange area directly from the kiss and drop zone via the internal car park road network. By installing a separating fence between these two facilities, students are instead directed to travel via the grade-separated underpass and follow the designated footpath to reach the bus interchange. By restricting this direct pedestrian access and instead directing users to separated facilities off-road, the risk of students being struck by vehicles is limited
- Minimise the impact to travel time for buses compared with the EIS due to access now being provided on the eastern service road rather than James Small Drive.



Legend

- Construction footprint
- Alignment
- North Coast Railway
- Watercourse
- Non-casualty
- Minor/Other Injury
- Moderate Injury
- Serious Injury
- 2 Number of crashes in group
- Group of crashes

Coffs Harbour Bypass
Crash locations – Coramba Road (2014-2018) Source: Centre for Road Safety, NSW Government
Figure 9

0 0.3 0.6 0.9 km
Scale @A4: 1:30,000
GDA 1994 MGA Zone 56
N

3.9 Pedestrians and cyclists

The proposed design changes are anticipated to result in the following improvements to the local pedestrian and cycle network, when compared with the EIS design:

- Introduction of a formalised shared path linking Spagnolos Road to the proposed Coramba Road school bus stop
- Improved safety for pedestrians and cyclists crossing the Pacific Highway at Charlesworth Drive with the introduction of signals at this intersection and subsequent signalised and protected crosswalks
- Reduce travel distance from the Luke Bowen footbridge to the entrance of the Kororo Public School
- Provide improved connectivity between the Luke Bowen footbridge, the Kororo Public School and the bus interchange
- Improve pedestrian connectivity and safety from Old Coast Road to the Kororo Public School, through provision of an off-road footpath along the length of the local access road located on the west side of the project to the Luke Bowen footbridge
- Provide grade-separated access from the bus interchange car park to Kororo Public School through introduction of an underpass. However, it is noted that based on the current design, the use of stairs may inhibit access for parents with prams.
- Off-road shared pathways are to be provided for people who ride at the roundabouts proposed at the Englands Road and Korora Hill interchanges. Refuge areas would be provided on roundabout approaches, to ensure cyclists are only required to cross one to two lanes of traffic at a time. The location of the crossing points on approach to the intersections would ensure vehicle speeds are minimised (as compared to the high speeds on the bypass) as drivers would either be turning into or out of the roundabout.

3.10 Property access

3.10.1 EIS design

Existing property accesses impacted by the project would be reinstated in consultation with affected landowners.

.In addition to property accesses, the existing access from the Solitary Rural Fire Services shed to the Pacific Highway via Old Coast Road would be affected by the project. Consultation with the Solitary Rural Fire Service will be undertaken during detailed design to ensure the revised access arrangements during and after construction would be appropriate.

3.10.2 Design changes

As per the EIS design, existing property accesses impacted by the project would be reinstated in consultation with affected landowners.

In addition to property accesses, the location of the Solitary RFS shed on Old Coast Road would be affected by the proposed design changes, as the existing shed would be directly impacted to accommodate the additional car park spaces and the new footbridge location. Consultation with RFS Mid North Coast Team about the design changes and impact to the existing shed has been ongoing since the exhibition of EIS. During this consultation, a location near Korora Hill interchange for a new shed and facilities on TfNSW owned property has been identified (within construction ancillary facility site 3B). The new shed and facilities are proposed to be constructed as part of the project. TfNSW will continue to consult with RFS Mid North Coast Team to confirm any additional requirements

3.11 Parking

3.11.1 EIS design

The EIS design was anticipated result in the removal of some informal parking on Isles Drive near Englands Road and at the corner of Coramba Road and Spagnolos Road[2].

Additionally, at the Kororo Public School, the following changes to the on-street parking supply were proposed as part of the EIS design:

- A total of 66 parallel parking bays (including two parking spaces for persons with disability) to be provided on the eastern side of the service road adjacent to the school
- Addition of 52 staff car parks within the proposed Kororo Public School bus interchange, accessed via James Small Drive
- A total of about 40[3] informal on-street parking spaces on the property access road (opposite the school).

This equated to a total parking supply surrounding the school of 118 formalised parking spaces (including the bus interchange and service road) and retainment of the informal parking spaces along the property access road. This exceeds the existing parking demand (98 spaces) of the school and is anticipated to cater for the parking demand currently observed during the school peak. However, it is noted that all formal parking spaces were to be provided on the eastern side of the project.

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[2] This was not previously discussed in the *Traffic and Transport Assessment* (Arup 2019) report.
[3] Value incorrectly reported as 90 spaces in the *Traffic and Transport Assessment* (Arup 2019) report.

3.11.2 Design changes

The proposed design changes are consistent with the EIS with respect to impacts to informal on-street parking at the Englands Road and Coramba Road interchanges, and the existing parking available at the Oz Group Packhouse at Isles Drive.

The proposed design change to the Englands Road interchange would result in an additional 0.03 hectares of land from the car park of the Oz Group Packhouse (37/51 Isles Drive), bringing the total directly impacted area to 0.54 hectares (about 21 per cent of the total lot area, compared to 20 per cent in the EIS). TfNSW will carry out further consultation with Oz Group Packhouse about the extent of temporary and/or permanent parking impacts during detailed design. Property adjustments, including parking arrangements, will be determined through further consultation with the property owner as part of the property acquisition process.

As part of the proposed design changes, the parking arrangements in the vicinity of the Kororo Public School are as follows:

- The off-street bus interchange would include capacity for 30 staff car park spaces
- Eighteen high turnover parking bays would be provided at the kiss and drop zone within the bus interchange, accessed via the eastern service road. The kiss and drop zone is provided off-street and is separated from the bus bays via a narrow raised-median (previously these were provided on the service road in the EIS design and therefore likely to interrupt through traffic flow on the service road during school peaks)
- Two parking spaces in proximity to the Kororo Public School entry on the eastern service road for persons with disability
- About 19 parallel parking bays along the eastern service road
- Additional 24 off-street car park spaces would be provided on the western property access road near the existing Solitary Rural Fire Services shed.

This equates to a total formal parking supply of 93 spaces within proximity to the Kororo Public School, where 18 are high turnover off-street parking bays within the kiss and drop zone, and 24 are provided on the western side of the highway. Previously no formal parking was provided on the western property access road as part of the EIS design.

Based on the survey of current parking demand at the Kororo Public School, the amended design parking arrangements will mean there is a shortfall of five spaces. Therefore, as design progresses, further liaison with the Department of Education, School Infrastructure NSW and Kororo Public School will be carried out by TfNSW to confirm parking arrangements and requirements.

4 Assessment of construction impacts

This section provides an assessment of the resulting transport-related impacts which are anticipated to occur during construction of the project.

4.1 Construction changes

4.1.1 EIS

The location and use of ancillary sites assessed for the EIS, were detailed and addressed in Section 6.6 of the *Traffic and Transport Assessment* (Arup 2019). The ancillary sites are located within three construction zones that have been defined for the project during concept design development. The primary vehicular access roads for each ancillary site within the zones are:

- Zone 1 – Englands Road to Roberts Hill ridge:
  - Vehicular access to Zone 1 would be via the existing Pacific Highway, Englands Road and North Boambee Road.
- Zone 2 – Roberts Hill ridge to Korora Hill:
  - Vehicular access to Zone 2 would be via Coramba Road, Shephards Lane, Bray Street, Mackays Road and West Korora Road.
- Zone 3 – Korora Hill to Sapphire:
  - Vehicular access to Zone 3 would be via the existing Pacific Highway, Bruxner Park Road, Old Coast Road and James Small Drive.

4.1.2 Amended design

Changes to the proposed approach to construction of the project, relevant to the traffic and transport assessment, are described in Section 2.2. Since submission of the EIS, proposed changes to the ancillary facilities to be used during construction have been addressed.

Potential locations of the new / amended / removed ancillary facilities and the likely public local roads by which they would be accessed, even outside typical construction hours, are shown in Table 9 (new ancillary sites are highlighted in blue and removed ancillary sites are in red text with strikethrough). Initial site work in these areas would involve site clearing, installing appropriate environmental controls and providing hardstand areas for storage, parking and access roads.

Table 9 Indicative new / amended ancillary sites

Site	Local access road	Main site compound	Secondary site compound	Concrete batch plant	Asphalt batch plant	Crushing plant	Stockpile site
1A	Englands Road	✓	✓	✓	✓	✓	✓
1C	Englands Road	✓	✓	✓	✓	✓	✓
1J	Englands Road	✓	✓	✓	✓	✓	✓
3A	Bruxner Park Road	✓	✓	✓	✓	✓	✓
~~3C~~	~~Bruxner Park Road~~		~~✓~~				~~✓~~
3D	Bruxner Park Road		✓				✓
3F	Pacific Highway		✓				✓

In addition to the ancillary sites proposed, new construction accesses are proposed (since submission of the EIS) on Buchanans Road and Gatelys Road. The impact of construction vehicles on these local roads has been assessed in Section 4.2.2 of this supplementary report.

The final locations and layout of ancillary facilities would be determined by the construction contractor.

4.2 Construction traffic impacts

4.2.1 EIS impacts

Construction of the project is planned to occur over a four-year period and would result in some traffic and transportation impacts to the surrounding public road network during this time.

To provide an indication of the worst-case impacts of construction traffic on the current network, the estimated daily volume (including both light and heavy vehicles) that would use the existing road network was detailed in Table 29 of the *Traffic and Transport Assessment* (Arup, 2019). The construction traffic volumes represented peak construction traffic movements for the haulage of materials and access by construction workers and have been developed in consultation with TfNSW. These volumes were dependent on the timing and duration of construction works and would need to be refined as the construction plan is further developed during detailed design.

The EIS construction traffic impact assessment demonstrated that for the majority of the road network, construction traffic was not anticipated to trigger adverse traffic impacts. This included Englands Road, Mackays Road, Bray Street, West Korora Road, Bruxner Park Road and Pacific Highway.

Where short term impacts on local roads was demonstrated, it was anticipated that appropriate mitigation and management measures within a Traffic Management Plan could be adopted to minimise impact to the operation of the surrounding road network. This included North Boambee Road, Shephards Lane, Coramba Road, James Small Drive and Old Coast Road.

4.2.2 Changes to the location and use of construction ancillary facilities

New and amended construction ancillary sites in Construction Zone 1 would be accessed via Englands Road. While the new sites, amended site and the other sites identified in the EIS may operate simultaneously, the peak construction traffic demand on Englands Road is expected to be the same as the peak demand identified in the EIS. This is because there are no changes to the expected workforce and construction resources for the project from what was identified in the EIS. As such, no additional traffic demand on Englands Road during construction is anticipated because of the changes to the proposed construction ancillary facilities, and this local sub-arterial road would continue to operate with volumes less than its nominal upper limit capacity.

To accommodate the proposed design changes outlined in Section 2, new ancillary sites in construction zone 3 (site 3A and site 3F) have been included, the boundary of site 3D has been amended and site 3C has been removed.

New ancillary site 3A and the amended site 3D would be accessed via Bruxner Park Road. Consistent with the EIS, there would be three potential ancillary sites accessed from Bruxner Park Road with the addition of site 3A and the removal of site 3C, and as such, the peak construction traffic demand on Bruxner Park Road is expected to be the same as the peak demand identified in the EIS. No additional traffic demand on Bruxner Park Road during construction is anticipated because of the changes to the proposed construction ancillary facilities, and the road would operate with acceptable travel times and level of service. Notwithstanding, the extent of Bruxner Park Road potentially affected by construction traffic could be slightly less than the extent identified in the EIS because the access to site 3A is close to the intersection of Bruxner Park Road and the existing Pacific Highway.

New ancillary site 3F is proposed to be accessed via the existing Pacific Highway, near the intersection of Opal boulevard and the existing Pacific Highway. Access to site 3F would include appropriate traffic management controls to ensure local access to Opal Boulevard is maintained throughout construction. The increase in construction traffic would represent increases of less than five per cent of existing daily traffic volumes and there would not be expected to be any noticeable impacts to travel time or level of service on the Pacific Highway because of the site 3F.

4.2.3 Changes to construction traffic management and access

Two new construction accesses were identified following the exhibition of the EIS. These new construction accesses are to be provided via Buchanans Road and Gatelys Road.

During construction, access to Korora School Road from the existing Pacific Highway would be closed and a temporary connection would be provided via

Russ Hammond Close to provide access to Kororo Public School and residential access to existing properties on Korora School Road. The temporary access via Russ Hammond Close could be in place for up to 18 months and would not be used for construction traffic. This connection would not be used by construction traffic and as such would only be used by school traffic (buses, staff, deliveries, parents etc.) and residential access to existing properties on Korora School Road.

These roads were not previously assessed in the EIS reporting. The anticipated increase in traffic volumes on these local roads because of construction activities is presented in Table 10.

Table 10 Construction traffic impacts

Road	**Peak daily construction vehicles**			**2016 daily volumes [vpd]**	**Total with const. traffic [vpd]**	**% increase due to const. traffic**
	No. HV [vpd]	No. LV [vpd]	Total [vpd]			
Buchanans Road	40	80	120	80*	200	150%
Gatelys Road	10	40	50	300	350	17%
Russ Hammond Close	-	170**	170	200*	370	85%

*Existing traffic volumes on Buchanans Road and Russ Hammond Close have been estimated assuming up to 10 vehicle trips per day per dwelling. Dwellings were based on aerial photography in March 2020.
**Re-distributed existing Kororo Public School traffic estimated based on current demands and assuming 50% will detour to this new connection, and 50% will remain on James Small Drive.

Buchanans Road

As shown in the table above, Buchanans Road is anticipated to experience high percent increases in estimated daily traffic volumes as it currently carries a low (50 vpd) level of traffic. The total predicted daily traffic volumes on this road with the addition of construction traffic are expected to be about 200 vpd.

Buchanans Road is a local Access Street with a nominated design capacity of 300 vpd (*Development Specification Design 0041 Geometric Road Layout*, CHCC 2009). As such, this road during its peak construction period, is expected to operate within acceptable travel times and level of service.

As the predicted volumes for Buchanans Road are less than the nominated acceptable capacity for an Access Street, construction traffic is not anticipated to significantly impact the operation of this road.

Given the predicted significant (>100%) increase in daily traffic volumes on the Buchanans Road link, the potential impacts on the operation of its intersection with Coramba Road has been considered. The practical absorption capacity of Coramba Road during the peak construction period will be in the order of 300 vehicles per hour based on Austroads guidance[4]. This means the predicted daily

[4] Austroads *Guide to Traffic Management Part 2: Traffic Theory* (2015) Figure C7 2, assuming a two-way hourly flow on Coramba Road of 1,115 vehicles per hour (sourced from the *Traffic and Transport Assessment* Arup, 2019 report), a critical acceptance gap of 5 seconds and follow up headway of 3 seconds (typical for turning movements in / out of a two-way, two lane major road at an unsignalised intersection).

volume of 200 vehicles per day on Buchanans Road during the peak construction period would not have a significant impact on the operation of the Coramba Road and Buchanans Road intersection.

Gatelys Road

Gatelys Road is classified as a Local Street based on the function of the road and definitions in *Development Specification Design 0041 Geometric Road Layout* (CHCC, 2009). This specification states that a Local Street has a nominal upper limit capacity of 2,000 vpd. The total predicted traffic volume on Gatelys Road with the addition of construction traffic would be about 350 vpd i.e. well under the nominal capacity for a Local Street.

As the predicted volumes for Gatelys Road are less than the nominated acceptable capacity for a Local Street, construction traffic is not anticipated to significantly impact travel time or level of service on this road.

Russ Hammond Close

Russ Hammond Close is anticipated to experience relatively high increases in estimated daily traffic volumes as it currently carries a low level of traffic, about 200 vpd. The total predicted daily traffic volumes on this road with the addition of redistributed school traffic are expected to be about 370 vpd.

Russ Hammond Close is a local Access Street with a nominated design capacity of 300 vpd (*Development Specification Design 0041 Geometric Road Layout*, CHCC 2009). This suggests that Russ Hammond Close will be operating at capacity during peak construction periods.

It is anticipated that the temporary traffic control measures to mitigate potential construction traffic impacts on Russ Hammond Close will be addressed in the Traffic Management Plan. The Traffic Management Plan, specific to Russ Hammond Close, would identify appropriate traffic control measures to regulate traffic movement, ensure the local community are well-informed of changes to the network and provide a monitoring framework to confirm controls are working and/or the need for contingency measures.

4.2.4 Construction traffic management measures

Based on the proposed design changes, additional local roads and property access roads affected during construction activities of the project include Buchanans Road, Gatelys Road and Russ Hammond Close. To manage the construction impacts on these roads, traffic control may be required. It is anticipated that traffic controls and measures to be provided on these local roads will be addressed and detailed in a construction Traffic Management Plan to be prepared by the contractor.

4.3 Impacts on other travel modes

The impacts to all other modes of transport (i.e. heavy vehicles, North Coast Railway, public transport, pedestrians and cyclists, parking and property access) with the proposed construction changes, are considered consistent with what was previously reported in the EIS.

However, it is noted the construction works associated with the proposed signalisation of the Pacific Highway / Charlesworth Bay Road intersection may impact the operation of an existing bus stop on the Pacific Highway located adjacent to the intersection. The impacts of this are to be mitigated through traffic control measures detailed in the construction Traffic Management Plan to be prepared by the contractor.

5 Conclusion

In accordance with the SEARs an EIS was prepared by TfNSW to assess the potential impacts of the project. The EIS was exhibited by TfNSW from 11 September 2019 to 27 October 2019.

Following consultation with community and landowners, and submissions received during the EIS public exhibition period, the concept design of the project has changed. The amended design incorporates four major design changes relevant to the traffic and transport assessment:

- Englands Road interchange
- Coramba Road school bus stop
- Korora Hill interchange
- Kororo Public School bus interchange and Luke Bowen footbridge.

The purpose of this supplementary report is to address the potential impacts of the project given the proposed design changes. This supplementary assessment only includes information that has changed since the EIS was prepared and should be read in conjunction with the *Traffic and Transport Assessment* (Arup 2019).

5.1 Assessment of operational impacts

The operational key findings of the amended design traffic assessment incorporating the proposed design changes are as follows:

- The proposed design changes at the Englands Road interchange, being the reduced delay associated with the amalgamation of two signalised intersections into one roundabout, are anticipated to attract additional daily traffic volumes to the bypass when compared to the EIS design (noting that overall traffic patterns are consistent with the EIS)
- The increased attractiveness of the bypass is expected to result in the following changes in operational impact when compared to the EIS:
  - Reduced demands and associated delays on the existing Pacific Highway therefore improved travel times on this congested link, and improved overall network speeds
  - Further reductions of traffic volumes on Isles Drive and therefore improved operation at the Pacific Highway and Isles Drive intersection
  - Increased localised traffic volumes on Englands Road and Coramba Road (between Shephards Lane and the bypass) on approach to the bypass.
- All three interchanges would continue to operate within an acceptable level of service
- The amended design includes proposed design changes to the intersection control and approach arrangements at the Korora Hill interchange. The resulting design is demonstrated to continue to operate within acceptable limits over the design horizon

- The proposed signalisation of the Pacific Highway and Charlesworth Bay Road intersection is expected to operate with a critical level of service of A at 2044, greatly improving the poor operation (LOS F) anticipated with the EIS design. While the EIS design would have the existing Pacific Highway free flowing, there would be significant delays on Charlesworth Bay Road during peak periods, well over the trigger criteria for LOS F. With the signalisation of this intersection, improved protection for vulnerable road users is provided through provision of signalised crosswalks on the southern and eastern approaches
- The amended design assessment predicts a reduction of four crashes (previously two with the EIS) on the Pacific Highway and project at 2044, even though the project attracts an additional 10,581 vpd to the assessed road network. This is because of a shift of traffic from key local roads onto the project. This reduction in daily traffic volumes on the local road network is anticipated to correspond to a resultant reduction in the crash exposure rate on these road segments
- Design changes to the Coramba Road school bus stop are anticipated to increase the capacity of the school bus stop, improve pedestrian access from the local road network and increase the separation of the bus stop from the adjacent Coramba Road interchange
- The proposed design changes in the vicinity of the proposed Kororo Public School provide several positive impacts, including safety and operational:
    - Separation of bus and private vehicle movements
    - Reduced traffic volumes on James Small Drive
    - Grade-separated pedestrian movements between the staff car park and the access to the school
    - Improved pedestrian connectivity between the bus interchange and car park, Luke Bowen footbridge, Old Coast Road and the school
    - 18 high turnover pick-up/drop off bays are now proposed off-street rather than being directly accessed via the service road as detailed in the EIS
    - Formalisation of 24 off-street car parking spaces on the property access road located on the west side of the project (previously in the EIS, none were to be formalised)
    - Increased capacity of the bus interchange to allow for eight buses nose-to-tail
    - Minor improvement to travel times for buses compared with the EIS because of access now being provided on the service road rather than James Small Drive.
- Further liaison with the Department of Education, School Infrastructure NSW and Kororo Public School would be carried out by TfNSW during detailed design to confirm parking arrangements and requirements at the Kororo Public School.
- Off-road shared pathways are proposed for people who ride at the proposed Englands Road and Korora Hill interchange roundabouts to provide greater lateral separation to vehicles

- The existing Solitary RFS shed would would be directly impacted to accommodate the additional car park spaces and the new footbridge location. TfNSW have commenced consultation with RFS Mid North Coast Team and identified a location near Korora Hill interchange for a new shed and facilities on TfNSW owned property (within construction ancillary facility site 3B). The new shed and facilities are proposed to be constructed as part of the project and would be undertaken as a pre-construction activity.

5.2 Assessment of construction impacts

Since exhibition of the EIS, proposed changes to the ancillary facilities to be used during construction have been investigated, including the removal of site 3C.

New and amended ancillary sites in Construction Zone 1 would continue to be accessed via Englands Road. No additional traffic demand on Englands Road during construction is anticipated due to the proposed changes to the construction ancillary facilities, and the road would continue to operate within acceptable limits. Similarly, the new ancillary site 3A and amended site 3D are not expected to generate additional traffic demand on Bruxner Park Road during construction, and the road would operate within acceptable limits.

New ancillary site 3F is proposed to be accessed via the existing Pacific Highway. The increase in construction traffic would represent increases of less than five percent of existing daily traffic volumes and as such ancillary site 3F is not expected to impact significantly on the operation of the Highway.

Since exhibition of the EIS, it is now proposed that construction access would also be provided on Buchanans Road and Gatelys Road. The assessment demonstrates that the addition of construction traffic on these two roads would not increase volumes beyond their current capacity. Any construction impacts on these local roads will be mitigated through traffic controls and measures to be addressed and detailed in a construction traffic management plan (to be prepared by the contractor).

Changes to the proposed construction approach have identified the use of Russ Hammond Close as a temporary connection to Korora School Road once access from the Pacific Highway and James Small Drive have been removed. This connection would not be used by construction traffic and as such would only be used by school traffic and residential access to existing properties on Korora School Road. It is anticipated the Traffic Management Plan, specific to Russ Hammond Close, would identify appropriate traffic control measures to regulate traffic movement, ensure the local community are well-informed of changes to the network and provide a monitoring framework to confirm controls are working and/or the need for contingency measures.

With the proposed construction approach changes, impacts to all other modes of transport (i.e. heavy vehicles, North Coast Railway, public transport, pedestrians and cyclists, parking and property access) are considered consistent with the EIS.

Any impacts to the existing bus stop adjacent to the Pacific Highway and Charlesworth Bay Road intersection are to be mitigated with the implementation of the Traffic Management Plan to be prepared by the contractor.

6 References

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7 Glossary

Table 11 Glossary of terms

Term	Definition
%	Per cent
AADT	Annual Average Daily Traffic
ARTC	Australian Rail Track Corporation
CBD	Central Business District
CHCC	Coffs Harbour City Council
CHSTM	Coffs Harbour Strategic Transport Model
CHTM	Coffs Harbour Traffic Model
CSSI	Critical State Significant Infrastructure
DP&E	Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979
km	Kilometres
LGA	Local Government Area
LOS	Level of Service
m	Metres
mvkt	million vehicle kilometres travelled
OD	Origin-destination
SEARs	Secretary's Environmental Assessment Requirements
TfNSW	Transport for New South Wales
The project	Coffs Harbour Bypass
TMP	Traffic Management Plan
veh/h	Vehicles per hour
vpd	Vehicles per day

Appendix B

Updated noise and vibration assessment (Main report, Sub-appendices A-F)

Transport for New South Wales

Coffs Harbour Bypass

Updated Noise and Vibration Assessment Report

AC01

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Appendix J
Construction Noise Results

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Executive Summary

This report provides an assessment of operational and construction noise and vibration associated with the development of the proposed Coffs Harbour bypass. Assessment has been undertaken in accordance with the provisions of the Secretary Environmental Assessment Requirements (SEARs) and supplemented where required with national and international guidance.

Attended and unattended noise monitoring has been conducted across the project area at a total of 25 sites. Noise monitoring data has been used to establish baseline ambient noise levels and to validate the acoustic model. The existing sound environment was observed to be characteristic of rural areas with the Pacific Highway having a significant influence on the prevailing soundscape.

A total of 2347 noise-sensitive receivers were included in the noise model for the project. Of the total number of receivers, 2332 are residential and 15 are other noise sensitive receivers out of which five are outdoor recreational spaces. To facilitate analysis, noise sensitive receivers were grouped together into 28 noise catchment areas (NCAs) based on areas that are expected to receive similar exposure to future noise from operation and construction of the project.

Development applications for proposed developments within the study area were sought from relevant approval authorities. A total of six residential subdivisions have been included in the assessment of at-source noise mitigation requirements for the project. Specific eligibility for at-property treatments with at-source noise mitigation in place vary depending on approval conditions and these have been summarised for each subdivision.

Operational noise and vibration has been assessed within a study area of 600 m for the project. This distance is based on the limit of accuracy of the road traffic noise model used for the assessment and is in accordance with the NSW Road Noise Policy (RNP). For receivers beyond this distance that have the potential to exceed operational noise criteria, further traffic noise monitoring and modelling will be undertaken during detailed design of the project to confirm requirements for additional mitigation including at property treatments.

Road traffic data derived as part of the traffic assessment for the project has been used to predict operational and construction traffic noise impacts. Tube count traffic data obtained during each of the noise monitoring periods has been used to validate the operational noise model.

A base case pavement surface of concrete was assessed for the mainline bypass with existing dense graded asphalt being maintained for the redevelopment of the Pacific Highway north of the Korora Hill Interchange. Ramps at interchanges were also identified as dense graded asphalt.

Operational road traffic noise impacts with and without the project have been assessed for the year of opening (2024) and design year (2034). It is noted that while the full extents of the existing Pacific Highway have not been included in the acoustic model, a reduction in noise impacts through the centre of Coffs Harbour is expected as a result of the introduction of the project.

Exceedances of operational noise criteria have been assessed in accordance with the provisions of the Roads and Maritime Noise Criteria Guideline. Noise mitigation measures have been assessed in accordance with the principles summarised in the Roads and Maritime Noise Mitigation Guideline. A total of 1401 noise-sensitive receivers qualify for consideration of mitigation with the introduction of the project.

A low noise pavement alternative to concrete was investigated as a preferred noise mitigation measure to address these receivers. As part of the design, it was a project decision based on community concerns to adopt low noise pavement for the full length of the project. A total of 1129 noise-sensitive receivers still qualify for at-property treatment with low noise pavement in place.

A full barrier analysis was undertaken initially, the results of which were coordinated with the design team to identify areas where the installation of earth berms was considered feasible to further reduce noise impacts. An updated terrain model with the earth berms in place was then used to re-analyse optimum noise wall heights and resulting at-property treatment requirements. A full barrier analysis was undertaken with low noise pavement in place where there were groups of four or more closely spaced receivers to identify feasible and reasonable heights and extents to address residual exceedances of the noise criteria. A total of eight design noise walls of varying heights were identified for the project. 619 noise sensitive receivers, out of which 11 are non-residential noise sensitive receivers, still qualify for at-property treatment with low noise pavement and design height barriers in place.

A qualitative analysis was undertaken of potential change in maximum noise impacts due to the project. Key features such as steep gradients, changes in speed, and changes in geometry were investigated. Noise monitoring data obtained during the environmental noise surveys was also analysed to quantify existing maximum noise level exposure. The overall magnitude of maximum road traffic noise events is not expected to change significantly along existing road corridors where alterations to geometry are minimal. It should be noted that the maximum noise assessment should be used as a tool to help prioritise and rank mitigation strategies but should not be applied as a decisive criterion in itself.

An industrial noise assessment has been undertaken for the proposed relocation of the bus interchange at Korora Public School. Noise impacts have been based on existing timetable information and an expected maximum of eight school buses during morning and afternoon peaks. Predicted noise levels are expected to be below target criteria as derived in accordance with the Noise Policy for Industry for all nearby receivers during the morning peak arrival period. Two receivers immediately south of the bus interchange are identified to exceed the daytime criterion during the morning peak departure period by 2 and 5 dB respectively at the first floor. An exceedance of up to 4 dB during the evening period for commuter bus operations is observed at the nearest affected receiver.

The in-tunnel jet fans for the Gatelys Road and Shephards Lane tunnels have also been considered as part of the industrial noise assessment. These have been assessed considering the infrequent, short duration routine testing. It is expected that testing would be undertaken during daytime periods. The predicted noise level from operation is expected to be below target criteria at all nearby noise sensitive receivers to the tunnel portals.

No development is proposed to the existing North Coast Railway line as a part of the project. An assessment was undertaken of the potential changes in rail noise exposure due changes to the surrounding terrain as a result of construction of the project. A criterion of 2 dB change in noise level was adopted as the assessment criterion as this represents what would be just noticeable difference in noise level. There are no instances of changes greater than 2 dB expected to the train noise levels at nearest affected noise sensitive receivers due to the introduction of the project.

Construction noise and vibration impacts have been based on constructability information available at this stage of development. This includes anticipated zoning, construction activities and equipment, staging, and associated construction traffic.

Construction of the project has been separated into three main zones and seven main stages. Construction noise impacts to noise sensitive receivers have been calculated using the acoustic model for the project. Construction works are anticipated to take place mostly within standard construction hours across most of the alignment. However, some work may be required during evening and night-time periods due to technical, safety and/or community amenity reasons.

Comparison against standard and out of hours works criteria has been provided for each construction zone and stage along with potential sleep disturbance. Significant exceedances of the Roads and Maritime Construction Noise and Vibration Guideline noise management levels are predicted and have been presented in 5 and 10 dB bands to indicate potential intrusiveness. Exceedances of the criteria are relative to the existing ambient noise level; areas which are further away from the urban centre of Coffs Harbour would experience a greater exceedance of the noise management levels.

A comparison has been made of predicted construction traffic on haulage routes identified for the project against existing traffic flows on those links. Comparative assessment has been undertaken during the daytime period for areas of project remote from the existing Pacific Highway and during the night-time period for areas on the existing Pacific Highway. This is due to the likelihood that out of hours work will be required for these upgrade works.

Construction traffic is expected to increase significantly on collector road links that currently carry very few vehicles. The additional impact of construction vehicles on the existing Pacific Highway is not expected to be as significant due to relatively high existing traffic volumes. A summary of expected noise level increases due to construction traffic noise impacts across the study area is provided to inform planning of management measures once further detail is understood for construction of the project.

Construction ground-borne noise has also been assessed to determine an estimate of the likely noise and vibration levels generated by future mechanised bored tunnelling works. This assessment provided indicative distances at which the predicted noise levels are expected to be below the criteria.

A qualitative analysis of potential cumulative impacts due to concurrent construction of other nearby developments has been included. Ten main projects have been identified as potentially occurring adjacent to the project. Specific details of staging and construction for each are not currently known. Should concurrent activities occur, there is a potential that receivers may be exposed to higher cumulative construction noise levels. This would need to be reviewed on a case by case basis once further detail is known.

Vibration screening criteria have been established for both structural damage and human perception along with safe working distances. Further information is provided for heritage structures and other potentially vibration sensitive receivers. Monitoring and condition surveys will be required by the contractor once specific detail is known to ensure structures are adequately protected.

Assessment has been made of potential air blast overpressure and ground vibration associated with blasting. Indicative maximum instantaneous charges have been provided based on distances to the nearest potentially impacts sensitive receivers. This assessment has been undertaken in accordance with the requirements of the SEARs. Further information is provided for consideration regarding more detailed international guidance on blasting for consideration by the contractor where proximity to vibration sensitive structures is expected.

A standard suite of mitigation measures is summarised in accordance with the provisions of the Roads and Maritime Construction Noise and Vibration Guideline. A detailed construction noise and vibration management plan will be required to be developed by the successful contractor once full details of construction methodology and staging are known.

1 Introduction

1.1 The proposed project

Transport for New South Wales (TfNSW) is seeking approval for the Coffs Harbour bypass (the project) under Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) as Critical State Significant Infrastructure (CSSI).

The project includes a 12 km bypass of Coffs Harbour from south of Englands Road to Korora Hill in the north and a two-kilometre upgrade of the existing highway between Korora Hill and Sapphire. The project would provide a four-lane divided highway that bypasses Coffs Harbour, passing through the North Boambee Valley, Roberts Hill and then traversing the foothills of the Coffs Harbour basin to the west and north to Korora Hill.

The key features of the project include:

- Four-lane divided highway from south of Englands Road roundabout to the dual carriageway highway at Sapphire
- Bypass of the Coffs Harbour urban area from south of Englands Road intersection to Korora Hill
- Upgrade of the existing Pacific Highway between Korora Hill and the dual carriageway highway at Sapphire
- Grade-separated interchanges at Englands Road, Coramba Road and Korora Hill
- A one-way local access road along the western side of the project between the southern tie-in and Englands Road, connecting properties to the road network via Englands Road
- A new service road, located east of the project, connecting Solitary Islands Way with James Small Drive and the existing Pacific Highway near Bruxner Park Road
- Three short tunnels through ridges at Roberts Hill (around 190 m long), Shephards Lane (around 360 m long), and Gatelys Road (around 450 m long)
- Structures to pass over local roads and creeks as well as a bridge over the North Coast Railway
- A series of cuttings and embankments along the alignment
- Tie-ins and modifications to the local road network to enable local road connections across and around the alignment
- Pedestrian and cycling facilities, including a shared path along the service road tying into the existing shared path on Solitary Islands Way, and a new pedestrian bridge to replace the existing Luke Bowen footbridge with the name being retained
- Relocation of the Kororo Public School bus interchange

- Noise attenuation, including low noise pavement, noise barriers and at-property treatments as required
- Fauna crossing structures including glider poles, underpasses and fencing
- Ancillary work to facilitate construction and operation of the project, including:
  - Adjustment, relocation and/or protection of utilities and services
  - New or adjusted property accesses as required
  - Operational water quality measures and retention basins
  - Temporary construction facilities and work including compound and stockpile sites, concrete/asphalt batching plant, sedimentation basins and access roads (if required).

1.2 Design changes

The environmental impact statement (EIS) for the project was exhibited by the Department of Planning, Industry and Environment for 47 days from 11 September 2019 to 27 October 2019. TfNSW has amended several aspects of the project as exhibited in the EIS. These changes have been developed in response to:

- Consultation with the community and landowners during the EIS public exhibition period (11 September 2019 to 27 October 2019)
- Submissions received during the EIS public exhibition period
- Continued development and refinement of the concept design and consultation with government agencies.
- Consultation with the community, landowners and stakeholder groups during the design changes display period (27 November 2019 to 13 December 2019).

The proposed design changes are:

- Englands Road interchange
- North Boambee Valley vertical alignment
- Coramba Road bus stop
- Coffs Creek flood mitigation
- Korora Hill interchange
- Kororo Public School bus interchange and Luke Bowen footbridge
- Pine Brush Creek and Williams Creek realignment
- Water quality basins.

The proposed construction changes are:

- Additional blasting
- New and revised ancillary sites

- Revised traffic management
- Construction sediment basins.

The concept design presented in the EIS incorporating the proposed design changes is referred to as the amended design.

1.3 Assessment methodology

Following exhibition of the EIS, a complete reassessment of the noise model has been carried out including the following changes into the operational and construction noise and vibration assessment:

- Updated design and construction methodology including changes described in Section 1.2
- Updated traffic modelling inputs including removal of local roads with low traffic volumes and updated predicted traffic volumes for the amended design
- Updated receiver classification and building footprint location where required
- Included additional construction noise impact assessment scenarios to provide a range of impacts additional to the worst-case scenarios.

1.4 Purpose of this report

A Noise and vibration assessment report (Arup 2019) was prepared in support of the EIS for the project. The purpose of the assessment was to address the Secretary's Environmental Assessment Requirements (SEARs) for the project for the purpose of seeking project approval under Division 5.2 of the EP&A Act.

Following exhibition of the EIS, receipt of submissions and further consultation with community and stakeholders a number of design and construction amendments have been made to the project.

This updated Noise and vibration assessment report has been prepared in accordance with the SEARs to assess the potential impacts of the project, including the design and construction amendments. Table 1 outlines the requirements relevant to this assessment and where they are addressed in the report.

Table 1: SEARS relevant to operational and construction noise and vibration

Secretary's requirement	Where addressed in this report
2. Noise and vibration – Amenity	
1. The Proponent must assess construction and operational noise and vibration impacts in accordance with relevant NSW noise and vibration guidelines. The assessment must include consideration of impacts to sensitive receivers, and include consideration of sleep disturbance and, as relevant, the characteristics of noise and vibration.	Section 3 Section 4 Section 5

Secretary's requirement	Where addressed in this report
2. An assessment of construction noise and vibration impacts which must address: (a) the nature of construction activities (including transport, tonal or impulsive noise - generating works and the removal of operational noise barriers, as relevant) (b) the intensity and duration of noise and vibration impacts (both air and ground-borne) (c) the nature, sensitivity and impact to receivers (including Bishop Druitt College and Kororo Public School) (d) the need to balance timely conclusion of noise and vibration generating works with periods of receiver respite, and other factors that may influence the timing and duration of construction activities (such as traffic management) (e) the potential for extended standard construction hours and/or works outside standard construction hours, including predicted levels, exceedances and number of potentially affected receivers and justification for the activity in terms of the Interim Construction Noise Guideline (DECCW, 2009) (f) a cumulative noise and vibration assessment inclusive of impacts from other major development projects preparing for or commencing construction in the vicinity of the proposal.	Section 5
3. Noise and vibration – Structural	
1. The Proponent must assess construction and operation noise and vibration impacts in accordance with relevant NSW noise and vibration guidelines. The assessment must include consideration of impacts to the structural integrity and heritage significance of items (including Aboriginal places and items of environmental heritage).	Section 3 Section 5
2. The Proponent must demonstrate that blast impacts are capable of complying with the current guidelines, if blasting is required.	Section 5.4

The assessment is prepared in accordance with the *Roads and Maritime Services Procedure for Preparing an Operational Traffic and Construction Noise and Vibration Assessment Report* [1].

A glossary of acoustic terminology is provided in Appendix A.

2 Existing ambient noise environment

The project is to be located through predominantly rural areas around the outskirts of Coffs Harbour. The topography of Coffs Harbour is formed such that the bulk of the township is surrounded by steep hills aligning the west and northwest.

The existing Pacific Highway dissects the existing township and passes Coffs Harbour Airport that is located close to the eastern coastline. The North Coast train line also traverses the proposed bypass and accommodates freight train haulage. Aircraft and train pass-by's contribute transient events to the overall soundscape.

The existing sound environment is characteristic of rural areas with the Pacific Highway having a significant influence on the prevailing soundscape. Depending on proximity to the existing highway, overall daytime ambient noise levels are generally higher than night-time noise levels. This is due to daytime levels being driven up by the volume of light vehicles but significantly reduced during the night-time. The volume of long-haul road freight vehicles becomes proportionally more significant during the night-time period and hence the determinant of road traffic noise disturbance.

With distance from road traffic noise sources, typical rural soundscape elements dominate the soundscape included flora and fauna and the difference between daytime and night-time ambient noise levels is reduced.

2.1 Noise survey

Noise surveys were undertaken at various locations along the proposed route corridor. Noise monitoring locations were selected in coordination with Roads and Maritime noise specialists to establish the following:

- Existing road traffic noise levels for validation of the EIS operational noise model
- Existing baseline noise levels for assessment of relative increases in road traffic noise and to set industrial and construction noise criteria.

Locations were chosen taking into account representative areas of potential construction and operational noise impact as well as specific areas of the project raised by the community as particularly sensitive to noise.

Noise monitoring locations are summarised on aerial imagery in Appendix B. A more detailed description of the prevailing sound environment at each monitoring location is provided in Appendix C.

2.1.1 Equipment

The equipment used to survey the existing sound environment is outlined in Table 2. Logger numbers are provided for ease of reference to the information provided in the Appendices.

The L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} noise indices were measured in free-field conditions (i.e. away from noise reflecting structures) with a sample period of 15 minutes.

Environmental noise loggers and sound level meters used in the survey were mounted at 1.5 m above ground level and set to fast time response for all measurements.

All equipment carried current calibration certification at the time of monitoring and was checked for any drift in calibration before and after the monitoring period and no significant deviation had occurred.

Table 2: Summary of noise measurement equipment

Manufacturer	Equipment	Type	Logger Number	Serial No.
Brüel & Kjær	Type 1 sound level meter	2250	N/A	2449851
		2270	N/A	2754328
	Sound level calibrator	4231	N/A	2445716
Acoustic Research Laboratories	Environmental noise logger	Ngara Type 1	1	8780D0
			2	8780E6
			3	8780D3
			4	8780E5
			5	87807F
			6	87809E
			7	878012
			8	878060
			9	878079
			10	8780EA
			11	87807B
			12	8780C7
			13	8780E8
			14	8780E6
			15	8780D0
			16	8780D1
			17	878042
			18	878000
			19	878061
			20	87809F
			21	8780D1

2.2 Unattended noise monitoring

Two rounds of long term noise monitoring were conducted during 2016 at a total of 21 locations. The first survey period was carried out between Tuesday 21 June 2016 and Thursday 30 June 2016 with the intention of recording a representative 7-day week prior to the school holiday period commencing Friday 1 July 2016. The second survey was carried out between Monday 28 November 2016 and Monday 12 December 2016 to provide information on the traffic noise impacts to educational institutions and to provide further insight into the impacts of compression braking along the Pacific Highway. The noise monitoring data collected is considered representative of current noise environment and is applicable for the purposes of the noise assessment.

Results of the unattended noise survey have been processed to derive the Rating Background Level (RBL) and L_{Aeq} noise levels for the time periods defined in Section 3 for the assessment of operational noise (in accordance with the NSW Road Noise Policy (RNP)) and construction noise (in accordance with the Roads and Maritime Construction Noise Vibration Guideline (CNVG)).

Weather conditions as recorded at the Coffs Harbour airport weather station throughout the measurement periods were used to exclude noise measurement data where adverse weather was noted as being unsuitable for noise monitoring (i.e. rain > 0 mm, wind speed > 5m/s). Periods of excluded data are clearly identified on noise monitoring results graphs presented in Appendix D. Table 3 provides a tabulated summary of processed long term unattended noise monitoring results.

Table 3: Summary of unattended noise monitoring results

Logger Number	Noise Catchment Area	Logger Purpose	Lot/DP	Property Address	Measured Noise Level (dB(A))							
					CNVG Defined Time Periods[1]						RNP Defined Time Periods[2]	
					RBL			L_{Aeq}			L_{Aeq}	
					Day	Evening	Night	Day	Evening	Night	Day	Night
1	NCA02	Validation	Lot 2311 / DP 1201335	498c-498d Pacific Highway, Boambee, NSW 2450	47	45	39	55	53	51	54	51
2	NCA06	Validation	Lot 101 / DP134857	North Boambee Road, North Boambee Valley, NSW 2450	32	32	31	54	45	44	53	44
3	NCA08	Baseline	Lot 100 / DP1145073	170 North Boambee Road, North Boambee Valley, NSW 2450	42	40	38	54	57	46	56	51
4	NCA13	Validation	Lot 36 / DP865042	12 Tamora Close, Coffs Harbour, NSW 2450	39	32	27	60	56	52	59	52
5	NCA12	Validation	Lot 221 / DP 1049858	20 Bennetts Road, Coffs Harbour, NSW 2450	37	31	30	48	43	42	47	41
6	NCA15	Baseline	Lot 22 / DP819245	263c Shephards Lane, Coffs Harbour, NSW 2450	28	28	28	47	47	47	47	47
7	NCA18	Baseline	Lot 10 / DP 807125	191 Mackays Road, Coffs Harbour, NSW 2450	28	39	28	46	40	38	45	40
8	NCA21	Validation	Lot 22 / DP716144	Opal Shop, 429a-429b Pacific Highway North, Coffs Harbour, NSW 2450	65[1]	59	40	75	74	71	75	71
9	NCA25	Validation	Lot 5 / DP270145	16 Fern Tree Place, Korora, NSW 2450	48	40	34	57	56	54	57	54
10	NCA28	Validation	Lot 7 / DP834748	1 Coachmans Close, Sapphire Beach, NSW 2450	60	50	42	68	67	64	68	65
11	NCA01	Validation	Lot 12 / DP546173	539 Pacific Highway, Boambee, NSW 2450	58	51	39	65	64	61	65	61

Logger Number	Noise Catchment Area	Logger Purpose	Lot/DP	Property Address	Measured Noise Level (dB(A))							
					CNVG Defined Time Periods[1]						RNP Defined Time Periods[2]	
					RBL			L_{Aeq}			L_{Aeq}	
					Day	Evening	Night	Day	Evening	Night	Day	Night
12	NCA14	Baseline	Lot 110 / DP1066077	19 Gillon Street, Coffs Harbour, NSW 2450	28	30	30	44	43	42	45	42
13	NCA18	Baseline	Lot 1 / DP884279	14 Jensen Close, Coffs Harbour, NSW 2450	31	31	29	48	45	48	48	48
14	NCA27	Validation	Lot 1 / DP270147	Paradise Palms, 675 Pacific Highway, Korora, NSW 2450	55	51	42	65	65	62	65	63
15	NCA26	Validation	Lot PT191 / DP752817	Kororo Public School, 3 Korora School Road, Korora, NSW 2450	52	46	37	59	59	55	59	56
16	NCA16	Baseline	Lot 57 / DP1182038	23 Rigoni Crescent, Coffs Harbour, NSW 2450	27	27	25	51	51	53	52	53
17	NCA19	Baseline	Lot 2381 / DP600581	170 West Korora Road, Coffs Harbour, NSW 2450	30	37	30	55	45	42	49	42
18	NCA23	Baseline	Lot 1 / DP1152336	111 Bruxner Park Road, Coffs Harbour, NSW 2450	43	38	34	51	47	46	50	45
19	NCA19	Baseline	Lot 162 / DP1033912	133b Mackays Road, Coffs Harbour, NSW 2450	26	29	28	56	37	45	54	45
20	NCA10	Baseline	Lot 2 / DP 1109067	20 Anniversary Place, Coffs Harbour, NSW 2450	31	30	30	44	38	39	45	39
21	NCA06	Baseline	Lot 1 / DP 1184888	Bishop Druitt College, 111 North Boambee Road, North Boambee Valley, NSW 2450	41	38	35	58	62	52	60	56

[1] Monday to Saturday, Day, 7.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night 10.00pm to 7.00am

Sundays & Public Holidays, Day 8.00am - 6.00pm; Evening 6.00pm - 10.00pm; Night 10.00pm - 8.00 am.

[2] Day, 7.00am to 10.00pm; Night 10.00pm to 7.00am

[3] Noise level updated since EIS due to misaligned weather data

2.3 Attended noise monitoring

Short term attended noise measurements were undertaken during both the daytime and night-time periods at all long term unattended noise monitoring locations. In addition, attended noise measurements were undertaken at the following 4 locations:

- 38 Korora Basin Road, Korora NSW 2450
- 83 Old Coast Road, Korora NSW 2450
- 111 Spagnolos Road, Coffs Harbour NSW 2450
- 77 Spagnolos Road, Coffs Harbour NSW 2450.

This measurement data is used to confirm and further analyse long term measurement data. A summary of measured results is provided in Appendix C along with site observations.

3 Noise and vibration criteria

Assessment criteria for this type of development are generally related to the following noise and vibration characteristics brought about by a scheme:

- Change in the level or character of ambient noise or vibration
- The average level of noise and vibration exposure
- The maximum level of the noise or vibration (e.g. during transient events)
- The duration and time of day at which noise or vibration occurs.

The following sections summarise relevant assessment criteria that address each of these characteristics for both operation and construction.

3.1 Operational noise and vibration

Noise impacts from the ongoing operation of the project are assessed under the criteria summarised in the following:

- Road Noise Policy, NSW Environment Protection Agency, 2011 [2]
- Noise Criteria Guideline, Roads and Maritime Services, December 2014 [3]
- Application Notes – Noise Criteria Guideline [4]
- Noise Mitigation Guideline, Roads and Maritime Services, December 2014 [5]
- Model Validation Guideline, Roads and Maritime Services, May 2018 [6]
- Environmental Noise Management Manual, Roads and Maritime Services, 2001 [7]
- Noise Wall Design Guideline, Roads and Maritime Services, 2007 [8]

3.1.1 Noise Criteria Guideline

Noise criteria are assigned to sensitive receivers using Roads and Maritime Noise Criteria Guideline (NCG). The NCG provides guidance on how to implement the NSW Road Noise Policy (RNP).

The operational noise criteria in the Road Noise Policy aims to stop 90% of the community from becoming highly annoyed by traffic noise. In principle, the intention is to protect existing quiet areas from excessive changes in acoustic amenity due to traffic noise.

It is noted that an operational road satisfying the criteria has the potential to be audible in the vicinity of the road corridor. The provision of a good acoustic environment for external spaces around a building (e.g. a courtyard or backyard of a residence) should be considered, although there are no specific criteria relating to these spaces.

The NCG sets out the following four key principles aimed to guide the assessment:

- Criteria are based on the road development type that a receiver would be affected by due to the project.
- Adjacent and nearby residences should not have significantly different criteria for the same road.
- Criteria for the surrounding road network are assessed where a road project generates an increase in traffic noise greater than 2 dB on the surrounding road network.
- Existing quiet areas are protected from excessive changes in amenity due to traffic noise.

Residences may be assigned new, redeveloped, transition zone or relative increase criteria depending on how the project will influence noise levels. For each façade of the residence the most stringent applicable criteria will be used in the assessment.

Criteria are based on the road development type a residence is affected by due to the project. In some instances, residences may be exposed to noise from both new and redeveloped roads. In this instance, the proportion of noise from each road is used to establish transition zone criteria. A further check is made to prevent large increases in noise level using the relative increase criteria.

The project consists of multiple alternating new and redeveloped road segments as shown in Appendix E with transition zones at the southern tie in of the project at Englands Road and at the interchanges at Coramba Road and Korora Hill. Note that a road is new where the road is a tunnel/bypass or has been substantially realigned (outside the NCG tolerance band and/or existing grade). However, consideration can be given to whether a road has been substantially realigned for distances less than six times the existing lane width using local context for guidance.

Table 4 and Table 5 present a summary of operational noise criteria from the NCG relevant to the project for residential land uses. Where these criteria are exceeded, consideration for mitigation is assessed against criteria presented in Section 4.8.

Table 4: Road traffic noise assessment criteria for residential land uses

Road category	Type of project/development	Total traffic noise level increase – (dB)	
		Day (7am–10pm)	Night (10pm–7am)
Freeway / arterial / sub-arterial roads	Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	$L_{Aeq, (15 hour)}$ 55 (external)	$L_{Aeq, (9 hour)}$ 50 (external)
	Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	$L_{Aeq, (15 hour)}$ 60 (external)	$L_{Aeq, (9 hour)}$ 55 (external)

Road category	Type of project/development	Total traffic noise level increase – (dB)	
		Day (7am–10pm)	Night (10pm–7am)
	Existing residences affected by noise from new and redevelopment of existing freeway/arterial/sub-arterial roads (Transition zones)1	$L_{Aeq, (15 hour)}$ 55 - 60 (external)	$L_{Aeq, (9 hour)}$ 50 - 55 (external)
	New road corridor/ redevelopment of existing road/land use development with the potential to generate additional traffic on existing road	Existing traffic $L_{Aeq, (15 hour)}$ + 12 dB (external)	Existing traffic $L_{Aeq, (9 hour)}$ + 12 dB (external)
Local roads	Existing residences affected by noise from new local road corridors Existing residences affected by noise from redevelopment of existing local roads. Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq, (15 hour)}$ 55 (external)	$L_{Aeq, (9 hour)}$ 50 (external)

The NCG also implements incremental transition zone criteria, identified from the contribution difference in noise from each road type using information provided in Table 5.

Table 5: Assignment of new and redeveloped transition zone criteria

Contribution difference, (dB(A)) New minus redeveloped segments	Total noise levels, (dB(A))	
	Daytime criteria	Night time criteria
Contribution difference ≥ +3.0	55	50
+3.0 > Contribution difference ≥ +1.5	56	51
+1.5 > Contribution difference ≥ 0	57	52
0 > Contribution difference ≥ -1.5	58	53
-1.5 > Contribution difference ≥ -3.0	59	54
-3.0 > Contribution difference	60	55

Noise contour difference plots that correspond to the corrections above are provided in Appendix E for all transition zones on the project.

Table 6 summarises NCG criteria for non-residential land uses. Where these criteria are exceeded, consideration of mitigation is assessed in accordance with exceeded, consideration for mitigation is assessed against criteria presented in Section 4.8.

Table 6: Road traffic noise assessment criteria for non- residential land uses

Existing sensitive land use	**Assessment criteria – (dB)**		**Additional considerations**
	Day (7am–10pm)	**Night (10pm–7am)**	
School classrooms	$L_{Aeq, (1\ hour)}$ 40 (internal) when in use	-	In the case of buildings used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the ‘maximum’ levels shown in Australian Standard 2107:2000 (Standards Australia 2000).
Hospital wards	$L_{Aeq, (1\ hour)}$ 35 (internal)	$L_{Aeq, (1\ hour)}$ 35 (internal)	
Places of worship	$L_{Aeq, (1\ hour)}$ 40 (internal)	$L_{Aeq, (1\ hour)}$ 40 (internal)	The criteria are internal, i.e. the inside of a church. Areas outside the place of worship, such as a churchyard or cemetery, may also be a place of worship. Therefore, in determining appropriate criteria for such external areas, it should be established what in these areas may be affected by road traffic noise. For example, if there is a church car park between a church and the road, compliance with the internal criteria inside the church may be sufficient. If, however, there are areas between the church and the road where outdoor services may take place such as weddings and funerals, external criteria for these areas are appropriate. As issues such as speech intelligibility may be a consideration in these cases, the passive recreation criteria may be applied.
Open space (active use)	$L_{Aeq, (15\ hour)}$ 60 (external) when in use	-	Active recreation is characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion. Passive recreation is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, e.g. playing chess, reading. In determining whether areas are used for active or passive recreation, the type of activity that occurs in that area and its sensitivity to noise intrusion should be established. For areas where there may be a mix of passive and active recreation, e.g. school playgrounds, the more stringent criteria apply. Open space may also be used as a buffer zone for more sensitive land uses.
Open space (passive use)	$L_{Aeq, (15\ hour)}$ 55 (external) when in use	-	

Existing sensitive land use	Assessment criteria – (dB)		Additional considerations
	Day (7am–10pm)	Night (10pm–7am)	
Childcare facilities	Sleeping rooms $L_{Aeq, (1\ hour)}$ 35 (internal) Indoor play areas $L_{Aeq, (1\ hour)}$ 40 (internal) Outdoor play areas $L_{Aeq, (1\ hour)}$ 55 (external)	-	Multi-purpose spaces, e.g. shared indoor play/sleeping rooms should meet the lower of the respective criteria. Measurements for sleeping rooms should be taken during designated sleeping times for the facility, or if these are not known, during the highest hourly traffic noise level during the opening hours of the facility.

For the purpose of assessment, where internal noise targets are stipulated, the corresponding external criterion is taken as 10 dB higher. This is a conservative estimate of the sound attenuation assumed to be provided by the facade of typical buildings when the facade glazing is open for the purpose of ventilation.

The Environmental Noise Management Manual (ENMM) provides a summary of indicative building noise reduction for various construction types. This information is reproduced in Table 7 for reference. Conservative assumptions for noise attenuation across building facades will need to be refined during detailed design.

Table 7: Indicative building noise reduction (ENMM Table 4.2)

Building type	Windows	Internal noise reduction (dB(A))
All	Open	10
Light frame	Single glazed (closed)	20
Masonry	Single glazed (closed)	25
	Double glazed (closed)	35

3.1.2 Noise Mitigation Guideline

A consistent approach to assessing whether a receiver should be considered for additional mitigation measures as a result of the traffic noise impacts from a road development is provided by Roads and Maritime in the Noise Mitigation Guideline (NMG).

The following principles take precedence over the procedure outlined in the NMG:

- Communities should receive reasonable and equitable outcomes.
- Noise mitigation should be designed to reduce noise levels to the criteria at qualifying receivers.

- Priority should be first given to reducing noise during corridor planning and road design where there may be greater opportunity to provide cost effective and integrated outcomes with better urban design.
- Following corridor and road design residual exceedances of noise criteria may be addressed at qualifying receivers using in order of preference quieter road surfaces, barriers and at-property treatments.
- Incidental benefits from the noise mitigation designed for qualifying receivers should be recognised at all receivers within a community where noise levels exceed WHO guidelines (Façade noise levels of 50 dB(A) during day and 45 dB(A) during night-time).
- Noise barrier evaluation processes must:
  - Give preference to reducing outdoor noise levels and the number of at-property treatments, and
  - Provide efficient barrier heights and extents without disregarding lengths of effective noise barrier in front of eligible groups of receivers.
- Noise mitigation shall be evaluated and installed where feasible and reasonable.

Feasible and reasonable definitions as per Roads and Maritime are provided in the NMG.

Table 8 presents a summary of noise mitigation criteria relevant to the project. These criteria are as per the NMG. Receivers that exceed these criteria qualify for consideration of additional mitigation.

Table 8: Road traffic noise assessment criteria for residential land uses

Assessment	**Road type**	**Noise criteria**	
		Day (7am-10pm) dB $L_{Aeq, (15 hour)}$	**Night (10pm-7am) dB $L_{Aeq, (9 hour)}$**
Cumulative limit	New Road	60	55
	Redeveloped Road	65	60
	Transition Zone	60 – 65[1]	55 – 60[1]
Acute	New and Redeveloped	65	60

[1] Dependant on source contribution as per Section 7.1 of the NCG.

The procedure to determine whether a receiver qualifies for consideration of additional mitigation requires analysis of the specific contribution from new, redeveloped and existing roads is required at each façade. A receiver is to be considered for additional noise mitigation if any of the following three conditions are met during the daytime or night-time periods:

Condition 1:

- The total noise level at the receiver in the build scenario is equal to or greater than the NCG controlling criterion plus 5dB, and

- The total noise level at the receiver in the build scenario minus the contribution from only existing roads in the build scenario at the receiver is greater than 2 dB.

Condition 2:

- The cumulative noise level contribution from all new and redeveloped roads part of the project is equal to or greater than the acute level.

Condition 3:

- The total noise level at the receiver in the build scenario is greater than the NCG controlling criterion, and
- The total noise level at the receiver in the build scenario minus the total noise level at the receiver in the no-build scenario is greater than 2 dB.

3.1.3 Maximum noise level

Maximum noise events, including compression braking, are assessed against the provisions of Practice Note (iii) of the *Environmental Noise Management Manual (ENMM)*. An assessment of the 'emergence' of the A-weighted maximum noise level above the 1-hour equivalent traffic noise level is used as a screening criterion for the assessment of potential sleep disturbance as follows:

$$L_{Amax} \geqslant L_{Aeq\,(1hour)} + 15\ dB(A)$$

The following is also noted in the ENMM:

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

3.1.4 Industrial noise

The relocation of the Kororo Public School bus interchange, relocation of the Coramba Road bus stop and installation of in-tunnel jet fans at the Shephard Lane and Gatelys Road tunnels have been identified as industrial noise sources requiring assessment.

Assessment of industrial noise sources is made against the *NSW Noise Policy for Industry (NPI)* [9] which is primarily concerned with controlling short-term intrusive noise impacts for residences and maintaining long-term noise level amenity for residences and other noise sensitive land uses.

The NPI sets out the procedure to determine the project noise trigger levels relevant to an industrial development. The project noise trigger level is a level that, if exceeded would indicate a potential noise impact on the community and so 'trigger' a management response.

3.1.4.1 Intrusive Noise Trigger Level

The intrusiveness noise trigger level is applicable to residential premises only and is summarised as follows:

$L_{Aeq,15minute} \leq$ Rating Background Level (RBL) plus 5 dB

where $L_{Aeq,15minute}$ represent the equivalent continuous noise level of the source.

As the Intrusive Noise Trigger Level is established from the prevailing background noise levels at the residential receiver location, the existing background noise level is to be measured.

3.1.4.2 Recommended and Project Amenity Noise Level

To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 of the NPI where feasible and reasonable. An extract from the policy is given below in Table 9.

Table 9: NPI Recommended Amenity Noise Levels (RANLs)

Receiver	**Noise amenity area**	**Time of Day[1]**	**Recommended amenity noise levels (RANLs) L_{Aeq}, dB(A)[2]**
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See column 4	5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School classroom - internal	All	Noisiest 1-hour period when in use	35 (see notes for table)
Hospital ward Internal External	 All All	 Noisiest 1-hour Noisiest 1-hour	 35 50
Place of worship – internal	All	When in use	40

Receiver	Noise amenity area	Time of Day[1]	Recommended amenity noise levels (RANLs) L_{Aeq}, dB(A)[2]
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50
Active recreation area (e.g. school playground, gold course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5 dB(A) to recommended noise amenity area

[1] The NPI defines day, evening and night time periods as:

- Day: the period from 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and Public Holidays.
- Evening: the period from 6 pm to 10 pm.
- Night: the remaining period.

(These periods may be varied where appropriate. In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable L_{Aeq} noise level may be increased to 40 dB $L_{Aeq(1hr)}$)

[2] The Recommended Amenity Noise Levels (RANLs) refer only to noise from industrial sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

The Recommended Amenity Noise Levels (RANL) represent the objective for total industrial noise at a receiver location, whereas the Project Amenity Noise Level (PANL) represents the objective for noise from a single industrial development at a receiver location.

To ensure that any new industrial source of noise is within the RANLs for an area, the PANL applies for each new source of industrial noise as follows:

Project Amenity Noise Level (PANL) = Recommended Amenity Noise Level (RANL) minus 5 dB(A).

The NPI also provides the following exceptions to the above method for deriving the project amenity noise level:

1. In areas with high traffic noise levels.
2. In proposed developments in major industrial clusters.
3. Where the resultant project amenity noise level is equal to or lower than 10 dB than the existing industrial noise level and it can be demonstrated that existing industrial noise levels are unlikely to reduce over time, the project amenity noise levels can be set at 10 dB below existing industrial noise levels.

4. Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for the development.

The NPI also sets the PANLs to $L_{Aeq(period(traffic))}$ minus 15 dB(A) in the case that the level of transport $L_{Aeq(period(traffic))}$ exceeds the RANL by 10 dB or more. This may be applied only if all the following apply:

- Traffic noise is identified as the dominant noise source at the site.
- The existing traffic noise level is 10dB or more above the recommended amenity noise level for the area.
- It is highly unlikely that traffic noise levels will decrease in the future.

The Kororo Public School bus interchange would be located in an area best represented as an urban environment in accordance with the NPI.

The NPI characterises an urban environment as an area that:

- Is dominated by ‘urban hum’ or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources
- Has through traffic with characteristically heavy and continuous traffic flows during peak periods
- Is near commercial or industrial districts, or
- Has any combination of the above.

The acoustic environment in the vicinity of the proposed Kororo Public School bus interchange is best described by Logger Location 9 identified in Table 3 and Appendix B. Processed noise logging results from this location are reproduced in Table 10 for reference.

The tunnels would be located at areas identified as rural environments characterised by the NPI as areas with:

- An acoustical environment that is dominated by natural sounds
- Having little or no road traffic noise
- Generally characterised by low background noise levels, or
- Settlement patterns would be typically sparse.

The acoustic environment around Gatelys Road tunnel and Shephards Lane tunnel are best described by logger locations 16 and 7 respectively, these are identified in Table 3. Table 10 also includes the processed noise logging results from these locations.

Table 10: Unattended noise monitoring results

Logger location	Representative Period	Rating background level[1]			Average L_{Aeq} levels		
		Day	Evening	Night	Day	Evening	Night
Residential around bus interchange Logger 9	Weekday	48	41	34	58	57	55
	Weekend	44	38	32	56	54	50
	Week	48	40	34	57	56	54
Residential around bus stop Logger 4	Weekday	39	32	27	60	56	52
	Weekend	38	32	28	59	55	52
	Week	39	32	27	60	56	52
Residential around Gatelys tunnel Logger 7	Weekday	31	30	28	46	40	39
	Weekend	25	27	26	47	38	36
	Week	28	30	28	46	40	38
Residential around Shephards tunnel Logger 16	Weekday	27	27	25	52	51	53
	Weekend	29	26	24	49	50	53
	Week	27	27	25	51	51	53

[1] where the rating background noise level is found to be less than 30 dB(A) for the evening and night periods, then it is set to 30 dB(A); where it is found to be less than 35 dB(A) for the daytime period, then it is set to 35 dB(A).

Note: Week day is considered the worst-case scenario due to the high frequency of school buses running during the week days.

As discussed in Section 2 and Appendix C, the ambient noise levels at the sensitive receivers near to the proposed bus interchange are characterised by heavy vehicle traffic flows along the existing Pacific Highway. The measured L_{Aeq} ambient noise levels are therefore representative of the L_{Aeq} traffic noise levels experienced in the area.

There are no industrial noise sources in the area and it is unlikely that there will be apart from the proposed bus interchange. Therefore, as stated in item 4 above, the -5 dB(A) correction to the recommended amenity levels does not apply.

Table 11 summarises the RANLs and the PANLs applicable for the project.

Table 11: NPI Recommended and Project Amenity Noise Levels

Receiver	Indicative Noise Amenity Area	Time of day[1]	Recommended Amenity Noise Level (RANL) $L_{Aeq(period)}$	Existing traffic $L_{Aeq(period)}$ exceeds RANL by 10 dB or more?	Other industrial noise sources present?	Project Amenity Noise Level (PANL) $L_{Aeq(period)}$
Residential around bus interchange Logger 9	Urban	Day	60	No	No	60
		Evening	50	No	No	50
		Night	45	Yes (during week days)[2]	No	40[2]
Residential around bus stop Logger 4	Rural	Day	50	Yes (during week days)	No	50
		Evening	45	Yes (during week days)	No	41
		Night	40	Yes	No	37
Residential around Gatelys tunnel Logger 7	Rural	Day	50	No	No	50
		Evening	45	No	No	45
		Night	40	No	No	40
Residential around Shephards tunnel Logger 16	Rural	Day	50	No	No	50
		Evening	45	No	No	45
		Night	40	Yes	No	35

Notes

[1] The NPI defines day, evening and night time periods as:

- Day: the period from 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and Public Holidays.
- Evening: the period from 6 pm to 10 pm.
- Night: the remaining period.

[2]: Traffic noise levels might decrease in the future in this area due to noise mitigation introduced for the project; in this case, traffic $L_{Aeq(period)}$ would not exceed the RANL by more than 10 dB(A) and the PANL would be equal to the RANL. As a conservative approach it is assumed that traffic noise might still be 10 dB or above RANL and therefore the PANL = RANL – 5 dB(A) for the night-time period

3.1.4.3 Correction factors

The NPI recommends correction factors be implemented for one-off events, such as the testing of in-tunnel fans, where a single noise event is continuous for a period of less than two and a half hours in any assessment period. Table 13 shows the relevant correction factors for each allowable duration of noise as per the NPI.

Table 12: Adjustment for duration

Allowable duration of noise (one event in any 24-hour period)	Allowable exceedance of $L_{Aeq,15min}$ equivalent project noise trigger level at receptor for the period of the noise event, dB(A)	
	Daytime and evening (7 am–10 pm)	Night-time (10 pm–7 am)
1 to 2.5 hours	2	Nil
15 minutes to 1 hour	5	Nil
6 minutes to 15 minutes	7	2
1.5 minutes to 6 minutes	15	5
Less than 1.5 minutes	20	10

It is anticipated that any testing of in-tunnel ventilation fans will occur during the daytime period and for a period not longer than one hour. Therefore, the project noise trigger level may be increased by +5 dB.

3.1.4.4 Sleep disturbance

The NPI also recommends the following screening criteria for the assessment of potential sleep disturbance, for the period between 10 pm and 7 am:

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

3.1.4.5 NPI Project specific noise levels

The project specific noise levels are the lower of the Intrusive Noise Trigger Levels and the Project Amenity Noise Levels. However, it is noted that the Intrusive Noise Trigger Levels apply for a 15-minute period while the Project Amenity Noise Levels apply for the whole daytime period (11 hours), evening period (4 hours) and night time period (9 hours). To enable a direct comparison between the two criteria, the NPI aims to standardise the assessment period and assumes that the intrusive noise emissions (over 15 minutes) are generally higher by 3 dB(A) than the amenity noise emissions (over a whole period of the day). Therefore, a 3 dB(A) correction factor is applied to the project amenity noise level ($L_{Aeq,\ period}$) to get to a project amenity noise level ($L_{Aeq,\ 15min}$).

The project specific noise levels in accordance with the NPI are highlighted in Table 13.

Table 13: NPI project specific noise levels

Receiver	Time Period[1]	Project Specific Noise Levels			
		Intrusive Noise Trigger Levels $L_{Aeq(15min)}$	**Project Amenity Noise Level (PANL)[3] $L_{Aeq(15min)}$**	**Sleep Disturbance $L_{Aeq(15min)}$**	**Sleep Disturbance $L_{Amax(night)}$**
Residential around bus interchange Logger 9	Day	**53**	63	N/A[2]	N/A[2]
	Evening	**45**	53	N/A[2]	N/A[2]
	Night	**39**	43	**40**	**52**
Residential around bus stop Logger 4	Day	**44**	53	N/A[2]	N/A[2]
	Evening	**37**	44	N/A[2]	N/A[2]
	Night	**32**	40	**40**	**52**
Residential around Gatelys tunnel Logger 7[4]	Day	**40**	53	N/A[2]	N/A[2]
	Evening	**35**	48	N/A[2]	N/A[2]
	Night	**35**	43	**40**	**52**
Residential around Shephards tunnel Logger 16[4]	Day	**40**	53	N/A[2]	N/A[2]
	Evening	**35**	48	N/A[2]	N/A[2]
	Night	**35**	38	**40**	**52**

Notes

[1] The NPI defines day, evening and night time periods as:

- Day: the period from 7 am to 6 pm Monday to Saturday; or 8 am to 6 pm on Sundays and Public Holidays.
- Evening: the period from 6 pm to 10 pm.
- Night: the remaining period.

[2] N/A Not Applicable

[3] In accordance with NPI, PANLs ($L_{Aeq, period}$) adjusted up by 3 dB for comparison with Intrusive Noise Trigger Levels ($L_{Aeq,15 min}$)

[4] Adjustment for duration not applied

3.2 Construction noise and vibration

Construction noise and vibration is assessed in accordance with the NSW Roads and Maritime Services *Construction noise and vibration guideline* (CNVG) [10], which superseded Section 5 and Practice Note (vii) of the ENMM. The CNVG is to be considered for all Roads and Maritime projects including minor works and maintenance projects but excluding emergency works. It is noted that construction vehicle traffic and traffic diversions are to be assessed and mitigated using standard road traffic noise processes.

The CNVG summarises all criteria to be applied to construction noise and vibration for road projects with reference to the following guidelines:

- Interim Construction Noise Guideline (ICNG), DECC, 2009 [11]
- Road Noise Policy (RNP), 2011 [2]
- Noise Policy for Industry (NPI), 2017 [9]
- Assessing Vibration: a technical guideline, DEC, 2006 [12]
- BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2, BSI, 1993 [13]
- DIN 4150: Part 3-1999 Structural vibration – Effects of vibration on structures, Deutsches Institute fur Normung, 1999 [14]
- AS 2187: Part 2 - Explosives Storage and Use: Use of explosives 2006 [15]
- BS 6472: Part 2 - Guide to evaluation of human exposure to vibration in buildings. Blast induced vibration 2008 [16]
- Australia and New Zealand Environment Conservation Council (ANZECC) Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration 1990 [17]
- Swedish Standard SS 460 48 66 - Vibration and shock – Guidance Levels For Blasting-Induced Vibration In Buildings 2011 [18]
- Report 429: Ground-borne vibration caused by mechanised construction works. Transport Research Laboratory 2000 [19]

3.2.1 Recommended hours of construction

The CNVG recommends construction activities (including the delivery of plant and equipment) should be limited to within the standard hours described in Table 14 below wherever feasible and reasonable.

Table 14: CNVG recommended construction hours

Construction hours	Monday to Friday	Saturday	Sunday / Public holiday
Standard construction hours	7:00 am to 6:00 pm	8:00 am to 1:00 pm	No work
Construction activities with impulsive or tonal noise emissions[2]	8:00 am to 5:00 pm[1]	9:00 am to 1:00 pm[1]	No work
Blasting[3]	9:00 am to 5:00 pm	9:00 am to 1:00 pm	No blasting

[1] Works may be carried out in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block. 'Continuous' includes any period during which there is less than a one-hour respite between ceasing and recommencing any of the work the subject of this condition.

[2] Examples include but are not limited to jackhammers, rock breakers, power saws, rock drilling, vibratory rollers, milling and profiling machines and impact piling

[3] Consistent with recent SSI approval conditions, it is anticipated blasting may also be carried out outside the CNVG recommended construction hours when no sensitive receivers would be impacted by blasting and/or when TfNSW has an agreement with the potentially affected receivers.

3.2.2 Airborne construction noise

In accordance with the CNVG, construction noise management levels (NMLs) are to be established in accordance with the ICNG. These NMLs are then used to determine the construction noise mitigation measures and control the noise amenity at residences, other sensitive land uses and, commercial and industrial premises.

The following sections discuss NML screening criteria for noise sensitive receiver types.

3.2.2.1 Residential receivers

The ICNG provides an approach for determining the construction NMLs for residential receivers based on the measured Rating Background Level (RBL). The ICNG establishes “Noise affected” and a “Highly noise affected” construction NMLs to determine the noise management requirements necessary to minimise the construction noise impacts upon noise sensitive residential receivers.

Table 15 summarizes the construction noise NMLs for residential receivers.

Table 15: Construction NMLs for residential receivers

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

Time of day	Construction NMLs [1] $L_{Aeq\ (15\ min)}$	How to apply
Outside recommended standard hours	Noise affected RBL + 5dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Notes:
[1] Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

3.2.2.2 Other sensitive land uses

The CNVG provides recommended noise management levels for sensitive land uses not classified in previous sections. These recommended limits are reproduced in Table 16.

Table 16: ICNG Construction NMLs for other sensitive receivers

Sensitive Land Use	Management level, $L_{Aeq,15min}$ (applies when properties are being used)
Classrooms at schools and other educational institutions.	Internal noise level 45 dB(A)
Child care facilities	Internal noise level 45 dB(A) (based on the maximum internal noise level for nurseries in AS 2107)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of Worship	Internal noise level 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)
Community centres	Internal noise levels 45 dB(A) (based on the maximum internal noise level for Reading Areas in public libraries in AS2107)

Sensitive Land Use	Management level, $L_{Aeq,15min}$ (applies when properties are being used)
Commercial premises	External noise level 70 dB(A)
Industrial premises	External noise level 75 dB(A)
Other business that may be noise sensitive (such as theatres, etc)	Internal noise level – Project Specific

For sensitive receivers such as hospitals, child care facilities, schools and places of worship, the NMLs presented in Table 16 are based on internal noise levels. For this assessment, it is conservatively assumed that these receivers have openable windows. On the basis that external noise levels are typically 10 dB higher than internal noise levels when windows are open, an external NML of 55 dB $L_{Aeq(15minute)}$ has been adopted. As noted in Section 3.1.1 this is a conservative estimate of the sound attenuation assumed to be provided by the facade of typical buildings when the facade glazing is open for the purpose of ventilation.

For work within standard construction hours, if after implementing all ‘feasible and reasonable’ noise levels still exceed the noise affected level, no further action is required.

For out-of-hours work, a noise level 5 dB above the noise-affected level as a threshold where the proponent should negotiate with the community. While there is no ‘highly-noise affected level’ outlined in the ICNG for out-of-hours work, this report adopts the terminology where the construction noise level is 5 dB above the noise affected level.

3.2.2.3 Sleep disturbance

Factors that are important in assessing the extent of noise impact include how often high noise events occur at night, the predicted maximum noise levels at night, whether there are times when there is a clear change in the noise environment, and the extent of noise emergence above the background noise. EPA's management level for assessing and managing construction noise is established with reference to a single digit rating background noise level (RBL) for the day, evening and night-time period. Using RBL is a conservative assessment approach as RBL is derived based on time periods where the lowest 10th percentile background noise level might occur.

For the assessment of noise disturbance during waking hours, the assessment adopts the equivalent sound pressure level indicator, L_{Aeq}. For screening potential awakening reactions, the assessment adopts the maximum noise level indicator, L_{Amax}. Both the L_{Aeq} and L_{Amax} assessment indicators are consistent with EPA's ICNG, and noise impact is assessed with reference to the RBL. The outcome of this approach coupled with worst case construction noise prediction is that the emergence above background noise will be conservatively over-estimated to ensure that the noise management level can be met for at least 90% of the time periods over which disturbance can occur.

3.2.2.4 CNVG

Appendix E of the CNVG refers to a 65 dB L_{Amax} external noise level as a sleep disturbance criterion which corresponds to the now superseded ENMM criteria (considering a 10 dB reduction from external level to internal level with windows open). For reference, the ENMM stated the following:

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

The CNVG describes the L_{Amax} as:

> "The L_{Amax} represents the "Maximum Noise Level" for an event, used in the assessment of potential sleep disturbance during night-time periods. The subscript "A" indicates that the noise levels are filtered to match normal human hearing characteristic (i.e. A-weighted). "Fast" time constant is used for this measurement."

3.2.2.5 ICNG

The ICNG also states the above-mentioned criteria and refers to the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA 1999) for assessment of sleep disturbance. The ECRTN discusses a guideline aimed at limiting the level of sleep disturbance due to environmental noise – that the $L_{AF1,1\text{-minute}}$ level of any noise should not exceed the ambient L_{AF90} noise level by more than 15 dB. The $L_{AF1,1\text{-minute}}$ descriptor is meant to represent a maximum noise levels equivalent to the L_{Amax} for the assessment of sleep disturbance.

The ICNG indicates that important factors to look at in assessing the extent of impact on sleep disturbance is how often high noise events occur at night, whether there are times when there is a clear change in the noise environment and the degree of maximum noise levels above the background noise level at night.

It is noted that most receiver locations across the project study area currently experience very low ambient background noise levels, particularly during the night-time period. Considering this and to protect the community against significant health impacts, this assessment has been undertaken using the ICNG and CNVG 'screening criterion' of RBL + 15 dB and maximum external 65 dB(A) criterion (Awakening reaction) as being the most stringent of the quoted literature.

3.2.2.6 Project specific construction NMLs

Measured noise data obtained at the logger location most representative of each noise catchment area has been used to derive appropriate construction NMLs for the project. These are summarised in Table 17.

The noise monitoring locations were selected to capture background noise levels at the typically most affected receiver locations in the various catchments along the alignment. The most affected receivers are usually front row receivers which have a direct line of sight to the construction works. Refer to Appendix B for the location of the Noise Catchment Areas (NCAs).

Table 17: Construction NMLs during intended working hours

Location	Logger ID	RBL, dB(A) (Refer to Section2.2)[1]			Construction NMLs, $dBL_{Aeq\ 15minute}$					Sleep Disturbance, dBL_{Amax}	
					Standard Hours		Outside of Standard Hours				
		Daytime	Evening	Night-time	Highly noise affected	Noise affected (RBL + 10 dB)	Noise affected (RBL + 5dB)			Screening criterion RBL + 15	Max
					Standard Hours - Day[3]	Standard Hours – Day[3]	OOSH – Day[4]	OOSH – Evening[5]	OOSH – Night-time[6]		
Residential											
NCA01	11	58	51	39	75	68	63	56	44	54	65
NCA02	1	47	45	39	75	57	52	50	44	54	65
NCA03	1	47	45	39	75	57	52	50	44	54	65
NCA04	1	47	45	39	75	57	52	50	44	54	65
NCA05	2	35	32	31	75	45	40	37	36	46	65
NCA06	2	35	32	31	75	45	40	37	36	46	65
NCA07	3	35	34	36	75	45	40	39	41	51	65
NCA08	3	35	34	36	75	45	40	39	41	51	65
NCA09	20	35	30	30	75	45	40	35	35	45	65
NCA10	20	35	30	30	75	45	40	35	35	45	65
NCA11	4	39	32	30	75	49	44	37	35	45	65
NCA12	5	37	31	30	75	47	42	36	35	45	65
NCA13	4	39	32	30	75	49	44	37	35	45	65
NCA14	12	35	30	30	75	45	40	35	35	45	65
NCA15	6	35	30	30	75	45	40	35	35	45	65
NCA16	16	35	30	30	75	45	40	35	35	45	65
NCA17	19	35	30	30	75	45	40	35	35	45	65
NCA18	13-7[2]	35	31	30	75	45	40	36	35	45	65

Location	Logger ID	RBL, dB(A) (Refer to Section2.2)[1]			Construction NMLs, $dBL_{Aeq\ 15minute}$					Sleep Disturbance, dBL_{Amax}	
					Standard Hours		**Outside of Standard Hours**				
		Daytime	**Evening**	**Night-time**	**Highly noise affected**	**Noise affected (RBL + 10 dB)**	**Noise affected (RBL + 5dB)**			**Screening criterion RBL + 15**	**Max**
					Standard Hours - Day[3]	**Standard Hours – Day[3]**	**OOSH – Day[4]**	**OOSH – Evening[5]**	**OOSH – Night-time[6]**		
NCA19	19	35	30	30	75	45	40	35	35	45	65
NCA20	13-7[2]	35	31	30	75	45	40	36	35	45	65
NCA21	8	65	53	38	75	75	70	58	43	53	65
NCA22	8	65	53	38	75	75	70	58	43	53	65
NCA23	18	43	38	34	75	53	48	43	39	49	65
NCA24	9	48	40	34	75	58	53	45	39	49	65
NCA25	9	48	40	34	75	58	53	45	39	49	65
NCA26	15	52	46	37	75	62	57	51	42	52	65
NCA27	14	56	47	38	75	66	61	52	43	53	65
NCA28	10	60	50	42	75	70	65	55	47	57	65
NCA29	14	56	47	38	75	66	61	52	43	53	65
Commercial	-	Use hours			-	70				-	-
Educational	-	Use hours			-	55				-	-
Hospital	-	Use hours			-	45				-	-
Place of worship	-	Use hours			-	55				-	-
Child care facilities	-	Use hours			-	45				-	-

Note 1: The RBLs have been adjusted in accordance with the NPI definition of minimum RBLs (daytime – 35 dB(A), Evening – 30 dB(A), Night-time – 30 dB(A))
Note 2: Minimum of monitoring location 7 and 13
Note 3 - 07:00-18:00 Monday to Friday, 08:00-13:00 Saturday
Note 4 - Outside Standard hours – Day 13:00-18:00 Saturday, 08:00-18:00 Sunday
Note 5 - Outside Standard hours – Evening: 18:00-22:00 Monday to Sunday
Note 6 - Outside Standard hours – Night: 22:00-07:00 Monday to Saturday and 22:00-08:00 Sundays & Public Holidays

3.2.3 Ground-borne construction noise

Ground-borne noise is generated from underground vibration-intensive works which may be transmitted through the ground into a building structure. This is a potential impact of the works involved in the construction of tunnels. The CNVG establishes criteria for ground-borne construction noise which is presented in Table 18.

Table 18: Ground-borne noise criteria

Time of day	Ground-borne noise objectives $L_{Aeq(15minute)}$
Daytime 7.00 am to 6.00 pm	Human comfort vibration objectives only
Evening 6.00 pm to 10.00 pm	40 dB(A) - Internal
Night-time 10.00 pm to 7.00 am	35 dB(A) - Internal

3.2.4 Construction road traffic noise

Noise emissions from trucks and other vehicles when travelling on a construction site are included in the overall construction site emissions which are assessed against the CNVG (which refers to the ICNG).

Noise emissions from trucks and other vehicles when travelling on the public roads are considered as additional road traffic noise and are assessed against the CNVG (which refers to the RNP).

When assessing noise impact from construction vehicles using the existing road network, an initial screening test is first undertaken by evaluating whether noise levels are expected to increase by more than 2 dB(A) due to construction traffic or a temporary reroute due to a road closure.

Where noise levels are predicted to increase by more than 2 dB(A) (i.e. 2.1 dB or greater) further assessment is required to be conducted in accordance with the RNP. The relevant section of the RNP is given below in Table 19.

Table 19: RNP criteria for assessing construction vehicles on public roads

Road Category	Type of Project/Land Use	Assessment Criteria (dB(A))	
		Daytime (7 am - 10 pm)	Night-time (10 pm - 7 am)
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

3.2.5 Ground-borne construction vibration

Criteria for construction vibration must address:

- The potential for disturbance and annoyance to building occupants (Human comfort vibration, Section 3.2.5.1)
- The potential damage to contents within a building, and
- The potential for damage to buildings and other structures.

Ground vibration is assessed in accordance with the CNVG which refers to the NSW "Assessing Vibration; a technical guideline" with regards to human comfort and to BS 7385 and DIN 4150 for damage to buildings.

3.2.5.1 Human comfort

Potential vibration disturbance to human occupants of buildings is made in accordance with the NSW DEC '*Assessing Vibration; a technical guideline*'. The criteria outlined in the guideline is based on the British Standard BS 6472-1992 '*Evaluation of human exposure to vibration in buildings (1-80Hz)*'. Sources of vibration are defined as either 'Continuous', 'Impulsive' or 'Intermittent', as described in Table 20.

Table 20: Types of vibration – Definition

Type of vibration	Definition	Examples
Continuous vibration	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time)	Machinery, steady road traffic, continuous construction activity
Impulsive vibration	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent vibration	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers, crushing. Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria.

Table 21 reproduces the 'Preferred' and 'Maximum' values for continuous and impulsive vibration from Table 2.2 of the Guideline.

Table 21: Preferred and maximum vibration acceleration levels for human comfort, m/s^2

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Critical areas[2]	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Workshops	Day- or night-time	0.04	0.029	0.080	0.058
Impulsive vibration (weighted RMS acceleration, m/s^2, 1-80Hz)					
Critical areas[2]	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92
Workshops	Day- or night-time	0.64	0.46	1.28	0.92

[1] Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am

[2] Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specified above. Alternative criteria are outside the scope of the policy and other guidance documents should be referred to.

Table 22 reproduces the ‘Preferred’ and ‘Maximum’ values for intermittent vibration from Table 2.4 of the Guideline.

It is noted that the VDV is dependent upon the level and duration of the vibration episode and the number of vibration episodes occurring during the assessment period.

Table 22: Acceptable vibration dose values (VDV) for intermittent vibration (m/s$^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26

Location	Daytime[1]		Night-time[1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

[1] Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am

[2] Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous of impulsive criteria for critical areas.
Source: BS 6472-1992

3.2.5.2 Structural damage

Potential structural or cosmetic damage to buildings as a result of vibration is typically assessed in accordance with BS7385-2. BS7385-1, defines different levels of structural damage as:

- *Cosmetic – The formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.*
- *Minor – The formation of large cracks or loosening of plaster or drywall surfaces, or cracks through bricks/concrete blocks.*
- *Major – Damage to structural elements of the building, cracks in supporting columns, loosening of joints, splaying of masonry cracks, etc.*

Table 1 and section 7.4.2 of BS7385-2 sets limits for the protection against the different levels of structural damage and those levels are reproduced below.

Table 23: BS 7385-2 structural damage criteria

Group	Type of structure	Damage level	Peak component particle velocity, mm/s[1]		
			4 Hz to 15 Hz	15 Hz to 40 Hz	40 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	Cosmetic	50		
		Minor[2]	100		
		Major[2]	200		
2	Un-reinforced or light framed structures Residential or light commercial type buildings	Cosmetic	15 to 20	20 to 50	50
		Minor[2]	30 to 40	40 to 100	100
		Major[2]	60 to 80	80 to 200	200

Notes:

[1] Peak Component Particle Velocity is the maximum Peak particle velocity in any one direction (x, y, z) as measured by a tri-axial vibration transducer.

[2] Minor and major damage criteria established based on British Standard 7385 Part 2 (1993) Section 7.4.2

The guide values in Table 23 relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 23 may need to be reduced by up to 50%.

Monitoring should be undertaken at strategic locations before and during construction to measure the Peak Particle Velocity at the structure and to check that the Peak Particle Velocity remains below the guide values in Table 23. Exceedances of those guide values might indicate that resonance has been activated in the structure. Reduction of the guide value and potential further investigations would then be required.

3.2.5.3 Heritage buildings

Regarding heritage buildings, British Standard 7385 Part 2 (1993, p.5) notes that heritage buildings should be assessed on a case by case basis and that "*a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive*".

If a heritage building has been identified as potentially sensitive to vibrations, the German Standard DIN 4150 - Part 3 '*Structural vibration in buildings - Effects on Structure*' (DIN 4150-3), which is more conservative than BS 7385 criteria, should be applied.

The DIN 4150 criteria for short term vibration are presented in Table 24. For heritage buildings, criteria associated with group 3 should be used.

Table 24: DIN 4150-3 structural damage criteria – Short term vibration

Group	Type of structure	Vibration velocity, mm/s			
		At foundation at frequency of			Vibration at horizontal plane of highest floor
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic value (e.g. buildings under a preservation order)	3	3 to 8	8 to 10	8

Note that short-term vibration is defined as vibration which does not occur often enough to cause structural fatigue, and which does not produce resonance in the structure being evaluated.

Buried Services

DIN 4150-2:1999 sets out guideline values for vibration effects on buried pipework and reproduced in Table 25 below.

Table 25: Guideline values for short-term vibration impacts on buried pipework

	Pipe material	Guideline values for vibration velocity measured on the pipe, mm/s
1	Steel (including welded pipes)	100
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
3	Masonry, plastic	50

Note: For gas and water supply pipes within 2m of buildings, the levels given in Table 25 should be applied. Consideration must also be given to pipe junctions with the building structure as potential significant changes in mechanical loads on the pipe must be considered.

The guideline values above may be reduced by 50% without further analysis when evaluating the effects of long-term vibration on buried pipework.

Note that short-term vibration is defined as vibration which does not occur often enough to cause structural fatigue, and which does not produce resonance in the structure being evaluated.

In addition, specific limits for vibration affecting high-pressure gas pipelines is provided in the UK National Grid's *Specification for Safe Working in the Vicinity of National Grid High Pressure Gas Pipelines and Associated Installations – Requirements for Third Parties* (report T/SP/SSW/22, UK National Grid, Rev 10/06, October 2006). This specification states that no piling is allowed within 15 m of a pipeline without an assessment of the vibration levels at the pipeline. The PPV at the pipeline is limited to a maximum level of 75 mm/s, and where PPV is predicted to exceed 50 mm/s the ground vibration is required to be monitored.

Other services that maybe encountered include electrical cables and telecommunication services such as fibre optic cables. While these may sustain vibration velocity levels from between 50 mm/s and 100 mm/s, the connected services such as transformers and switchgear, may not. Where encountered, site specific vibration assessment in consultation with the utility provider should be carried out to identify and manage impacts on potentially vibration sensitive infrastructure.

3.2.6 Blasting

In accordance with the CNVG, preliminary assessment of ground vibration and blast over pressure is to be undertaken where blasting is anticipated. The CNVG refers to AS2187, BS6472 and BS7385-2 for assessment.

Ground vibration and air blast (also called blast overpressure) are two environmental impacts from blasting. Ground vibration from blasting is the radiation of mechanical energy within a rock mass or soil. Air blast is the pressure wave (sound) produced by the blast and transmitted through the air.

The air blast is generally more noticeable than the ground vibration and the cause of more complaints than ground-borne vibration. High levels of vibration transmitted through the ground and the air blast could annoy residents, or in the extreme, cause damage to buildings or structures.

Appendix J of AS2187.2:2006 provides general guidance on appropriate limits for ground vibration and air blast overpressure from blasting.

With respect to the criteria presented, AS2187 notes the following:

- A sensitive site includes houses and low rise residential buildings, theatres, schools, and other similar buildings occupied by people
- The table does not cover high-rise buildings, buildings with long-span floors, specialist structures such as reservoirs, dams and hospitals, or buildings housing scientific equipment sensitive to vibration
- The recommendations are informative only.

Building damage is unlikely to be caused below these vibration levels and below the overpressure limits. Studies and experience show that well designed and controlled blasts are unlikely to create ground vibrations of a magnitude that causes damage. Also, it is noted that cracks in buildings may be attributable to causes other than ground vibration, including ground or foundation movements (settlement and swell) associated with reactive clay soils during periods of prolonged dry or wet weather.

The Maximum Instantaneous Charge (MIC) will typically be limited to prevent unacceptable levels of air overpressure and noise.

Should levels be predicted to increase beyond those outlined below, written agreements would be sought with affected land owners.

3.2.6.1 Ground vibration limits

AS2187 recommended limits for ground vibration associated with blasting are summarised in Table 26.

Table 26: AS2187 recommended ground vibration limits for blasting

Category	Type of blasting operations	Peak component particle velocity (mm/s)
Human comfort limits		
Sensitive site*	Operations lasting longer than 12 months or more than 20 blasts	5 mm/s for 95% blasts per year 10 mm/s maximum unless agreement is reached with the occupier that a higher limit may apply
Sensitive site*	Operations lasting for less than 12 months or less than 20 blasts	10 mm/s maximum unless agreement is reached with occupier that a higher limit may apply
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	25 mm/s maximum unless agreement is reached with occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation
Structural control limits		
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction	All blasting	Frequency-dependent damage limit criteria Tables J4.4.2.1 and J4.4.4.1 of the standard.
Unoccupied structures of reinforced concrete or steel construction	All blasting	100 mm/s maximum unless agreement is reached with the owner that a higher limit may apply
Service structures, such as pipelines, powerlines and cables	All blasting	Limit to be determined by structural design methodology

3.2.6.2 Air blast overpressure limits

AS2187 recommended limits for air blast overpressure associated with blasting are summarised in Table 27.

Table 27: AS2187 recommended air blast overpressure limits for blasting

Category	Type of blasting operations	Peak component particle velocity (mm/s)
Human comfort limits		
Sensitive site*	Operations lasting longer than 12 months or more than 20 blasts	115 dBL for 95% blasts per year. 120 dBL maximum unless agreement is reached with occupier that a higher limit may apply
Sensitive site*	Operations lasting for less than 12 months or less than 20 blasts	120 dBL mm/s for 95% blasts. 125 dBL maximum unless agreement is reached with occupier that a higher limit may apply
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum unless agreement is reached with the occupier that a higher limit may apply. For sites containing equipment sensitive to vibration, the vibration should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation
Damage control limits		
Structures that include masonry, plaster and plasterboard in their construction and also unoccupied structures of reinforced concrete or steel construction	All blasting	133 dBL maximum unless agreement is reached with the owner that a higher limit may apply
Service structures, such as pipelines, powerlines and cables	All blasting	Limit to be determined by structural design methodology

The ANZECC document acknowledges that there could be some exceedance of the overpressure limit of 115 dB and the ground vibration limit of 5 mm/s on infrequent occasions. This should be limited to not more than 5% of total blasts. During this time, the overpressure level should not exceed 120 dB at any time and the ground vibration limit should not exceed 10 mm/s at any time.

3.2.6.3 Swedish standard SS 460 48 66

Swedish Standard SS460 48 66 [18] summarises a method for a more detailed calculation of vibration from blasting for different types of buildings and ground conditions. The guidance levels are for the peak particle velocity monitored in vertical direction. The Swedish Standard accounts for the type of frequencies generated by the blast, travelling through the ground and within the structures.

Screening criteria and calculations provided in AS2187 have been used as the basis of this assessment in alignment with SEARs requirements for the EIS. For locations where a more detailed understanding of potential vibration impacts from blasting is required due to proximity to sensitive structures, it is recommended that the Swedish standard SS 460 48 66 be referenced with assistance from a specialist consultant.

4 Operational noise and vibration assessment

4.1 Study area

The project assessment area extends to a maximum width of about 600 metres either side of the project. This distance is based on the limit of accuracy of the road traffic noise model used for the assessment and is in accordance with the RNP. For the rural areas of the project, the criteria provided in Section 3 may still be exceeded beyond 600 metres. The potential for these exceedances will be investigated during detailed design with further traffic and noise monitoring and modelling being undertaken to confirm requirements for additional mitigation including at property treatments. The project assessment area is shown in Appendix B.

4.2 Noise sensitive receivers

Noise sensitive receivers aligning the project area are predominantly residential with a limited number of non-residential noise sensitive receivers. Non-residential receiver locations have been summarised in Table 28. Where these receivers are within the study area, they have been summarised in Appendix G and shown on the maps in Appendix B. To assist with identification, building IDs have also been provided in Table 28 for cross reference against Appendices.

Table 28: Non-residential noise sensitive receiver locations

Receiver type	Description	Building ID	Address
Education	Kororo Public School	NCA26.SCH.0001.01	3 Korora School Road, Korora NSW 2450
	Bishop Druitt College	NCA06.SCH.0001.01	111 North Boambee Road, North Boambee Valley NSW 2450
	Coffs Harbour Montessori Preschool	NCA26.SCH.0002.01	27 James Small Drive, Korora NSW 2450
	NSW School of Natural Medicine[1]	NCA08.SCH.0008.01	202 North Boambee Road, North Boambee Valley NSW 2450
Health	Coffs Harbour Health Campus	NCA05.HOS.0001.01	345 Pacific Highway, Coffs Harbour NSW 2450
	Coffs Harbour GP Super Clinic	NCA03.HOS.0001.01	51 Stadium Drive, Coffs Harbour NSW 2450
Places of Worship	The Foursquare Church Australia	NCA05.POW.0001.01	10/12 Elswick Place, North Boambee Valley NSW 2450
	Bishop Druitt School Chapel	NCA06.POW.0001.01	111 North Boambee Road, North Boambee Valley NSW 2450

Receiver type	Description	Building ID	Address
Active recreation	Coffs coast sport and leisure field	NCA03.ARA.0001.01 To NCA03.ARA.0004.01	Stadium Drive, Coffs Harbour NSW 2450
	Boambee equestrian Centre (Outdoor grassed riding area)	NCA02.ARA.0001.01	498a Pacific Highway, Coffs Harbour NSW 2450
	Pacific Bay Resort Golf Course	NCA22.ARA.0001.01	Cnr Pacific Highway and Charlesworth Bay Road, Coffs Harbour NSW 2450
	Elite Training Centre Pacific Bay Resort[1]	NCA21.ARA.0001.01	Lot 5 DP 820652, West Korora Road, Coffs Harbour NSW 2450
Passive recreation	Kororo Nature Reserve	NCA23.PAS.0001.01	Korora NSW 2450
Child care facilities	Petit Early Learning Journey Coffs Harbour	NCA05.CCF.0001.01	1 Kiddell Place, North Boambee Valley NSW 2450
	Cow & Koala Professional Child Care	NCA13.CCF.0001.01	15 William Sharp Drive, Coffs Harbour NSW 2450

[1] It is noted that this receiver is no longer operational, however, has been retained for the purpose of this assessment.

Appendix B provides an aerial image that depicts all receivers within the study area classified by type.

4.3 Noise catchment areas

Noise sensitive receiver locations within the study area were determined using a combination of the following resources:

- Aerial imagery (captured July 2018)
- Council databases (March 2018);
- Noise survey site visits (June/November 2016)
- Ground truthing of temporary accommodation sites at Boambee Palms Holiday and Accommodation Park[1] and Bananacoast Caravan Park (August 2018).

Noise sensitive receivers within the study area are predominantly rural residential. There are a small number of non-residential receivers in proximity to the proposed alignment which are summarised in Table 28.

To facilitate analysis, noise sensitive receivers were grouped together into 28 noise catchment areas (NCAs) based on areas that receive similar exposure to future noise from operation and construction of the project. Noise catchment areas are numbered and clearly identified on aerial images in Appendix B along with identification of individual receiver types.

[1] Changed ownership in 2019, previously known as Koala Villas & Caravan Park

4.3.1 Approved Development Applications

Development Applications (DA) for proposed developments within the study area were sought from relevant approval authorities. Available applications lodged as of November 2019 have been considered in the assessment and are discussed in this section. The responsibility to provide at-property treatments to mitigate traffic noise impacts from the project varies in each case depending on the approved DA conditions.

The six approved residential subdivisions and masterplan considered as part of this assessment are:

- Elements Estate, near the Englands Road Interchange
- Highlands Estate, near North Boambee Road
- The Lakes Estate, near North Boambee Road
- Sunset Ridge Estate, near Shephards Lane
- Pacific Bay Eastern Lands, near James Small Drive
- Korora Residential Subdivision, near Opal Boulevard.

Each of the above listed subdivisions is shown on aerial imagery for the project in Figure 1 and on corresponding noise prediction maps in Appendix G.

A search of recently approved DAs, particularly residential subdivisions, within 600 m of the project was undertaken for the period following exhibition of EIS up until 14 May 2020. One DA for a new residential development at 65A-65C Stadium Drive, Coffs Harbour was considered relevant to the project and is considered in Section 4.3.1.1.

Other recently approved DAs within 600 m of the project only consisted of individual dwellings, minor subdivisions (e.g. one larger lot being divided into three) or modifications to existing premises. These receivers will be considered during further detailed design assessment.

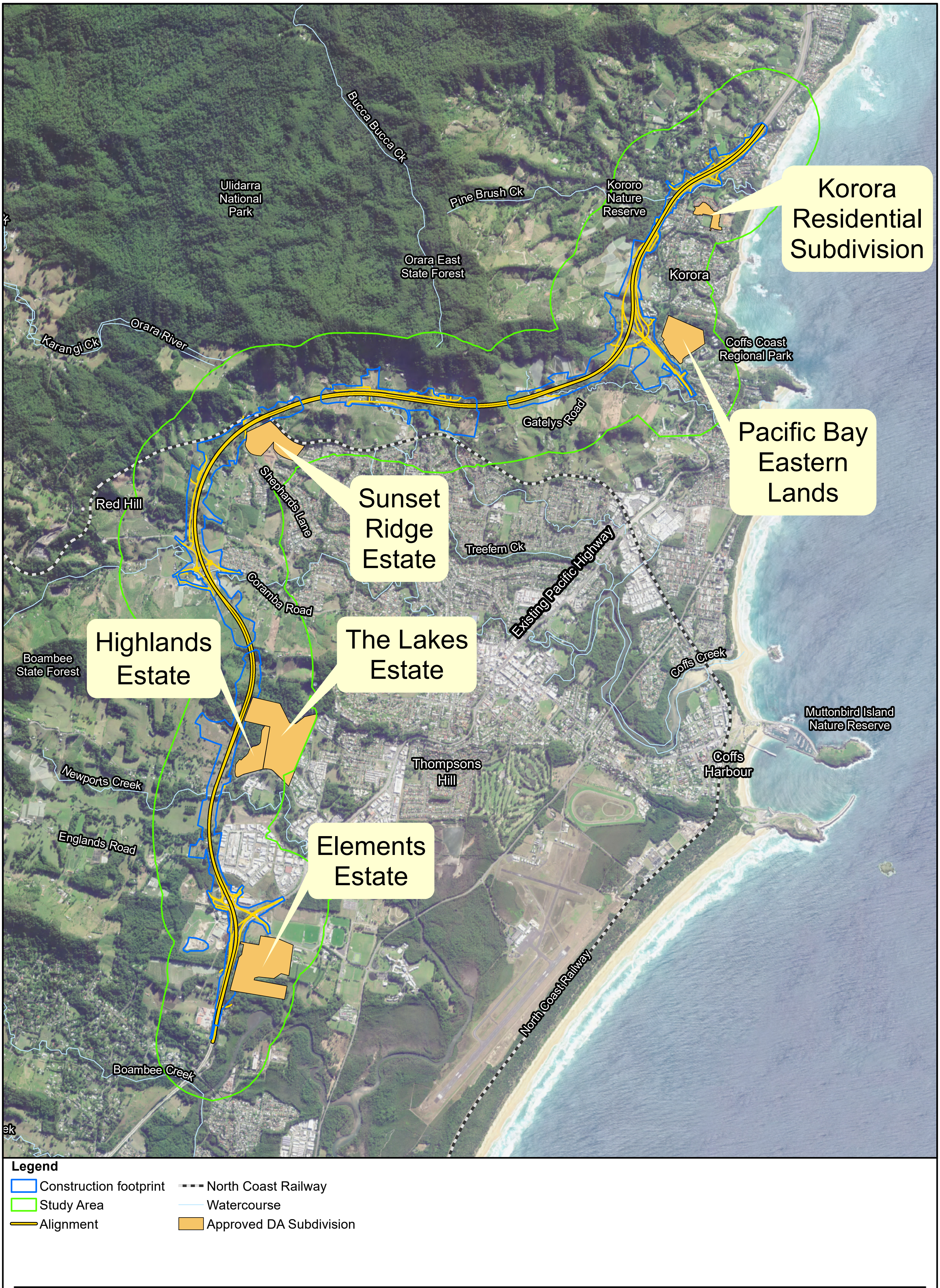
If required, at-property treatment would only apply to new DA approved dwellings if they have been built to a stage that would allow the installation of the architectural treatment prior to project completion as per Practice Note ii of ENMM.

4.3.1.1 New residential development at 65A-65C Stadium Drive

A development application for a new residential development at 65A-65C Stadium Drive, Coffs Harbour South was approved on 27th March 2020. The development is located partially within the study area of the project in NCA03.

Based on the predicted operational noise assessment discussed in the following sections, low noise pavement and a 5.0 m noise barrier are considered feasible noise mitigation measures to reduce traffic noise impacts for receivers in NCA03. The nearest residential noise sensitive receiver considered for at-property treatment is part of the Elements Estate subdivision. This receiver will be located at least 400 m closer to the Pacific highway relative to the location of the proposed development.

It is therefore unlikely for these future noise sensitive receivers to require consideration of additional noise mitigation due to the project. Also, considering the approved DA location, the noise contribution from the project would be lower relative to the noise contribution from the nearest existing traffic noise source (Stadium Drive). As such, the development has not been considered in this assessment. Notwithstanding, further consideration for assessment is would be undertaken during detailed design.



Coffs Harbour Bypass
DA approved residential subdivisions within project study area
Figure 1

For reference, each approved subdivision is depicted in Figure 2 through Figure 7.

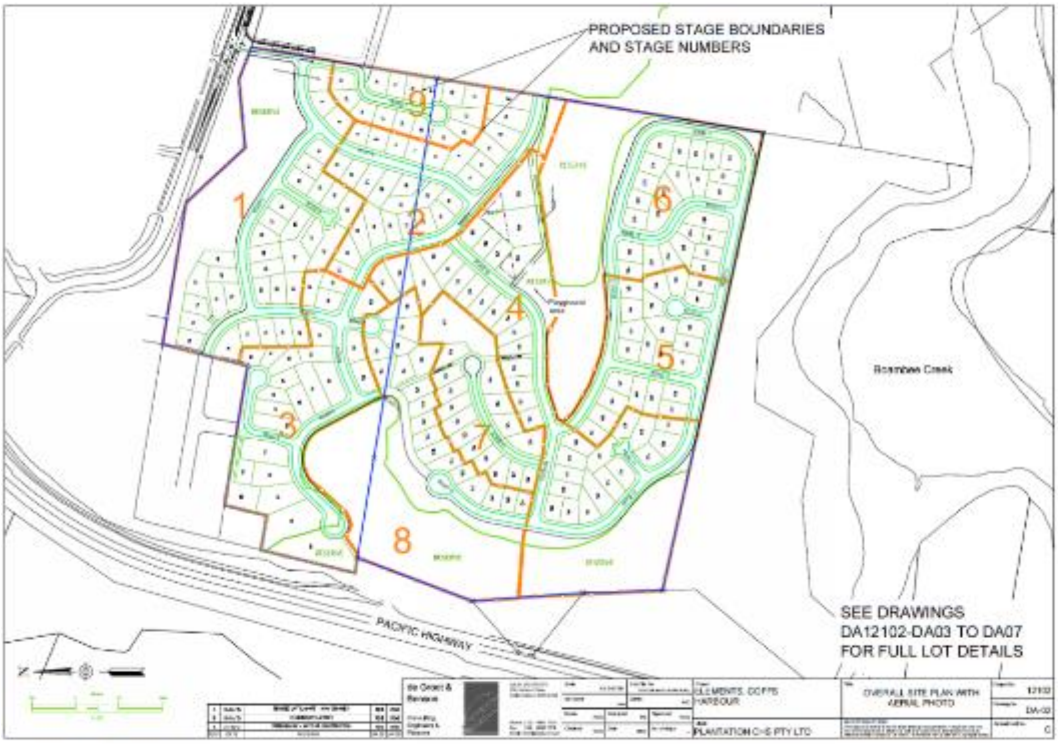


Figure 2: Approved residential subdivision – Elements Estate

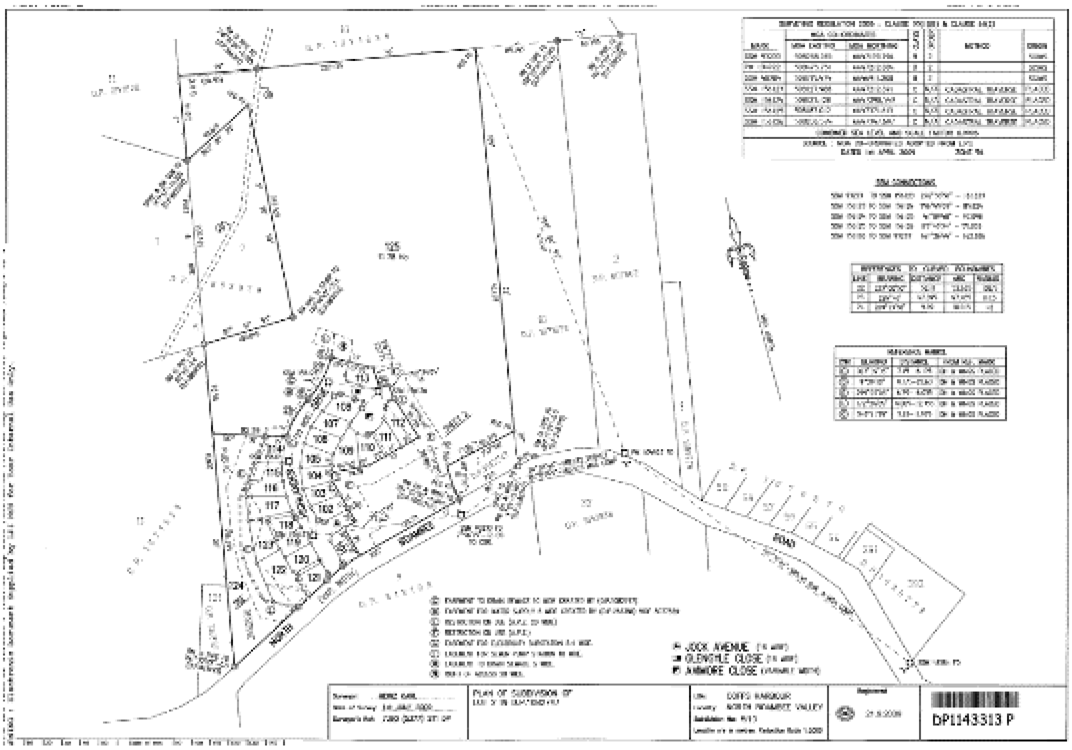


Figure 3: Approved residential subdivision – Highlands Estate

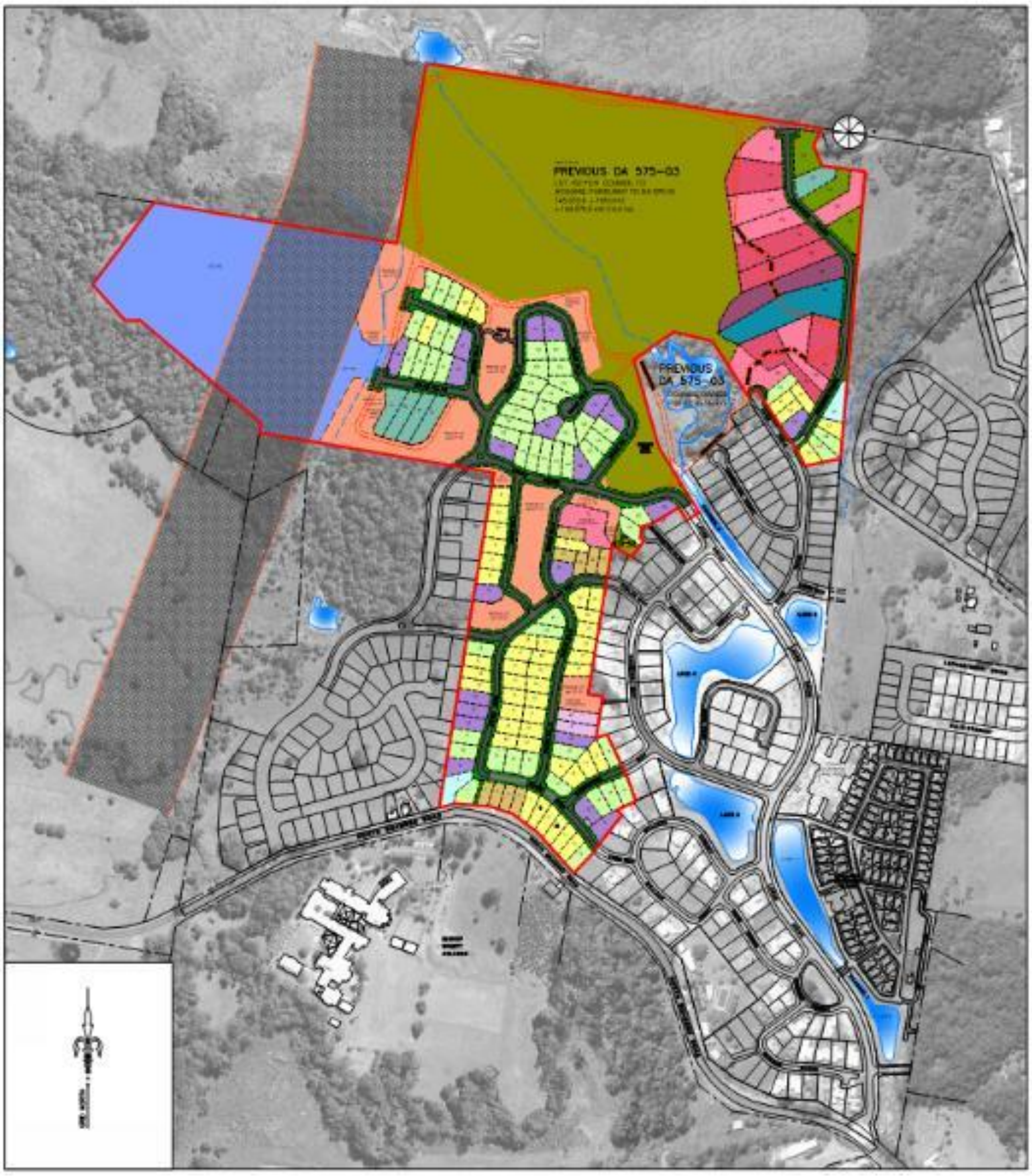


Figure 4: Approved residential subdivision – The Lakes Estate

Figure 5: Approved residential subdivision – Sunset Ridge Estate

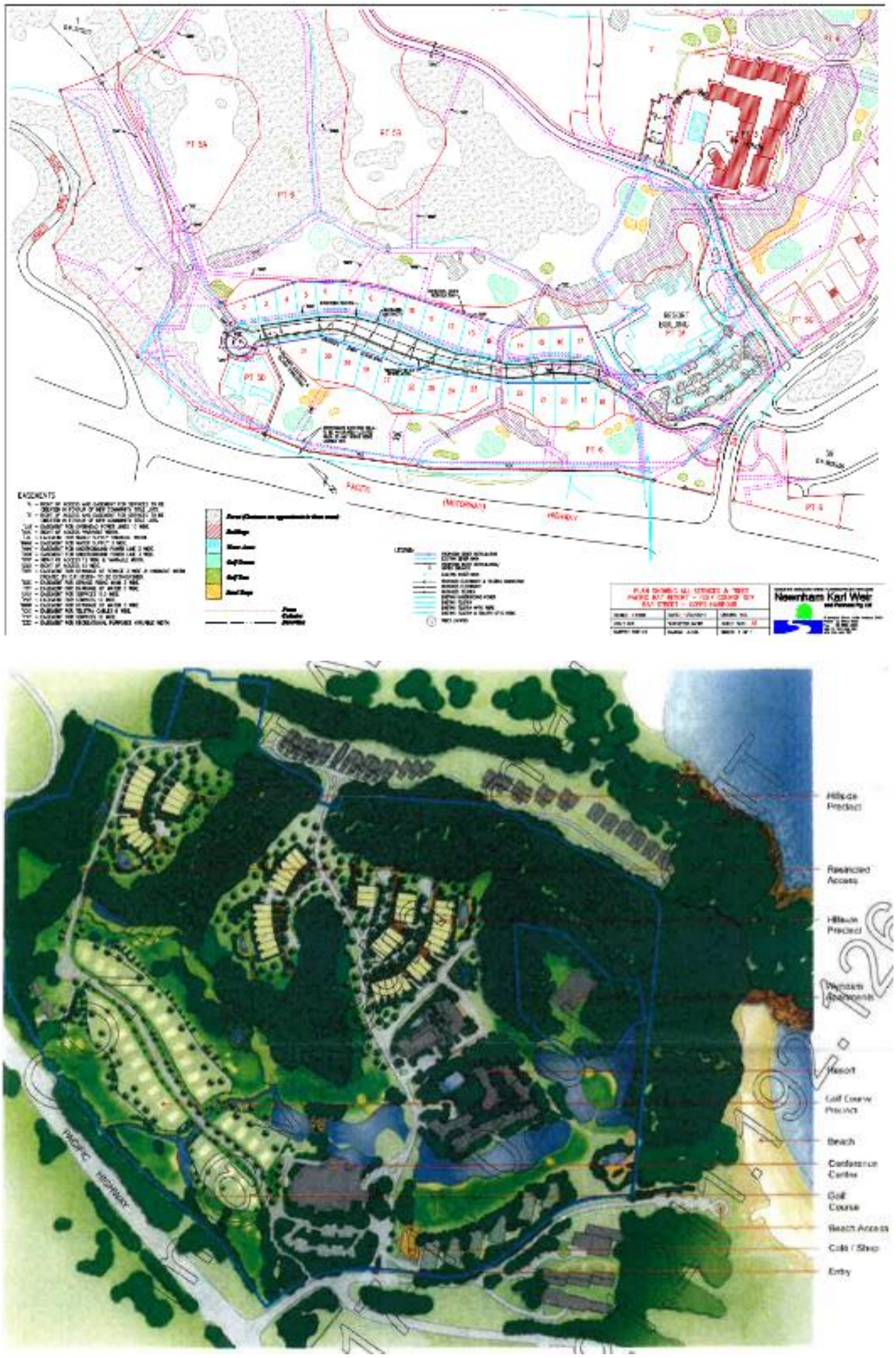


Figure 6: Approved residential subdivision – Pacific Bay Eastern Lands currently approved development (top) and approved masterplan (bottom)

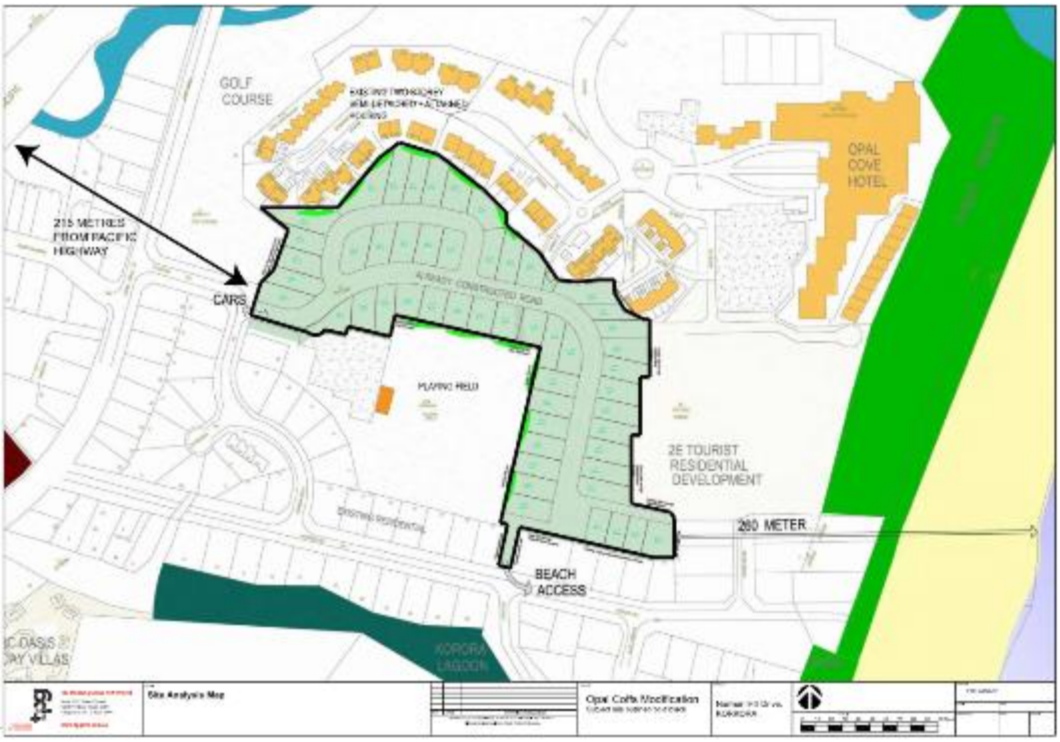


Figure 7: Approved residential subdivision – Korora Residential Subdivision

Future residential dwellings were included in the noise assessment. For the Pacific Bay Eastern Lands development, notional two-storey buildings have been included for each residential subdivision on the approved DA. Other areas covered by the masterplan have also been included with relevant heights based on the assumption of 3 m high storeys. For all other subdivisions, a notional single storey building outline has been included in the SoundPLAN model for the project per cadastral boundary for each of the residential subdivisions listed. The results were used to inform the design of operational at-source noise mitigation design (i.e. noise barrier and/or low noise pavement).

Details of approval conditions are summarised in Table 29 for reference. At-property treatments within each subdivision are identified as part of this assessment for developments where architectural noise mitigation requirements are excluded from the DA conditions of approval.

Table 29: Residential subdivision DA approval conditions

Location	DA conditions	Project response
Elements Estate	Northern Joint Regional Planning Panel approved the subdivision in 18/09/13 subject to conditions which included consideration of road traffic noise from the highway. Condition of Consent 41 required each lot title to include: *"An acoustic report is to be prepared in association with each house design to address traffic and sports field noise impacts and mitigation measures in accordance with the relevant provisions of NSW EPA Environmental Guidelines. The measures detailed in the acoustic report are to be implemented in the house design and construction."*	Any noise sensitive receivers that are still predicted to exceed the noise criteria should have adequate at-property treatment based on the requirements set out in the DA consent conditions.
Highlands Estate	Development consent for DA 711/06 included the following requirement regarding road traffic noise from the highway: *4. "A covenant shall be created for the lots within the Subdivision pursuant to Section 88B of the Conveyancing Act 1919 and must be registered on the title of each such lot. Registration must be effected in conjunction with registration of the Plan of Subdivision. The restriction requires Council's approval to variation or removal.* *The covenant shall require the preparation of an acoustic report prior to the issue of Development Consent for any future dwellings on the affected lots. The acoustic report shall have regard to the design, internal layout, materials and ventilation of any proposed dwelling relative to traffic noise impacts (from North Boambee Road and the future Pacific Highway).* *Note, where the EPA external noise criteria would not feasibly or reasonably be met, the RTA recommends the following internal noise objectives for all habitable rooms under ventilated conditions complying with the Building Code of Australia:* *- All habitable rooms other than sleeping rooms: 45 dB(A) Leq* *(5hr), 40 dB(A) Leq (9hr), and;* *- Sleeping rooms: 35 dB(A) Leq (9hr)."*	Any noise sensitive receivers that are still predicted to exceed the noise criteria should have adequate at-property treatment based on the requirements set out in the DA consent conditions.

Location	DA conditions	Project response
The Lakes Estate	DP&E approved MP05_0129 on 07/06/13. A modification for 160 additional residential allotments as part of Stage 2 and 3 approved in 07/08/15. Both the original conditions of approval and instrument of modification append the project's statement of commitments (SoC) in Schedule 3. SoC C11 states: *"The proponent commits to initiating discussion with Roads and Maritime Services (RMS) for the construction of the Pacific Highway Bypass for the provision of noise mitigation measures. These measures should be undertaken by the RMS as part of the design and construction of the bypass."*	At-property treatment if required would only apply to dwellings that have DA approval and have been built to a stage that would allow the installation of the architectural treatment prior to project completion as per Practice Note ii of ENMM.
Pacific Bay Eastern Lands	Development consent for DA 1209/10 includes the following requirement regarding road traffic noise from the highway: *"32. A restriction as to user shall be created for all lots within the subdivision pursuant to Section 88B of the Conveyancing Act 1919 and must be registered on the title of each such lot. Registration must be effected in conjunction with registration of the Plan of Subdivision. The restriction requires Council's approval to variation or removal.* *The restriction is to state that all future dwellings within the subdivision are to be constructed to meet "Category 2 construction under Australian Standard AS3671:1989 Acoustics - Road Traffic Noise Intrusion – Building Siting and Construction.* *Details of this restriction are to be submitted with the application for construction certificate.*	Construction of the residential lots subject to DA 1209/10 has not commenced. Notwithstanding, it is considered that any noise sensitive receivers that are predicted to exceed the noise criteria should have adequate at-property treatment based on the requirements set out in the DA consent conditions.
Sunset Ridge Estate	Development consent for DA 351/05 includes the following requirement regarding road traffic noise from the highway: *"31. The proponent is encouraged to incorporate measures into the subdivision to achieve the external noise target levels identified in the May 1999 Environmental Criteria for Road Traffic Noise produced by the Department of Environment and Conservation's (DEC-ex Environment Protection Authority). For the Preferred Route for the Strategy in the vicinity of the*	At-property treatment if required would only apply to dwellings that have DA approval and have been built to a stage that would allow the installation of the architectural treatment prior to project completion as per Practice Note ii of ENMM.

Location	DA conditions	Project response
	subdivision, the target levels are Leq(9hr) and 50 dB(A). *If the above DEC external noise targets are not achieved by the proponent, the RTA recommends that residences within the subdivision be designed to achieve the following internal noise objectives for all habitable rooms under ventilated conditions (refer to the Building Code of Australia).* *a. All habitable rooms other than sleeping areas: 45 dB(A) Leq(1hr) and 40 dB(A).* *b. Sleeping rooms: 35 dB(A) Leq(9hr)"*	
Korora Residential Subdivision	The original approval was for 85 community strata title lots. However, Modification No. 1 reduced this to 52 torrens title lots. Preliminary review of the conditions didn't find any related to mitigating road traffic noise. The EA prepared for Modification No. 1 states: *"The subject site and the proposed housing lots are not in a direct line-of-sight from the Pacific Highway. The site is separated from the Highway by more than 200m of housing, local roads, open space and dense vegetation. The site is located over 200m from the Pacific Highway at its closest western point and 500m from the Highway at its far eastern end, and it sits approximately 10m lower in elevation than the Highway. TPG NSW has inspected the site and observed that the background noise on the site is dominated by coastal wave noise, and Highway noise is not audible. Given these circumstances, an acoustic assessment and noise attenuation from the Highway is not warranted according to the new Development near Rail Corridors and Busy Roads - Interim Guidelines."*	At-property treatment if required would only apply to dwellings that have DA approval and have been built to a stage that would allow the installation of the architectural treatment prior to project completion as per Practice Note ii of ENMM.

Other development applications which have not received approval are not considered as part of this assessment and are no longer discussed in this report. These include but are not limited to:

- North Boambee Valley (West) – Urban Release Area
- Korora Large Lot Residential – Urban Release Area.

It is not considered feasible or reasonable to assess dwellings that have received approval after the project approval, or prior to the approval but have not yet been built to a stage allowing installation of at-property treatment at project completion, and as such these dwellings have not been included in this assessment. Responsibility of treatment for these properties would be the responsibility of the Developer. A review of the stage of development of these areas is recommended during detailed design to determine whether it would be reasonable to consider at-source treatment to be considered as part of the project.

4.3.2 Temporary accommodation

Where locations containing temporary accommodation have been identified (e.g. caravan parks), analysis of noise mitigation has been restricted to permanent residential accommodation buildings (e.g. cabin manager and permanently residing caravan users) when assessing eligibility for consideration of additional noise mitigation. This approach to assessment is in accordance with standard Roads and Maritime procedure and takes into account reasonable mitigation being provided for residents experiencing long term road traffic noise exposure and further acknowledges limitations associated with opportunities for at-property treatment of temporary accommodation structures such as caravans and cabins. Identification of permanent accommodation has been provided as the outcome of ground truthing exercise in August 2018.

4.4 Traffic modelling parameters

Measured and modelled traffic data was used as the basis of the operational noise impact assessment for the project.

Classified traffic counts were taken concurrently with noise monitoring at locations relevant to the validation procedure. This includes locations on:

- The existing Pacific Highway
- North Boambee Road
- Coramba Road
- Bennetts Road.

Noise model validation of the existing scenario is discussed further in Section 4.6.

To assess the future road traffic noise impacts for the project, projected traffic flow data for both the No-Build and Build scenarios have been used. For both scenarios, modelling has been undertaken for the assumed year of opening (i.e. 2024) and ten years after operation (i.e. 2034).

The extents of road traffic noise modelling include existing main road noise sources identified within the study area.

Full details of all traffic modelling parameters used for existing, No-Build and Build scenarios are summarised in Appendix F.

4.4.1 Changes to traffic modelling parameters compared to the EIS

The following changes were made to the traffic modelling parameters following the exhibition of the EIS:

- Local roads with low traffic volumes considered in the assessment carried out for the EIS were excluded from the noise model for the amended design. These are:
  - Shephards Lane
  - Roselands Drive
  - Spagnolos Road
  - William Sharp Drive
  - Mackays Road

  These roads were excluded in response to concerns raised in EIS submissions about the effect of considering the contribution of local roads on noise levels at sensitive receivers for the No-Build and Build scenarios. A reduction of traffic noise contribution from existing roads at the nearest noise sensitive receivers is observed in the No Build and Build scenarios.
- Predicted traffic volumes on the project and on existing main roads close to the project were updated based on the traffic model outputs for the amended design described in the Coffs Harbour Bypass Supplementary traffic and transport assessment (May 2020).

4.5 Modelling methodology

The operational noise model is based upon the 80% Concept Design alignment for the proposed bypass and road system.

The following methodology was followed for the operational noise impact assessment. Each stage is described in more detail in the following sections:

1. Construction of an acoustic model based on the 80% Concept Design
2. Validation of modelled traffic noise levels against measured results at all validation noise monitoring locations
3. Identification of noise sensitive receivers which qualify for consideration of mitigation through prediction of traffic noise levels for year of opening and design year (ten years after opening), for both daytime and night-time periods and comparison between the build and no build scenarios

4. Design of noise mitigation strategies to meet performance requirements for the project.

Noise modelling was undertaken by using the noise modelling software package SoundPLAN version 8.0 to implement the *Calculation of Road Traffic Noise (CoRTN)* [20] methodology.

Whilst there is no strict requirement under the RNP that noise levels be met under adverse meteorological conditions, it is noted that the CoRTN algorithm predicts noise impacts under moderately adverse wind conditions. As observed from other bypass projects, the effect of temperature inversion can increase the predicted noise level by up to 3 dB at any receiver near the noise source during the period of temperature inversion. While a noticeable increase in noise level may be observed during the period of the temperature inversion, the effect over the entire 9-hour period of night-time will only likely result in an increase of up to 1 dB at some receivers. Therefore, temperature inversion is not expected to significantly increase the operational noise from the project.

Further to considering adverse meteorological conditions, members of the community have raised through public consultation sessions the perception of a subjective sound phenomenon termed an “amphitheatre effect”. The term has been used to describe reflections from surrounding topographical features. The acoustic model for the project incorporates distribution of relevant ground absorption parameters to represent absorptive and reflective surfaces throughout the study area. Combined with the analysis of meteorological effects on sound propagation, the predictions of operational road traffic noise are considered to be robust within the constraints of modelling algorithms available.

Specific design inputs are provided in Table 30.

Table 30: Acoustic model input data

Input	Description
Traffic data	Traffic volumes and % heavy vehicles based on: • Classified traffic counts undertaken concurrently with noise monitoring • Projected traffic model results. Refer to Appendix F for details.
Traffic speeds	Validation speed – Measured 85th percentile • Design speed – Posted • 110 km/h for light vehicles and 100 km/h for heavy vehicles on the highway • 40-80 km/h on all other roads. Refer to Appendix F for details.
Topography	1 m elevation LiDAR information
Road alignment	80 % Concept Design

Input	Description
Road surface	Existing road surface based on site observations and input information from Roads and Maritime. Project road segments as follows: • Main carriageway – concrete as base case, OGA is assessed as part of at-source noise mitigation strategies • Highway ramps (between the edge of gore and edge of shoulder) – concrete • Highway ramps and all other roads – flexible pavement (DGA).
Buildings	Building footprints based on aerial photography and number of storeys based on street view. Modelled storey heights are as follows: • 1 storey residential 4 m • 2 storeys residential 6 m • Large commercial 8 m
Noise barriers	Existing noise barrier locations and heights have been based on as-built information where available and supplemented with street-view and site observations as required. General locations include: • In front of Boambee Palms Holiday and Accommodation Park • In front of Kororo Public School and extending south past the residences accessed by Fern Tree Place Refer to Appendix G for detail.
Source heights	• 0.5m for light vehicles • 1.5m for heavy vehicle engines • 3.6m for heavy vehicle exhaust
Tunnel portals	• Incorporated into the model via implementation of four point sources at the tunnel openings. • Sound power levels calculated in accordance with the *NORD2000* [21] methodology • Propagation as per ISO 9613-2 [22]
Ground absorption	Global factor of 0.75 with the exception of water which is set at 0.
Model search radius	2500 m
Receiver height	• Ground floor – 1.5 m • First floor – 4.5 m • Mitigation governed by 1st and 2nd storey only
Contour output	Set at 1.5 m height with 20m grid spacing.

Table 31 summarises the corrections and adjustments applied to the CoRTN calculation methodology in the acoustic model.

Table 31: Acoustic model corrections and adjustments

Correction, dB(A)	Description
-3	Conversion from L_{10} to L_{eq}
+2.5	Façade reflection

Correction, dB(A)	Description
+3 concrete 0 dense graded asphalt (DGA) 0 stone mastic asphalt (SMA10) -2 open graded asphalt (OGA)	Pavement corrections
0 tyre source -0.6 truck engine -8.6 truck exhaust	Split height corrections

In addition to the corrections listed in Table 31, specific corrections to CoRTN for Australian conditions were calculated based on traffic mix and prevailing temperature. These corrections were as provided by Roads and Maritime noise specialists and were then applied to all traffic strings for all stages of modelling.

The calculation of project specific corrections considers traffic mix by separating Aust Road classified traffic data by light (1-2), medium (3-5) and heavy (6+) classifications [23]. This information is then used to derive corrections to be applied to the heavy vehicle road string within the SoundPLAN implementation of the CoRTN algorithm. This is done in an attempt to account for the difference in sound power level produced by larger multi-axel trucks as compared with rigid heavy vehicles on which CoRTN empirical data is based. The specific equation used to calculate corrections is as follows:

$$L_{WA(6-category)} = 10log_{10} \sum_{i=1}^{6} \left(r_{HVi} 10^{L_{WA(HVi)}/_{10}} \right)$$

The correction applied to the modelled heavy vehicles is the difference between the sound power level calculated using the six-category model and the predicted sound power levels using CoRTN and are dependent on the ratio of medium to heavy vehicles as a function of travel speed.

A full list of correction factors for each road string and scenario are included with traffic data presented in Appendix F.

4.5.1 Changes to modelling methodology compared with the EIS

The following changes were made to the modelling methodology following the exhibition of the EIS:

- The noise model input data corresponding to the road alignment was updated to include the proposed design changes from 50% to 80% Concept Design outlined in Section 1.2.

4.6 Modelling validation

The acoustic model has been validated against measured noise monitoring data using concurrently measured road traffic data. Model validation has been undertaken in general accordance with the *Noise Model Validation Guideline* [6]. Modelled results that are within 2 dB of measured levels at validation noise monitoring locations are considered to be validated.

Modelled and measured operational road traffic noise results for the existing scenario are provided in Table 32. Site notes on ambient noise conditions at each noise logger location are provided in Appendix C.

Table 32: Acoustic model validation results

Logger number	**Day $L_{Aeq\ (15h)}$ dB(A)**			**Night $L_{Aeq\ (9h)}$ dB(A)**		
	Measured	**Predicted**	**Difference**	**Measured**	**Predicted**	**Difference**
Pacific Highway north of Coffs Harbour						
8	75.1	74.4	-0.7	71.3	69.1	-2.2
9	57.2	59.5	2.3	53.8	55.9	2.1
10	67.9	69.8	1.9	64.5	64.5	0.0
14	65.5	66.6	1.1	62.9	62.4	-0.5
15	59.3	60.3	1.0	55.7	56.3	0.6
Median difference			1.1			0.0
Pacific Highway south of Coffs Harbour						
1	54.1	56.7	2.6	50.9	51.2	0.3
11	64.9	66.1	1.2	61.2	60.5	-0.7
Median difference			1.9			-0.2
North Boambee Road						
2	52.6	52.9	0.3	43.8	42.9	-0.9
Coramba Road						
4	59.1	58.0	-1.1	51.9	49.1	-2.8
5	47.2	51.3	4.1[1]	41.4	42.3	0.9
Median difference			1.5			-0.9

[1] Daytime traffic volumes on Coramba Road west of Bennetts Road have been based on traffic counts undertaken at Bishop Druitt college. Over predictions in road traffic noise levels are considered due to vehicles diverting to the residential subdivision particularly during the daytime period.

4.7 Predicted noise levels

The validated acoustic model detailed in Section 4.6 was used to predict traffic noise levels for the eight scenarios presented in Table 33.

Table 33: Project stages, summary design scope

No.	**Scenario**	**Year**	**Period**	**Index (dB)**
1	No-Build	Year of Opening	Daytime	$L_{Aeq,\ (15\ hour)}$
2			Night-time	$L_{Aeq,\ (9\ hour)}$
3		Design Year	Daytime	$L_{Aeq,\ (15\ hour)}$
4			Night-time	$L_{Aeq,\ (9\ hour)}$
5	Build	Year of Opening	Daytime	$L_{Aeq,\ (15\ hour)}$

No.	Scenario	Year	Period	Index (dB)
6			Night-time	$L_{Aeq, (9\ hour)}$
7		Design Year	Daytime	$L_{Aeq, (15\ hour)}$
8			Night-time	$L_{Aeq, (9\ hour)}$

Appendix G summarises specific operational noise results and contours for each of the above scenarios at all noise sensitive receivers with and without additional noise mitigation in place.

A summary of noise sensitive receivers per catchment area that exceed NCG and NMG criteria is presented in Table 34 for reference. This is provided for the unmitigated Build scenario in the design year (2034) with no additional noise mitigation in place.

Table 34: Number of noise sensitive receivers that exceed design year operational noise criteria with no additional noise mitigation in place

NCA	Receiver type	Number of exceedances						
		NCG	NMG					
			Number of exceedances			Eligibility Triggers		
			Total	Existing receivers	Non-existent approved residential subdivisions	Cumulative Limit	Acute	>+2dB and >NCG
NCA01	Residential	27	18	18	0	18	16	5
NCA02	Residential	13	13	13	0	9	9	12
	Active recreation	1	1	1	0	0	0	1
NCA03	Residential	162	115	4	111	77	41	89
	Hospital	1	1	1	0	1	0	0
	Active recreation	0	0	0	0	0	0	0
NCA04	N/A[1]	0	0	0	0	0	0	0
NCA05	Hospital	1	1	1	0	1	0	1
	Place of worship	1	1	1	0	1	0	1
	Child care facility	1	1	1	0	1	0	1
NCA06	Residential	315	315	100	215	261	11	315
	School	1	1	1	0	1	1	1
	Place of worship	1	1	1	0	0	0	1
NCA07	Residential	5	5	5	0	5	1	5
NCA08	Residential	7	7	7	0	7	4	7
	School	1	1	1	0	1	1	1
NCA10	Residential	4	4	4	0	4	1	4
NCA11	Residential	22	9	9	0	3	0	9
NCA12	Residential	28	26	26	0	17	5	26

NCA	Receiver type	Number of exceedances						
		NCG	NMG					
			Number of exceedances			Eligibility Triggers		
			Total	Existing receivers	Non-existent approved residential subdivisions	Cumulative Limit	Acute	>+2dB and >NCG
NCA13	Residential	100	90	90	0	13	1	90
	Child care facility	1	1	1	0	1	0	1
NCA14	Residential	110	110	110	0	100	0	110
NCA15	Residential	15	15	15	0	14	4	15
NCA16	Residential	193	193	137	56	128	8	193
NCA17	Residential	3	3	3	0	3	1	3
NCA18	Residential	213	213	213	0	169	5	213
NCA19	Residential	11	11	11	0	11	7	11
NCA20	Residential	7	7	7	0	6	3	7
NCA21	Residential	13	4	4	0	3	3	1
	Active recreation	0	0	0	0	0	0	0
NCA22	Residential	69	15	1	14	15	1	2
	Active recreation	0	0	0	0	0	0	0
NCA23	Residential	8	7	7	0	5	3	7
	Passive recreation	1	1	1	0	1	0	1
NCA24	Residential	55	36	36	0	26	10	27
NCA25	Residential	29	10	10	0	5	5	7
NCA26	Residential	67	61	59	2	40	40	45
	School	2	2	2	0	2	2	2
NCA27	Residential	21	20	20	0	13	13	20
NCA28	Residential	77	73	73	0	25	25	72
NCA29	Residential	5	9	9	0	4	3	8
Total Residential		1579	1389	991	398			
Total non-residential		12	12	12	0			
TOTAL		1591	1401	1003	398			

[1] Only commercial / industrial receivers located in NCA04

[2] Note the identifier NCA09 has not been used for any of the noise sensitive receivers

There are 1591 noise sensitive receivers which are predicted to be exposed to road traffic noise levels exceeding the traffic noise assessment criteria of which 1389 residential receivers qualify for consideration for additional noise mitigation.

A receiver is eligible for consideration of additional noise mitigation by triggering any of the conditions listed in Section 3.1.2. These eligibility triggers are also summarised in Table 34.

Approximately 60% of the total number of noise sensitive receivers (residential and non-residential) identified within the study area qualify for consideration of additional noise mitigation. Generally, noise catchment areas located further away from the existing Pacific Highway (e.g. NCA06 to NCA20) will experience a greater change in the sound environment as a new sound source would be introduced. The change in noise level varies on a case-by-case basis as the exposure from each receiver to the project relies on specific features in the terrain, including tunnels, as well as shielding from adjacent buildings. Details of the change in noise level for each receiver are presented in the results in Appendix G1.

Section 4.8 summarises the analysis of operational road traffic noise mitigation requirements for the project.

4.7.1 Existing Pacific Highway

The existing highway is the main street through the town which currently accommodates significant heavy vehicle usage. The project is being proposed to improve road safety, freight productivity and reliability for travel as well as to minimise social impact on the community.

In addition to the predicted operational noise impacts for the future design, a significant reduction of noise impacts from vehicles using the existing Pacific Highway would also be expected. Traffic mix is predicted to change significantly with the introduction of a new bypass. It is expected that a significant portion of heavy vehicle traffic would be bypassed around the town centre, reducing the number of heavy vehicle movements through the centre of town.

This reduction in noise impacts through the more populated area of Coffs Harbour is not quantitatively captured in the noise modelling. Focus is instead placed on opportunities to ameliorate increases in noise impact. The benefits of this noise reduction through the town centre, however would be significant and are worth noting.

4.8 Design of noise mitigation measures

Options for noise mitigation were assessed in the following order of preference as per the NMG:

- Low noise pavement surfaces
- Noise mounds
- Noise walls
- At-property treatments.

In accordance with the NMG, analysis is undertaken of overall noise mitigation benefit taking into account feasible and reasonable implementation. The analysis is undertaken where the existing road network contributes to the overall road traffic noise level experienced at residences. In accordance with the NMG, in instances where the project was not a significant contributor to exceedance of trigger levels at any façade, these receivers do not qualify for consideration of additional mitigation.

Noise mitigation measures should be reasonable and feasible to implement. Factors such as roadway and stormwater flow obstruction, access requirements, space limitations as well as wind loading, and unsuitable ground conditions should be considered when introducing noise mitigation measures as part of the design. As such, these non-acoustical design factors are to be evaluated at each assessed location and the appropriate allowable barrier heights recommended for further consideration during detailed design.

Once the project is operational, a noise review will be undertaken in accordance with Roads and Maritime Preparing a Post Construction Noise Assessment Report brief.

The review will:

- Assess actual noise performance compared to predicted noise performance
- Assess the performance and effectiveness of noise and vibration mitigation measures
- Where deficiencies in performance are identified, provide recommendations for additional feasible and reasonable measures in accordance with the Roads and Maritime NMG.

4.8.1 Low noise pavement

In accordance with the NMG, a low noise pavement surface was investigated where groups of four or more closely spaced receivers were identified to qualify for consideration of additional noise mitigation, prior to investigating the implementation of noise barriers. In addition, a project decision was made to adopt low noise pavement for the full length of the project in order to address community concerns.

Investigation of the benefits of installing low noise pavement was undertaken and limited to an overall correction of -2 dB as compared with dense graded asphalt (DGA) based on the recommended correction for open grade asphalt (OGA) as per the Noise Model Validation Guideline [6]. This correction was applied within the noise model to both light and heavy vehicle road strings at the direction of Roads and Maritime noise specialists.

The proposed concrete pavement surface was replaced with a low noise pavement (OGA) alternative in the operational acoustic model between chainages CH 9700, at the southern roadworks tie in, to CH 23650, at the northern extent of the project, excluding the extents of the tunnels. The extent is depicted in Figure 8.

Coffs Harbour Bypass
Road Surface Types
Figure 8

It is noted that the Pacific Highway north of the Korora Hill interchange is currently a combination of DGA and stone mastic asphalt (SMA10) for which the correction is already 0 dB.

The acoustic benefit of installing low noise pavement is summarised in Appendix G. A summary of noise sensitive receivers that exceed NCG criteria for the mitigated Build scenario in the design year (2034) with low noise pavement in place is presented in Table 35 for reference. These receivers would qualify for consideration of at-property treatment should there be no implementation of further at-source noise mitigation measures (i.e. noise barriers).

Table 35: Number of noise sensitive receivers that exceed design year operational noise criteria with low noise pavement in place

NCA	Receiver type	NCG Exceedances			
		Total	<5 dB	5-10 dB	>10 dB
NCA01	Residential	18	4	14	0
NCA02	Residential	12	5	4	3
	Active recreation	0	0	0	0
NCA03	Residential	95	61	34	0
	Hospital	1	0	0	1
	Active recreation	0	0	0	0
NCA04	N/A[1]	0	0	0	0
NCA05	Hospital	1	0	0	1
	Place of worship	1	0	1	0
	Child care facility	1	0	0	1
NCA06	Residential	286	123	152	11
	School	1	0	0	1
	Place of worship	1	1	0	0
NCA07	Residential	5	0	4	1
NCA08	Residential	7	0	7	0
	School	1	0	1	0
NCA10	Residential	4	1	2	1
NCA11	Residential	5	2	3	0
NCA12	Residential	23	13	6	4
NCA13	Residential	38	29	9	0
	Child care facility	1	0	1	0
NCA14	Residential	105	80	25	0
NCA15	Residential	14	2	6	6
NCA16	Residential	140	52	55	33
NCA17	Residential	3	0	2	1
NCA18	Residential	177	109	62	6
NCA19	Residential	11	0	1	10

NCA	Receiver type	NCG Exceedances			
		Total	**<5 dB**	**5-10 dB**	**>10 dB**
NCA20	Residential	7	3	3	1
NCA21	Residential	4	1	3	0
	Active recreation	0	0	0	0
NCA22	Residential	15	9	6	0
	Active recreation	0	0	0	0
NCA23	Residential	6	4	1	1
	Passive recreation	1	1	0	0
NCA24	Residential	31	8	21	2
NCA25	Residential	5	2	3	0
NCA26	Residential	48	21	23	4
	School	2	0	0	2
NCA27	Residential	13	4	9	0
NCA28	Residential	40	22	16	2
NCA29	Residential	6	3	2	1
Total Residential		1118	558	473	87
Total non-residential		11	2	3	6
TOTAL		1129	560	476	93

[1] Only commercial / industrial receivers located in NCA04

[2] Note the identifier NCA09 has not been used for any of the noise sensitive receivers

With low noise pavement in place, 1129 noise sensitive receivers still exceed the road traffic noise criteria and hence still qualify for consideration of additional noise mitigation. This is 462 less receivers than were identified as exceeding the road traffic noise criteria for the unmitigated scenario, however only 272 less than the number of receivers that qualify for consideration of additional mitigation.

Further investigation into the effectiveness of noise barriers as an additional noise mitigation measure is summarised in the following section.

4.8.2 Noise barriers

Following the use of at-source noise control measures (i.e. low noise pavement), a combination of noise barrier (i.e. noise mounds and noise walls) and at-property noise treatment can provide the most reasonable overall reduction for an affected community when consideration is given to urban design, visual impact and engineering constraints. It is noted that while most types of at-property noise treatment do not provide any external noise reduction benefit; the achievable internal noise reduction may be higher than for most external noise barrier solutions. The process of deriving the most effective combination of noise barrier height and at-property noise treatment is given in Roads and Maritime's NMG, whereby the process gives preference to a hierarchy of noise control measures that reduce outdoor noise levels as per EPA's NSW Road Noise Policy.

In addition to the investigation of low noise pavement, further analysis of the benefits of noise barriers was undertaken in accordance with the NMG. A full noise wall analysis was undertaken initially, the results of which were coordinated with the design team to identify areas where the installation of earth berms was considered feasible to further reduce noise impacts. An updated terrain model with the earth berms in place was then used to re-analyse optimum noise wall heights and resulting at-property treatment requirements.

At locations where the project extends over existing noise barriers (walls, mounds or a combination of both) the existing barrier top of height has been moved to an adjacent new location within the design after investigating the implementation of low noise pavement.

The extent and location of noise barriers considered locations where four or more closely spaced receivers were identified to qualify for additional noise mitigation. A full barrier design assessment is carried out at each identified location considering the benefit with low noise pavement and earth berms in place, often resulting in a combination of mounds with walls on top.

When optimising the noise barrier height in the noise mitigation design, the process described in the NMG identifies three heights. These are the maximum barrier height, initial design barrier height and design barrier height. The maximum barrier height is the barrier height that strives to result in external noise criteria being met at all receivers. Roads and Maritime's policy is that barrier heights above 8 metres will not be assessed as part of the noise abatement design. Next, the initial barrier height is defined at a height between zero and maximum barrier height, where the trend in noise benefit is characterised by a rapid reduction in the number of properties that are eligible for consideration of additional noise mitigation. Subsequently in the noise mitigation design process, between the initial barrier and maximum design barrier heights, the design barrier height is identified by also taking into consideration the area of noise barrier and noise reduction benefits across the broader community. This barrier height forms the acoustic recommendation and is further evaluated in a multi-criteria decision-making process to determine the feasible and reasonable combination of noise mitigation measures. As a guide, a noise barrier is considered to be a reasonable noise mitigation option where it is capable of providing an insertion loss of 5 dB(A) for heights up to 5 metres or 10 dB(A) for heights above 5 metres and up to 8 metres high. It is also important to note that where the predicted total diffraction attenuation exceeds 20 dB(A) for single diffraction, further increase in noise barrier height is not considered in the aforementioned process as this level of noise reduction is nearly impossible to attain in practice.

The higher the barrier, the greater the level of noise reduction, however; as identified in Roads and Maritime's Noise Wall Design Guideline, noise barriers that are excessively high can cause visual intrusion, reduction of sunlight, loss of character and view and social alienation, compromising on urban design and resulting in unacceptable visual impact. In addition, a noise barrier that is reasonable may not always be feasible to build, which can be attributed to roadway and stormwater flow obstruction, access requirements, space limitations as well as wind loading and unsuitable ground conditions. As such, these non-acoustical design factors are evaluated at each assessed location and the appropriate allowable barrier heights recommended for further consideration during detailed design. Considering community preferences, the final design barrier height with acceptable visual impact will be confirmed during detailed design for construction.

A total of 14 locations were assessed to determine the benefit of a noise barrier to further mitigate operational traffic noise impacts out of which:

- Nine are new barriers
- Three existing barriers are to be relocated and/or supplemented in height due to the project
- Two noise barrier analyses resulted in the barriers being considered unreasonable in accordance with the provisions of the NMG.

In addition, as described above, it is important to apply a reasonable and feasible analysis to noise barriers due to a number of environmental, social, engineering and cost factors. Five barriers initially evaluated for which the assessment outcome is not considered reasonable or feasible include:

- NW_NCA01_SB_01 – located at the southern end of the project adjacent Boambee Palms Holiday and Accommodation Park
- NW_NCA22_SB_01 – located along the existing Pacific Highway and bypass mainline at Korora Hill interchange
- NW_NCA24_SB_01 – located near the Korora Hill interchange
- NW_NCA26_SB_01 – located north of Korora Public School on the eastern side of the project
- NW_NCA27_NB_02 – located at the northern end of project adjacent Seaview Close.

Further discussion on these barriers is provided below.

NW_NCA01_SB_01

In accordance with the NMG, this barrier was recommended at a height of 7.0 m to replace the existing 3.0 m high noise wall located adjacent the Boambee Palms Holiday and Accommodation Park within NCA01. While this noise barrier would mitigate sensitive receivers behind the barrier, this noise barrier was not considered feasible or reasonable due to the following considerations:

- The height of this barrier was considered to result in high visual impacts and would cause significant overshadowing issues to the residences immediately to the east of the existing barrier. The receivers are unlikely to receive significant noise attenuation at the detriment of the overshadowing impacts.
- Construction of a 7.0 m high barrier including the substantial supporting structure and footings would result in clearing vegetation identified as koala habitat.

- Construction of a 7.0 m high barrier at this location would have substantial constructability challenges and safety issues due to the proximity of the existing Pacific Highway.
- It would require removal of the existing barrier.

Following consideration of the above it was concluded that sensitive receivers within NCA01 should be subject to at-property noise mitigation only in consultation with the owner of Boambee Palms Holiday and Accommodation Park and the existing barrier to be retained at the same top of height.

NW_NCA22_SB_01

The two separate noise walls that form the barrier at this location were recommended at a height of 5.0 m for receivers within NCA22. While this noise barrier would mitigate sensitive receivers behind the barrier, this noise barrier was not considered feasible or reasonable due to the following considerations:

- The barrier would be a substantial structural element to be constructed in a landscape identified as having a high visual sensitivity. Given the proposed constraints with the wall alignment, e.g. located on elevated structures within the Korora Hill interchange, it is unlikely that landscape plantings or other design mitigation could be effectively included to adequately minimise all visual impacts. Additionally, there would likely to be localised overshadowing and/or coastal view impacts with the construction of a 5.0 m high noise wall on top of the elevated structures within the Korora Hill interchange at this location.
- The barrier would be in conflict with urban design principles and key design criteria for the Korora Hill interchange as the northern gateway to Coffs Harbour and would limit opportunities to frame views celebrating the arrival/exit experience.
- The barrier would not effectively treat all sensitive receivers within NCA22 with only two residences experiencing benefit. Several proposed dwellings associated with Pacific Bay Eastern Lands development experience a benefit. However, only one of these dwellings has DA approval.
- Due to the number of utility adjustments in this location, there is likely to be a number of conflicts with the barrier alignment and utility design which would result in safety risks for construction and maintenance personnel and could result in a public hazard.

NW_NCA24_SB_01

This barrier was recommended at a height of 5.0 m for receivers within NCA24. While this noise barrier would mitigate sensitive receivers behind the barrier, this noise barrier was not considered feasible or reasonable due to the following considerations:

- The barrier would be required to be located adjacent the eastern side of the service road, above a 210 m long retaining wall with a maximum height of 10.5 m. The noise wall alignment would generally follow the property boundary and would need to be constructed either at the top of the ridgeline or on the steep slopes immediately below the ridge towards the retaining wall and service road. Construction of a 5.0 m high barrier at this location would have substantial engineering and geotechnical challenges given the existing landform, the proximity of the retaining wall and its associated reinforcing elements (e.g. soil nails) and the significant foundation supports that would be required for such a noise wall. In addition, there would be safety hazards during construction and maintenance due to the need to work at height and adjacent to live traffic with heavy construction machinery, such as drilling/piling rigs and large cranes.

- The barrier would be a substantial structural element to be constructed in a landscape identified as having a high visual sensitivity. Given the proposed constraints with the wall alignment, utilities, etc., it is unlikely that landscape plantings or other design mitigation could be included to adequately minimise all visual impacts. Additionally, there would likely to be localised overshadowing and/or coastal view impacts with the construction of a 5.0 m high noise wall on top of the ridgeline at this location. In addition, experience with other noise walls similar to this in urban areas has found ongoing graffiti issues and associated unauthorised community access/safety issues.
- The barrier would not effectively treat all sensitive receivers within NCA24 with all but one residence still requiring at-property mitigation.
- Due to the number of utility adjustments in this location, there is likely to be a number of conflicts with the barrier alignment and utility design which would result in safety risks for construction and maintenance personnel and could result in a public hazard.

Following consideration of the above it was concluded that sensitive receivers within NCA24 should be subject to at-property noise mitigation only.

NW_NCA26_SB_02

Following the noise wall analysis undertaken in accordance with the NMG, the barrier at this location was recommended at a height of 6.5 m high for receivers within NCA26. However, due to the following reasons, the barrier has been limited to 5.0 m in height:

- Construction of a 6.5 m high barrier would include substantial supporting structure and footings which would increase the size of bridge BR 21 across Pine Brush Creek.
- Construction of a 6.5 m high barrier on top of the retaining walls would increase the size and complexity of the retaining walls to support the 6.5 m high barrier.
- Construction of a 6.5 m high barrier at this location would have greater constructability challenges and safety issues due to the proximity of the existing Pacific Highway compared to a 5.0 m high barrier.
- The barrier would not effectively treat all sensitive receivers within NCA26.
- The 6.5 m high barrier would have substantially greater urban design and visual impacts when compared to a 5.0 m high wall and would have the

greater potential to impact existing ocean views from residences to the west of the project which would unlikely be able to be completely mitigated with the inclusion of transparent panels.

NW_NCA27_NB_02

This barrier was recommended at a height of 6.5 m for receivers within NCA27.

While this noise barrier would mitigate sensitive receivers behind the barrier, this noise barrier was not considered feasible or reasonable due to the following considerations:

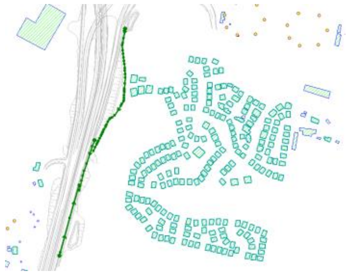
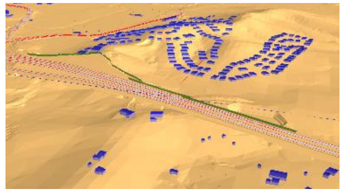
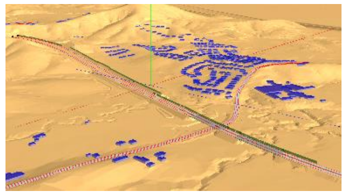
- The barrier would be required to be located on western side of the upgraded Pacific Highway above the service road and built on top of a retaining wall between 3.3 m and 7.2 m in height. Construction of 6.5 m high barrier at this location would not be safe for construction or maintenance personnel.
- The barrier would not effectively treat all sensitive receivers within NCA27 with three of the five receivers still requiring at-property mitigation.
- Due to the number of utility adjustments in this location, there is likely to be a number of conflicts with the barrier alignment and utility design which would result in safety risks for construction and maintenance personnel and could result in a public hazard.
- The height of this barrier would impact existing ocean views from residences to the west of the project which would unlikely be able to be completely mitigated with the inclusion of transparent panels. A high visual impact was identified.

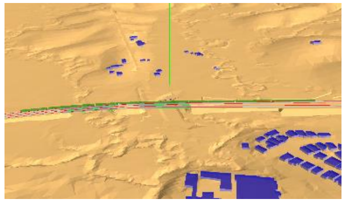
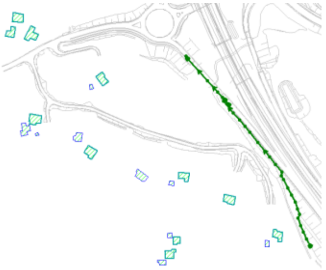
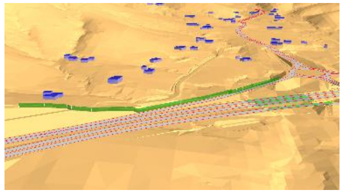
Following consideration of the above it was concluded that sensitive receivers within NCA27 should be subject to at-property noise mitigation only.

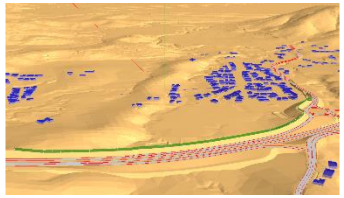
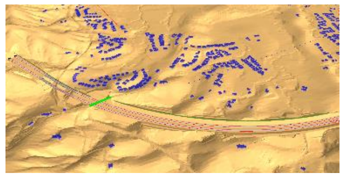
Table 36 summarises the location and extent of design noise barriers, and the allowable barrier height for each length of noise barrier. Full analysis of noise barrier results is summarised in Appendix H.

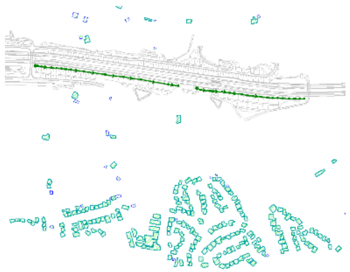
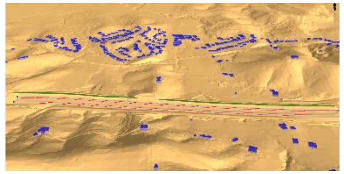
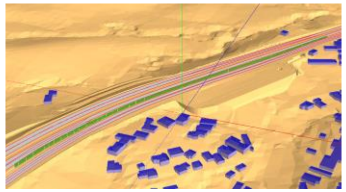
The updated outcomes of the noise barrier assessment relative to the EIS are a result of the reassessment of the project considering the changes summarised in Section 4.9.

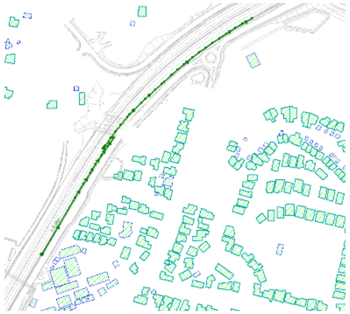
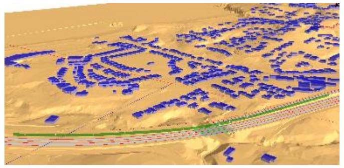
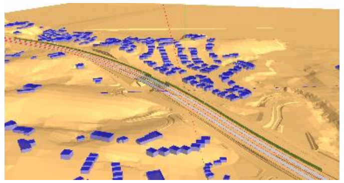
Table 36: Noise barrier summary

Barrier Name	Chainages	Barrier height (m)				Insertion loss (dB)				Recommended design height	Notes	Indicative noise barrier extent (plan view)	Indicative recommended design height barrier (axonometric view)
		Existing	Maximum	Initial design	Final design	Existing	Maximum	Initial design	Final design				
NW_NCA03_SB_01	9830 to 10530	-	8.0m	5.0m	5.0m	-	8.8	5.8	5.8	5.0m	*Final design height barrier is recommended because it provides more than 5dB insertion loss.		
NW_NCA06_SB_01	11900 to 13610	-	8.0m	6.0m	6.0m	-	11.1	9.2	9.2	5.0m	*5m barrier is recommended because final design height does not achieve more than 10dB insertion loss.		

Barrier Name	Chainages	Barrier height (m)				Insertion loss (dB)				Recommended design height	Notes	Indicative noise barrier extent (plan view)	Indicative recommended design height barrier (axonometric view)
		Existing	Maximum	Initial design	Final design	Existing	Maximum	Initial design	Final design				
NW_NCA08_NB_01	11890 to 12500	-	8.0m	0.0m	0.0m	-	4.7	0.0	0.0	0.0m	*Maximum barrier height does not provide more than 10dB insertion loss at most benefiting receiver; *Initial design height is 0m due to points weighting; *Noise barrier not recommended at this location.		
NW_NCA12_NB_01	14300 to 14680	-	8.0m	0.0m	0.0m	-	6.6	0.0	0.0	0.0m	*Maximum barrier height does not provide more than 10dB insertion loss at most benefiting receiver; *Initial design height is 0m due to points weighting; *Noise barrier not recommended at this location.		

Barrier Name	Chainages	Barrier height (m)				Insertion loss (dB)				Recommended design height	Notes	Indicative noise barrier extent (plan view)	Indicative recommended design height barrier (axonometric view)
		Existing	Maximum	Initial design	Final design	Existing	Maximum	Initial design	Final design				
NW_NCA13_SB_01	14580 to 15430	-	8.0m	4.5m	4.5m	-	11.3	7.4	7.4	4.5m	*Final design height barrier is recommended because it provides more than 5dB insertion loss.		
NW_NCA14_SB_01	15430 to 16970	-	8.0m	5.5m	6.0m	-	9.4	6.8	7.3	5.0m	*5m barrier is recommended because final design height does not achieve more than 10dB insertion loss.		

Barrier Name	Chainages	Barrier height (m)				Insertion loss (dB)				Recommended design height	Notes	Indicative noise barrier extent (plan view)	Indicative recommended design height barrier (axonometric view)
		Existing	Maximum	Initial design	Final design	Existing	Maximum	Initial design	Final design				
NW_NCA18_SB_01	17810 to 18900	-	8.0m	5.0m	5.5m	-	6.4	4.7	5.0	5.0m	*5m barrier is recommended because final design height does not achieve more than 10dB insertion loss.		
NW_NCA25_SB_01	21590 to 22150	3.0m	8.0m	5.5m	5.5m	3.5	7.4	6.1	6.1	5.0m	*5m barrier is recommended because final design height does not achieve more than 10dB insertion loss. *Supplemented height is recommended due to road widening and the additional noise reduction is greater than 2.0dBA		

Barrier Name	Chainages	Barrier height (m)				Insertion loss (dB)				Recommended design height	Notes	Indicative noise barrier extent (plan view)	Indicative recommended design height barrier (axonometric view)
		Existing	Maximum	Initial design	Final design	Existing	Maximum	Initial design	Final design				
NW_NCA26_SB_01	22150 to 22725	-	8.0m	4.5m	6.5m	-	12.2	8.2	10.7	5.0m	*Final design height barrier is recommended because it provides more than 5dB insertion loss; *Final design height is limited to 5m considering feasible and reasonable analysis (refer to NW_NCA26_SB_01 text preceding this table)		
NW_NCA28_SB_01	22725 to 23650	3.0m	8.0m	4.0m	4.5m	5.4	13.4	7.5	8.4	4.5m	*Final design height barrier is recommended because it provides more than 5dB insertion loss; *Supplemented height is recommended due to road widening.		

4.8.3 At-property treatments

At-property treatments would be considered at sensitive receivers where low noise pavement and noise barriers do not result in the NCG being met. At this stage in the assessment, the identification of at-property treatments is indicative only, as further consideration would be given to the following points at the detailed design stage to confirm the final extent of treatments required:

- The build date of the property and the related conditions of consent which may require that the property has been built to account for existing high levels of road traffic noise
- The condition of the property, as treatment would be less effective and may not provide any appreciable noise reduction benefit where the building is in a poor state of repair, so caution needs to be exercised
- Heritage advice should be sought if the treatments have the potential to impact the heritage significance of a property. In extreme cases this could result in a decision not to proceed with a treatment on the grounds that it was not considered to be a reasonable or feasible mitigation option.

The NMG identifies that at-property noise mitigation measures such as façade treatments and localised screens may replace at-source mitigation, subject to a reasonable and feasible assessment, only in the following circumstances:

- Isolated single residences or isolated groups of closely spaced residences
- Where the affected community expresses a preference for at-property treatment and the cost is less than a combination of a barrier and at-property treatment
- Where noise barriers cannot achieve the level of noise mitigation (insertion loss) required
- Where the only applicable noise criteria are internal (e.g. places of worship, hospitals or schools and child care facilities where play areas meet external criteria)
- Where other noise mitigation measures have been shown not to be feasible or reasonable.

These treatments are generally limited to acoustic treatment of the building elements and the installation of acoustic screen walls close to the receiver where they also protect outdoor living spaces. Such treatments would be considered based on Roads and Maritime guidance.

With low noise pavement and noise barriers in place, at-property treatments are still required for some noise sensitive receiver locations. These locations are summarised in Appendix G in both mitigated results tables and noise contour plots.

A summary of noise sensitive receivers that exceed NCG criteria for the mitigated Build scenario in the design year (2034) with low noise pavement and recommended design noise barriers in place is presented in Table 37 for reference. These receivers would qualify for consideration of at-property treatment.

Table 37: Number of noise sensitive receivers that exceed design year operational noise criteria with low noise pavement and design height noise barriers in place

NCA	Receiver type	NCG Exceedances			
		Total	**<5 dB**	**5-10 dB**	**>10 dB**
NCA01	Residential	18	5	11	2
NCA02	Residential	12	5	4	3
	Active recreation	0	0	0	0
NCA03	Residential	0	0	0	0
	Hospital	1	0	0	1
	Active recreation	0	0	0	0
NCA04	N/A[1]	0	0	0	0
NCA05	Hospital	1	0	0	1
	Place of worship	1	0	1	0
	Child care facility	1	0	0	1
NCA06	Residential	134	102	32	0
	School	1	0	1	0
	Place of worship	1	1	0	0
NCA07	Residential	5	0	4	1
NCA08	Residential	7	0	7	0
	School	1	0	1	0
NCA10	Residential	4	2	1	1
NCA11	Residential	4	1	3	0
NCA12	Residential	23	13	6	4
NCA13	Residential	7	5	2	0
	Child care facility	1	0	1	0
NCA14	Residential	54	50	4	0
NCA15	Residential	14	2	6	6
NCA16	Residential	109	52	37	20
NCA17	Residential	3	0	2	1
NCA18	Residential	99	79	16	4
NCA19	Residential	11	0	1	10
NCA20	Residential	7	3	3	1
NCA21	Residential	4	1	3	0
	Active recreation	0	0	0	0
NCA22	Residential	15	9	6	0
	Active recreation	0	0	0	0

NCA	Receiver type	NCG Exceedances			
		Total	<5 dB	5-10 dB	>10 dB
NCA23	Residential	6	4	1	1
	Passive recreation	1	1	0	0
NCA24	Residential	31	8	21	2
NCA25	Residential	3	3	0	0
NCA26	Residential	10	8	2	0
	School	2	0	1	1
NCA27	Residential	13	4	9	0
NCA28	Residential	9	7	2	0
NCA29	Residential	6	3	2	1
Total Residential		608	366	185	57
Total non-residential		11	2	5	4
TOTAL		619	368	190	61

[1] Only commercial / industrial receivers located in NCA04

[2] Note the identifier NCA09 has not been used for any of the noise sensitive receivers

4.9 Changes in operational noise impacts compared with the EIS

The main reasons for changes in the outcomes of the operational noise impact relative to the EIS are:

- Minor updates to the horizontal and vertical alignment of the design within the overall road corridor
- Removal of noise mounds around North Boambee Road
- Updated receiver classification as required (e.g. residential receivers reclassified as auxiliary buildings or vice versa based on feedback received from community and landowners during the EIS public exhibition period)
- Updated building footprint location at NCA03 and NCA06
- Revised inclusion of local roads.

Changes in potential operational noise and vibration impacts compared with the EIS include:

- 85 additional noise sensitive receivers qualifying for consideration of additional noise mitigation
- 120 additional receivers identified for consideration of at-property treatment after implementing low noise pavement as noise mitigation strategy
- Updated height and extents of recommended noise barriers
- 141 additional receivers identified for consideration of at-property treatment after implementing low noise pavement and noise barriers as noise mitigation strategies.

4.10 Maximum noise level assessment

Various road design features have the potential to alter maximum noise level events due to road traffic. Main areas of interest include:

- Steep gradients
- Changes in speed
- Changes in geometry.

Each of these components is discussed qualitatively in the following sections. Receivers located close to areas of identified impacts have the potential to experience a change in maximum noise levels. As per the NMG, it should be noted that the maximum noise assessment should be used as a tool to help prioritise and rank mitigation strategies but should not be applied as a decisive criterion in itself.

The most effective measure for addressing engine brake noise is at the source through Australian Design Rules (ADR) and in-service standard for engine brake noise. These measures are obviously outside the scope of the Project.

It is expected that locations which are not currently near major sources of industrial or road traffic noise (greenfield areas) will likely experience more change in the acoustic environment than those adjacent to major sources of noise such as the existing Pacific Highway. Existing maximum noise level events in greenfield areas are predominantly a combination of local fauna (e.g. dog barks or seasonal noise), agricultural machinery and rail noise events.

The character of maximum noise level events related to traffic noise will be affected by design features such as road gradients and areas that cause vehicle acceleration or deceleration as explained in the following sections.

Generally, signage is found across the Pacific Highway indicating areas of noise sensitive receivers where maximum noise level events such as compression braking should be limited to reduce the number of adverse noise impacts. The assessment has also identified receivers which qualify for at-property treatment due to the introduction of the project. The implementation of at-property treatments is significant within greenfield areas and is largely regarded as a prioritised mitigation measure for maximum noise events such as compression braking.

4.10.1 Gradient

One of the major causes of maximum noise level events is the use of engine brakes on heavy vehicles. Engine compression braking (ECB) is a secondary braking system which is present on most heavy vehicles. Engine compression brakes dissipate the vehicle’s kinetic energy by opening the exhaust valves near the top of the compression stroke, releasing stored energy in the cylinder, which causes the characteristic sound. Engine compression brakes are used to reduce the strain placed on the vehicle’s conventional braking system and are commonly used when descending steep grades. Reduced usage of the conventional braking system also lowers maintenance costs through reduced brake wear. The fitting of

ECB systems to heavy vehicles leads to higher vehicle efficiency, productivity and safety.

However, ECB noise is a significant source of community complaint regarding the heavy vehicle industry. This is due to the low-frequency nature of the noise, which has relatively low attenuation with propagation distance, and also the characteristic sound.

In 2006, Arup undertook an investigation into compression braking noise levels on behalf of Roads and Maritime. The aim of the study was to quantify the incidence of engine braking events and loudness on roads of varying gradient.

A brief summary of mean measured maximum noise levels for all downhill events is provided in Figure 9 below for reference.

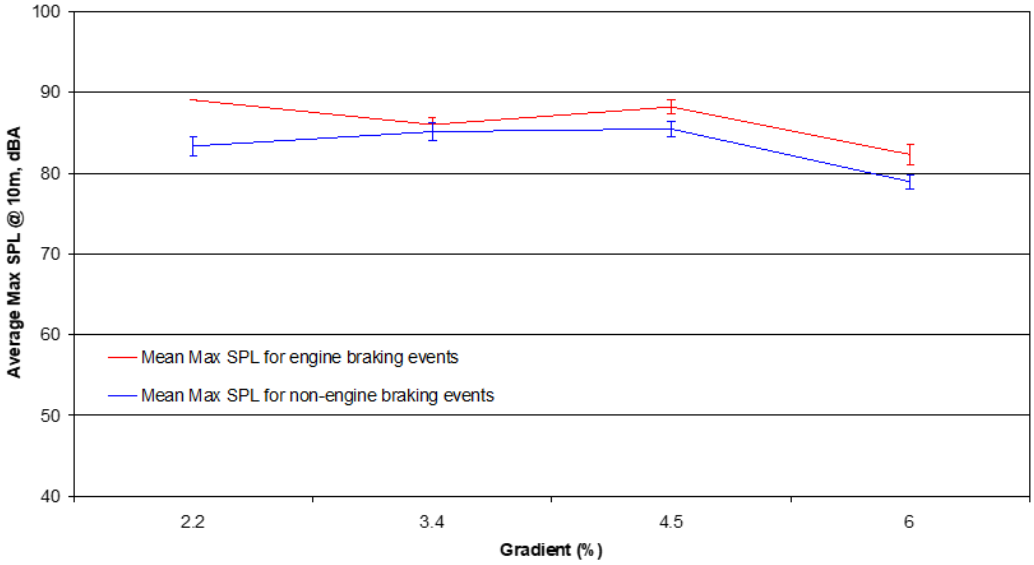


Figure 9: Mean max SPL for all downhill events

Figure 9 shows that there is typically, little difference (around 1–3 dB) between noise levels from engine braking events and non-engine braking events. This shows good correlation with a study which was carried out by the Environmental and Resource Management Group of HDR in Minneapolis, USA, which concluded that peak noise levels due to engine compression braking were 2 dB higher than typical heavy vehicle pass-by noise levels. Further, there is no obvious correlation between increased gradients and higher maximum noise levels.

4.10.2 Acceleration and deceleration

Maximum noise events also occur with acceleration and deceleration of heavy vehicles due to the significant contribution of engine noise. Further to the previous section of this report, it is noted that steep gradients coupled with changes in speed may also have the potential to result in an increased number of compression braking events.

Road design features that have the potential to influence truck acceleration and deceleration include:

- Small radii curves
- Changes in posted speed limit
- Turning bays
- Heavy vehicle inspection bays
- Rest areas
- Intersections / interchanges
- Signalisation.

A review of strategies to minimise potential impacts from these features was undertaken at an early stage of the project. Of the listed road design items, those relevant to the project are located around intersections, ramps and interchanges at four main locations:

- Southern tie-in to Pacific Highway
- Englands Road interchange from roundabout to signalised intersection
- Coramba Road interchange
- Korora Hill interchange near James Small Drive.

On approach and departure to and from these interchanges, trucks would be required to accelerate and decelerate accordingly. In addition, the regular changes in maximum noise level events due to engine noise, there is the potential that compression brakes would be used in place of standard braking.

For areas where new interchanges are proposed in relatively green field areas, future road traffic noise impacts would be significantly altered as a result of the project. The emergent maximum noise level impact would be determined relative to future overall operational road noise impact from the project. A discussion of maximum noise level events as compared with free-flow traffic is provided in Section 4.10.3.

At locations where interchanges tie into the existing Pacific Highway, maximum noise level exposure is expected to currently be reasonably high due to existing heavy vehicle flows in these areas. Analysis of measured maximum noise levels is discussed further in Section 4.10.4.

4.10.3 Maximum noise level data

NCHRP REPORT 635 *Acoustic Beamforming: Mapping Sources of Truck Noise* [24], produced by the Transportation Research Board includes detailed measurement results for a total of 59 heavy truck pass-by's using acoustic beamforming as the measurement method. The results of this research are presented in Table 38. Data is considered commensurate with the type of heavy vehicles currently in use on NSW highways and likely to be in use on the proposed Coffs Harbour bypass.

Table 38: NCHRP Heavy vehicle noise level measurement data

Truck type	Speed (km/h)	RPM	Gear	Notes	L_A (dB(A)) at	
					7.5 m	15 m
9200i	0	1100	Neutral	Stationary	74.6	68.2
		1400			78.8	72.2
		1500			78.6	71.7
		1800			81.1	74.1
	56	1400	8th		77.8	72.3
	74	1800	8th		84.2	77.9
	80	1500	9th		83.0	77.5
	80	1100	10th		82.6	76.5
	From 80	*	9th	Coast down	81.4	74.7
	From 80	*	9th	Compression brake	83.6	77.3
9200i Eagle Truck (modified exhaust, no muffler)	0	Idle	Neutral	Stationary	68.6	63.5
		1500			77.6	72.8
		1600			89.6	74.9
		1900			81.7	76.7
	56	1900	7th		85.2	79.9
	56	1500	8th		82.6	76.7
	72	1900	8th		89.2	84.3
	80	1600	9th		89.6	82.1
	From 80	*	*	Coast down	80.0	75.6
	From 80	1400	9th	Compression brake	96.2	90.9

Table 38 shows that noise levels from compression brake events are noted to be within 9 dB of pass-by events at 80 km/hr. This difference would be expected to be less at higher speeds such as on the project, however this would potentially be greater at larger distances due to the low frequency nature of compression braking.

4.10.4 Noise monitoring data analysis

Maximum noise level analysis has been undertaken of existing noise exposure derived from noise logger data for the project. Analyses have been restricted to locations where maximum noise level events are considered clearly attributable to road traffic noise events.

In accordance with Practice Note iii of the ENMM, an assessment of the impact of sleep disturbance on residents is made in terms of likely maximum noise levels from road traffic, the extent to which these maximum noise levels exceed the ambient level, and the expected number of noise events from road traffic during the night.

Appendix I presents graphs of the analysis results based on current exposure to maximum noise level events from road traffic.

The emergence of maximum noise level events over the background noise will depend on the characteristics of the acoustic environment, i.e. locations with characteristically low background noise (greenfield areas away from industrial or traffic noise sources) will perceive the occurrence of a maximum noise level events more significantly than locations with typically higher background noise levels (closer to major roads or urban centres). It should be noted that ambient noise levels in greenfield areas is expected to be elevated with the introduction of road traffic noise associated with the project. Emergence of maximum noise level events above ambient levels is therefore expected to be relative to this new noise source.

The overall magnitude of maximum road traffic noise events is not expected to change significantly along existing road corridors where alterations to geometry are minimal. Change in maximum noise impact from the existing road network in these locations is therefore expected to be limited to an alteration in number of events commensurate with the change in projected traffic flows.

For locations where the road geometry is being significantly altered in either vertical or horizontal profile, there is a potential that maximum noise impacts would be either increased or reduced depending on changes to distance attenuation or shielding. This predominantly occurs near to the southern and northern tie-ins to the existing Pacific Highway where the main alignment is raised or lowered in locations to accommodate the bypass.

For sections of the existing Pacific Highway through Coffs Harbour, this would likely result in a reduction in number of maximum noise events due to the reduction in overall traffic flow as discussed in Section 4.7.1. Where an increase in traffic flow is predicted on the existing road network, an increase in number of events would be expected to occur.

4.11 Operational vibration

Operational vibration arises from vehicles travelling on an uneven pavement (e.g. bumps, old joints, etc) which would not be the case with a brand-new pavement. Further, operational vibration from road traffic movements is low because the vehicles are generally well isolated from the ground by pneumatic tyres and vehicle suspension systems. Operational vibration due to the project is therefore not expected to be above perceptible levels at any of the sensitive receivers.

4.12 Industrial noise assessment

4.12.1 Kororo Public School bus interchange

The existing Kororo Public School bus interchange is located directly west of Kororo Public School. The bus interchange is proposed to be relocated to just south of Kororo Public School.

Traffic investigations and information provided by local bus companies indicate that up to eight buses are likely to be on the site during the morning and afternoon school peak periods. Eight buses are school buses operating drop-off / pick-up services. An additional non-school bus is also expected to use the interchange during this period and periodically throughout the day.

The existing bus timetable indicates that a maximum of two buses per 15 minutes are operating during daytime hours and up to one bus per 15 minutes is operating during the early evening. There are no buses using the bus interchange during night-time hours.

Figure 10: Depiction of proposed Kororo Public School bus interchange

Buses travelling on site were modelled using SoundPLAN 8.0 with ISO 9613 [22] algorithm. Assumptions and data used in this assessment are summarised below:

- Bus sound power level of 104 dB(A) derived from measurements of STA buses travelling at 40 km/hr
- During the morning peak period,
  - Eight buses entering the site during a 15-minute period (8:00am-8:15am) and idling for the remainder of the period

  - Eight buses idling during the first 10 minutes of the following 15-minute period and departing simultaneously (8:25am)

- Up to three buses movements (entering, idling and departing) during a 15-minute period during the afternoon peak period (3:20pm-3:40pm)
- One bus entering, idling and exiting the site within a 15-minute period during the evening time
- A speed limit of 5 km/hr for buses travelling on site
- Distance travelled from entrance to exit of 260 m
- The nearest noise sensitive receiver is located south of the proposed bus interchange in Fern Tree Place.

For the morning peak period as buses arrive to site, the noise level predicted at the worst affected residential receiver is 50 dB(A) at ground floor and 51 dB(A) at first floor. The predicted bus arrival noise levels are below the project specific trigger levels of 53 dB(A).

During the morning peak departure period, the noise level predicted at the worst affected receiver is 56 dB(A) at ground floor and 58 dB(A) at first floor. The noise level predicted at the next worst affected receiver is 55 dB(A) at first floor. It is noted that the exceedance of the project specific trigger levels of 53 dB(A) during the morning peak departure period is because of the simultaneous departure of the bus fleet.

For the afternoon peak period, noise levels predicted at the nearest residential receivers are 52 dB(A) at ground floor and 54 dB(A) at first floor. Afternoon peak predicted noise level meets the project specific trigger level of 53dB(A) at ground floor and exceeds it by up to 1 dB at first floor. An exceedance of 1dB residual noise level is deemed to represent a negligible impact and not subjectively discernible.

For the evening assessment, noise levels predicted at the nearest residential receivers are 47 dB(A) at ground floor and 50 dB(A) at first floor. Evening predicted noise levels exceed the project specific trigger levels of 46 dB(A) at ground and first floors by up to 1 dB and 4 dB respectively.

Calculations undertaken are conservative and based on measurements of buses traveling at greater speed than will be experienced on site. A combination of localised screening and at-property treatment options could be further investigated for the exceeding properties. It is noted that the two properties showing exceedance of the industrial noise criteria are not currently identified to qualify for consideration of additional noise mitigation as per NMG. It is also noted that the predicted noise level from traffic noise sources at the most affected façade by the bus interchange is greater than the impact from bus movements and this assessment only considers impacts from vehicle movements in the bus interchange.

4.12.1.1 Changes to Kororo Public School interchange compared with the EIS

The following changes were made to the design of the Kororo Public School interchange following the exhibition of the EIS:

- Refinement of operational noise impact assessment based on surveyed observations of current operational and forecasted usage of the existing bus interchange
- Redesign of the bus interchange location, access and extents to address functionality.

Figure 11: Bus interchange design change between the EIS and the amended design (yellow)

4.12.2 Coramba Road bus stop

The Coramba Road bus stop is being relocated further south east of the current location used along Coramba Road.

Buses travelling on site were modelled using SoundPLAN 8.0 with ISO 9613 [22] algorithm. Assumptions and data used in this assessment are summarised below:

- Bus sound power level of 104 dB(A) derived from measurements of STA buses travelling at 40 km/hr
- Up to four buses entering, idling and exiting the site within a 15-minute period
- A speed limit of 5 km/hr for buses travelling on site
- Distance travelled from entrance to exit of 85 m
- The nearest noise sensitive receivers are located north of Coramba Road.

The noise level predicted at the worst affected residential receiver is 60 dB(A) for an unmitigated operational noise assessment scenario. Considering the recommended 4.0 m noise wall at this location (NW_NCA13_SB_01), the noise level predicted at the worst affected residential receiver is 50 dB(A). The predicted noise levels for the period where up to four buses are expected to enter, idle and exit the site exceeds the project specific daytime trigger levels of 44 dB(A).

It is noted the proposed relocation of the bus stop will largely overlap with the current location and is therefore not expected that the current noise impacts from the bus stop operations will change significantly at the worst affected receivers, conversely, it is expected that the recommended noise wall will reduce the noise impacts of the current bus stop location at the worst affected receivers.

4.12.3 In-tunnel ventilation fans

In-tunnel ventilation fans are installed for smoke management in the rare case of a tunnel fire incident. This equipment is not intended for routine operation however, periodic testing is likely to be required. It is anticipated that Shephards Lane tunnel would have a maximum of three banks of jet fans and Gatelys Road tunnel would have a maximum of four banks of jet fans. Typically, the jet fan banks are spaced on average 110 m apart with the first set of fans located around 80 to 100 m inside the portal.

It is understood from Roads and Maritime that the Scope of Works and Technical Criteria for in-tunnel fans will state that the ventilation design achieves a maximum sound of 85dB(A) so that the emergency systems / responders can be heard and that people in the tunnel can use the emergency phones to communicate effectively.

A desktop assessment has been carried out taking into account the following assumptions:

- The measured sound pressure level from the bank of jet fans does not exceed 85 dB(A) measured at 1.5 m above the centreline of the road.
- The nearest set of fans is located 80 m from the tunnel portal.
- Fan testing can be carried out in a period between 15 minutes to 1 hour during the daytime period.

The sound power level for a single in-tunnel fan was back calculated assuming a maximum reverberant sound pressure level of 85 dBA within the tunnel and a typical spectrum for an axial fan. This information was then used to predict potential impacts to the nearest receiver taking into account direct and reverberant contribution from the tunnel portal to the nearest noise sensitive receiver.

The distance to the nearest noise sensitive receiver from the Shephards Lane and Gatelys Road tunnel portals is approximately 180 m and 190 m respectively. The predicted noise level at each of the nearest noise sensitive receivers was found to be within 1 dB of the assessment criteria of 45 dBA, taking into account the correction factors for duration as defined in the NPI.

No further mitigation is recommended for industrial noise emissions associated with operation of the in-tunnel ventilation fans at this stage however, all assumptions and inputs should be reviewed once further detail becomes available specific to the project.

4.13 Rail noise assessment

While there are no proposed alterations to the North Coast Railway, changes in topography surrounding the train line may have the potential to alter train noise impacts to the community.

Therefore, an analysis was undertaken of the change in topography adjacent to the railway due to the project to ascertain whether a significant increase in rail noise impacts would be expected to occur due to construction of the project. A notional broadband line source was included in the acoustic model aligning the railway and a direct comparison plot between Build and No-Build terrain models was made using ISO 9613 [22].

Figure 12 shows localised areas where there would be a change greater than 2 dB in the noise level, however there are no instances where these areas encompass noise sensitive receivers due to the introduction of the project.

Generally, receivers near the railway are identified as qualifying for consideration of noise mitigation due to increased exposure to road traffic noise from the project. No noise mitigation measures are considered for these receivers additional to those recommended as outcomes of the road operational noise assessment.

Figure 12: Change in noise level exposure from existing rail corridor due to changes in terrain topography (from SoundPLAN 8.0)

5 Construction noise and vibration assessment

This section assesses the potential noise and vibration impacts associated with the activities likely to be required for construction of the project.

Construction noise and vibration impacts will vary depending on factors such as the proximity of sensitive receivers, the overall duration of the construction works, the intensity of the noise and vibration levels, the time at which the construction works are undertaken and the character of the noise and vibration emissions.

Chapter 3 of the Amendment Report identifies the construction footprint for the project which has been used to assess potential noise and vibration impacts from the construction. The construction footprint is indicative only and would be subject to refinement during detailed design and construction. Some factors that could affect the final construction footprint include the location and size of sedimentation basins, the construction methodology and arrangements made with potentially affected land owners.

At this stage of the project detailed constructability information (such as construction methodology, selection of plant and equipment and construction staging) is not currently available. This assessment provides guidance on the likely noise and vibration impacts on nearby receivers and potential feasible and reasonable mitigation based upon a combination of information provided in the project description, standard construction methodologies and scenarios expected for this type of project and available information provided by Roads and Maritime.

According to the CNVG, an additional Construction Noise and Vibration Impact Assessment (CNIA) may be required for each major construction stage or key activity. The CNIA would be included or referenced in the Construction Noise and Vibration Management Plan (CNVMP) to be prepared by the contractor.

5.1 Description of Works

In addition to new road works associated with construction of the bypass, modifications and additions to various sections of the existing Pacific Highway and Coramba Road will also be made.

In addition to major roadworks, the project would likely include:

- Setup of construction sites compounds
- Areas of onsite manufacturing / storage
- Development of ancillary services / utilities.

Three major construction zones that have been defined based on separating the project into sections where significant construction issues or differences in construction methods are likely to be undertaken. It is noted that this approach has mainly been developed as a planning tool and may be altered during construction. The construction zones and associated significant features are reproduced below.

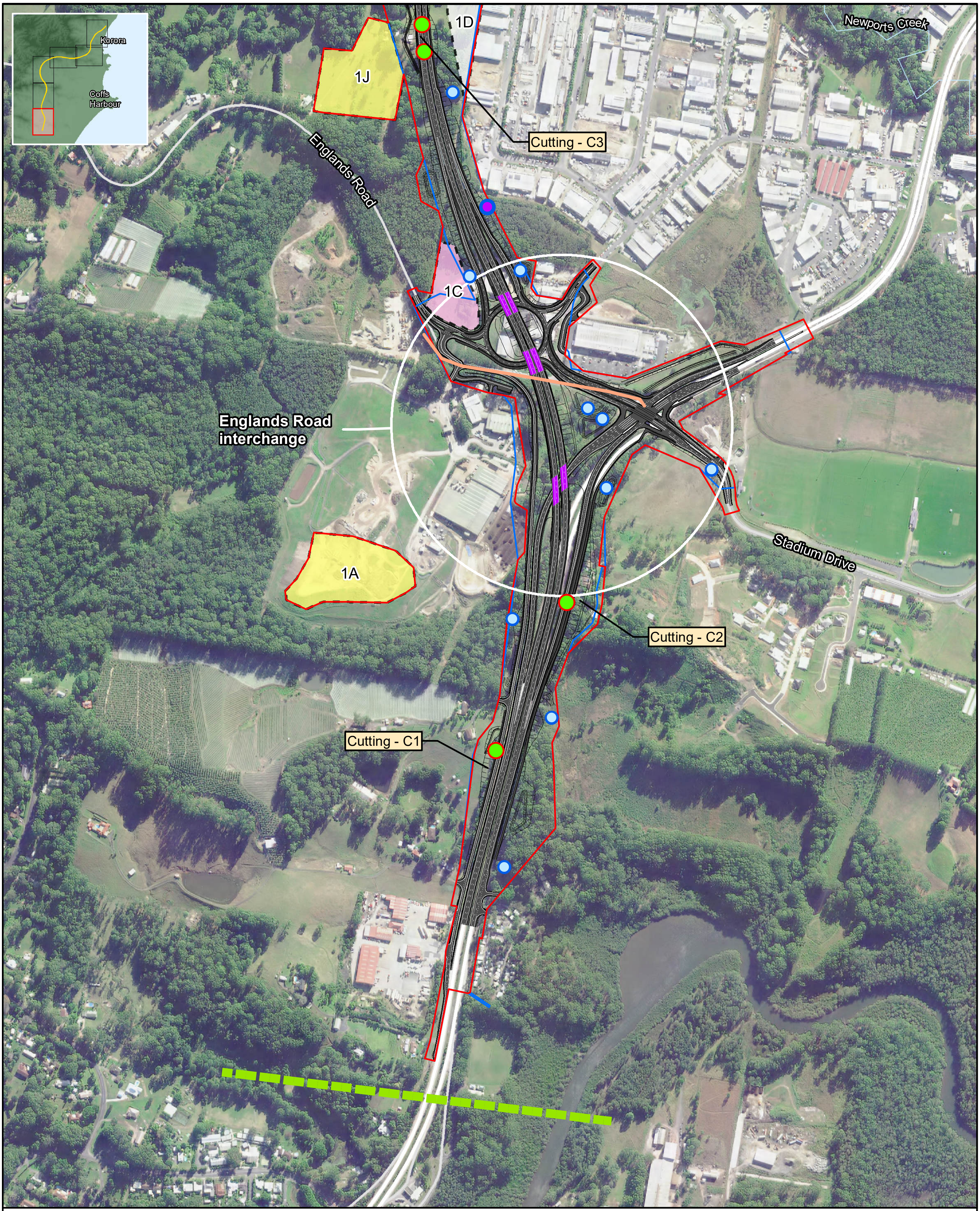
5.1.1 Zone 1 – Englands Road to Roberts Hill ridge

This construction zone covers the area of the project from the southern tie-in to the existing Pacific Highway, south of Englands Road, to the north of Roberts Hill ridge. Most of this construction zone would be constructed away from the existing Pacific Highway and across the Newports Creek floodplain. It includes the Englands Road interchange and the Roberts Hill tunnel.

Key features of this construction zone are discussed in Table 39 and shown in Figure 13 and Figure 14.

Table 39: Zone 1 construction features

Key features	Comments
Zone length	• Around 4.4 km
Construction access	• Via the existing Pacific Highway and Englands Road • Via North Boambee Road. • Via Buchanans Road
Earthworks	• Potential excess of material when comparing cut and fill volumes • Project largely in fill across the North Boambee Valley floodplain.
Tie in to existing Pacific Highway south of Englands Road	• Connects to the existing dual carriageway highway about 1.1 km south of Englands Road • New koala underpass south of Englands Road would be built about 10m north of the existing location.
Englands Road interchange	• Includes converting Englands Road / Stadium Drive roundabout to a traffic light intersection • Bridge over the proposed northbound exit ramp (BR01) • Grade separated roundabout interchange with two elevated highway bridges (BR02 and BR25). • Realignment of Englands Road and Isles Drive to tie into existing roads
Newports Creek bridge (BR23)	• Bridge to minimise impacts on Newports Creek, which would require minor realignment to reduce potential impacts on habitat.
North Boambee Road bridge (BR04)	• Bridge over the existing North Boambee Road.
Roberts Hill tunnel	• Twin tunnels about 190 m long and about 35 to 40 m below the crest of Roberts Hill ridge • May require drill and blast to excavate material.

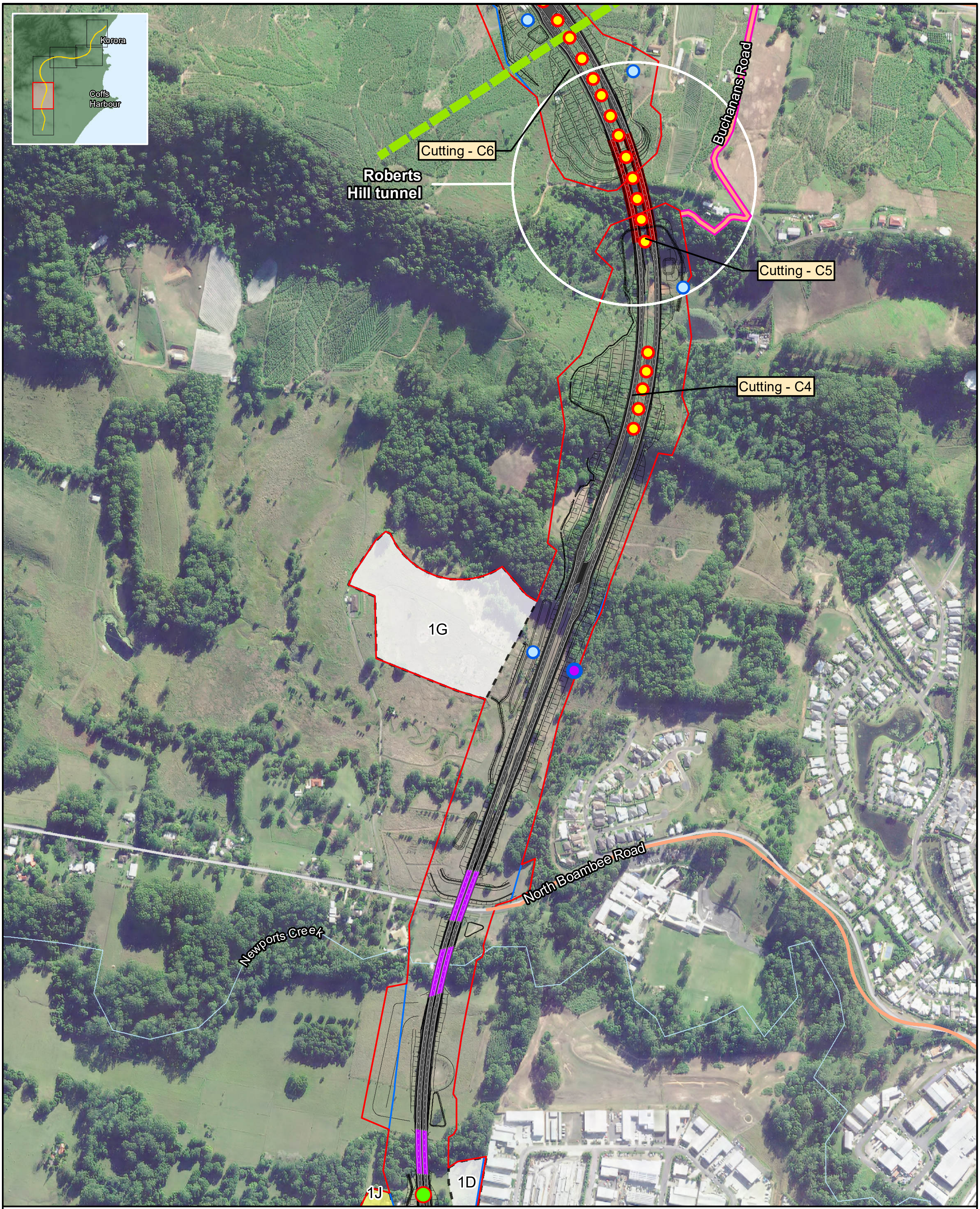


Legend

- Construction footprint May 2020
- Alignment
- Construction zone
- Potential construction access
- Additional potential construction access
- Temporary access road
- Potential ancillary site
- Revised potential ancillary site
- Additional potential ancillary site
- Potential controlled blasting sites
- Additional potential controlled blasting sites
- Indicative construction sediment basin location
- Modified construction sediment basin location
- North Coast Railway
- Watercourse

Coffs Harbour Bypass
Proposed construction changes
Figure 13

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N



Legend

- Construction footprint May 2020
- Alignment
- Construction zone
- Potential construction access
- Additional potential construction access
- Temporary access road
- Potential ancillary site
- Revised potential ancillary site
- Additional potential ancillary site
- Potential controlled blasting sites
- Additional potential controlled blasting sites
- Indicative construction sediment basin location
- Modified construction sediment basin location
- North Coast Railway
- Watercourse

Coffs Harbour Bypass
Proposed construction changes
Figure 14

0 0.1 0.2 0.3 km
N
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56

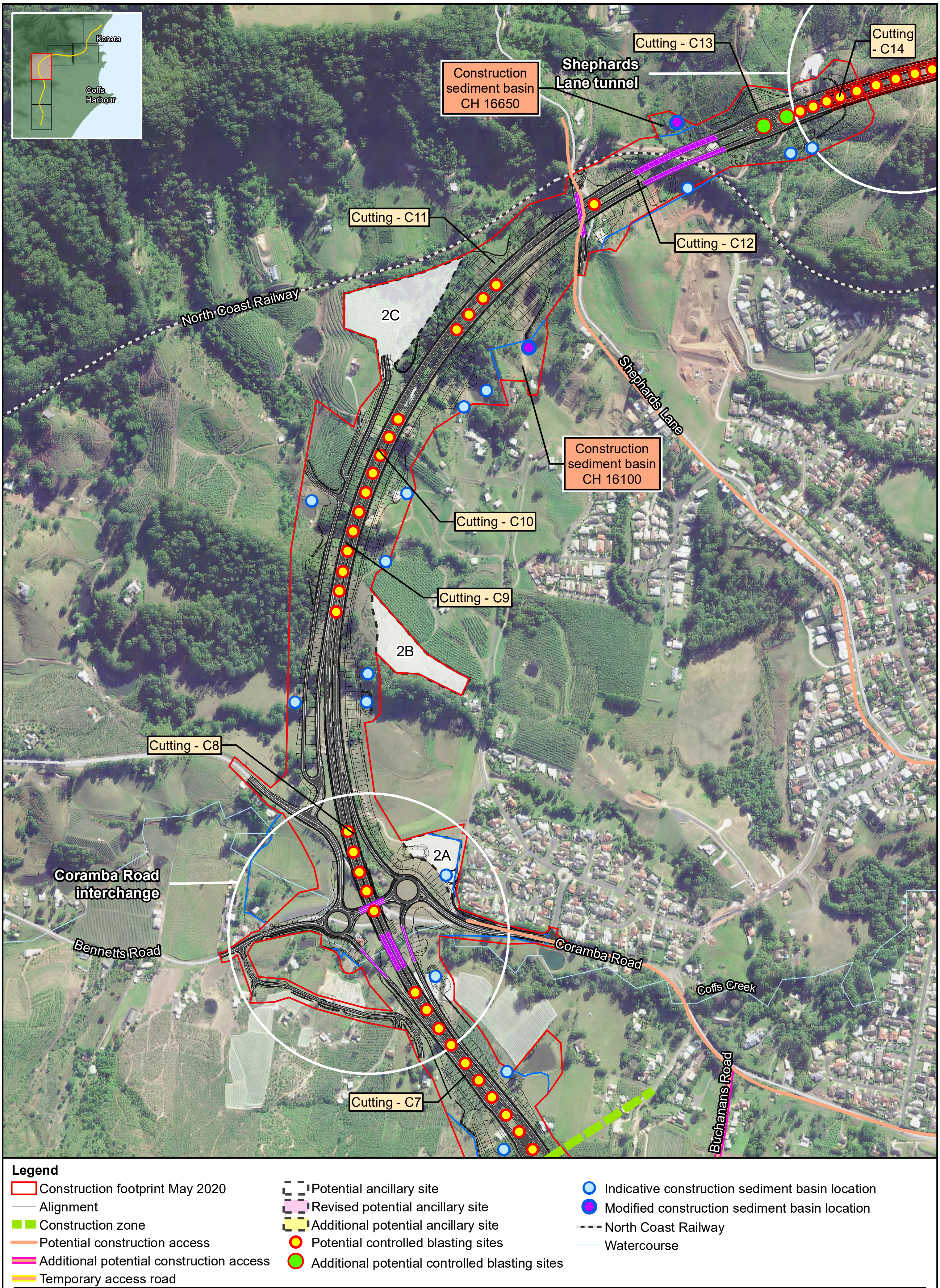
5.1.2 Zone 2 – Roberts Hill ridge to Korora Hill

This construction zone covers the area of the project north of Roberts Hill ridge to south of the Korora Hill interchange. It traverses a number of minor ridges, with a series of cuts and fills along the project and includes the Shephards Lane and Gatelys Road tunnels. This construction zone also includes the Coramba Road interchange and a crossing of the North Coast Railway.

Key features of this construction zone are discussed in Table 40 and shown in Figure 15 and Figure 16.

Table 40: Zone 2 construction features

Key features	Comments
Zone length	• Around 6.2 km
Construction access	• Via Coramba Road • Via Shephards Lane • Via Bray Street and Mackays Road • Via West Korora Road.
Earthworks	• Potential shortfall of material when comparing cut and fill volumes • Series of cuts and fills along the zone length. • Embankments and cuttings for Coffs Creek flood mitigation
Coramba Road interchange	• Includes diversion of Coramba Road to pass over the project alignment and ramps to provide access to and from the project. • Relocation of the Coramba Road Bus Stop
Shephards Lane bridge (BR11)	• Bridge over the project to reconnect Shephards Lane. Temporary diversion of Shephards Lane needed to construct the bridge • Bridge would be constructed next to the existing North Coast Railway tunnel currently below Shephards Lane and west of the project.
Bridge over North Coast Rail Line (BR12)	• Bridge spanning the North Coast Railway and a local access road.
Shephards Lane tunnel	• Twin tunnels about 360 m long and about 60 m below the crest of Shephards Lane ridge • May require drill and blast to excavate material.
Mackays Road underpass (BR13)	• Underpass south of Mackays Road to provide access to properties west of the project. This would require realignment of Mackays Road
Gatelys Road tunnel	• Twin tunnels about 450 m long and about 70 m below the crest of Gatelys Road ridge • May require drill and blast to excavate material.
West Korora Road underpass (BR16)	• Underpass along the existing alignment of West Korora Road to provide access to properties west of the project.



Coffs Harbour Bypass
Proposed construction changes
Figure 15

Legend

- Construction footprint May 2020
- Alignment
- Construction zone
- Potential construction access
- Additional potential construction access
- Temporary access road
- Potential ancillary site
- Revised potential ancillary site
- Additional potential ancillary site
- Potential controlled blasting sites
- Additional potential controlled blasting sites
- Indicative construction sediment basin location
- Modified construction sediment basin location
- North Coast Railway
- Watercourse

Coffs Harbour Bypass
Proposed construction changes
Figure 16

0 0.1 0.2 0.3 km
N
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56

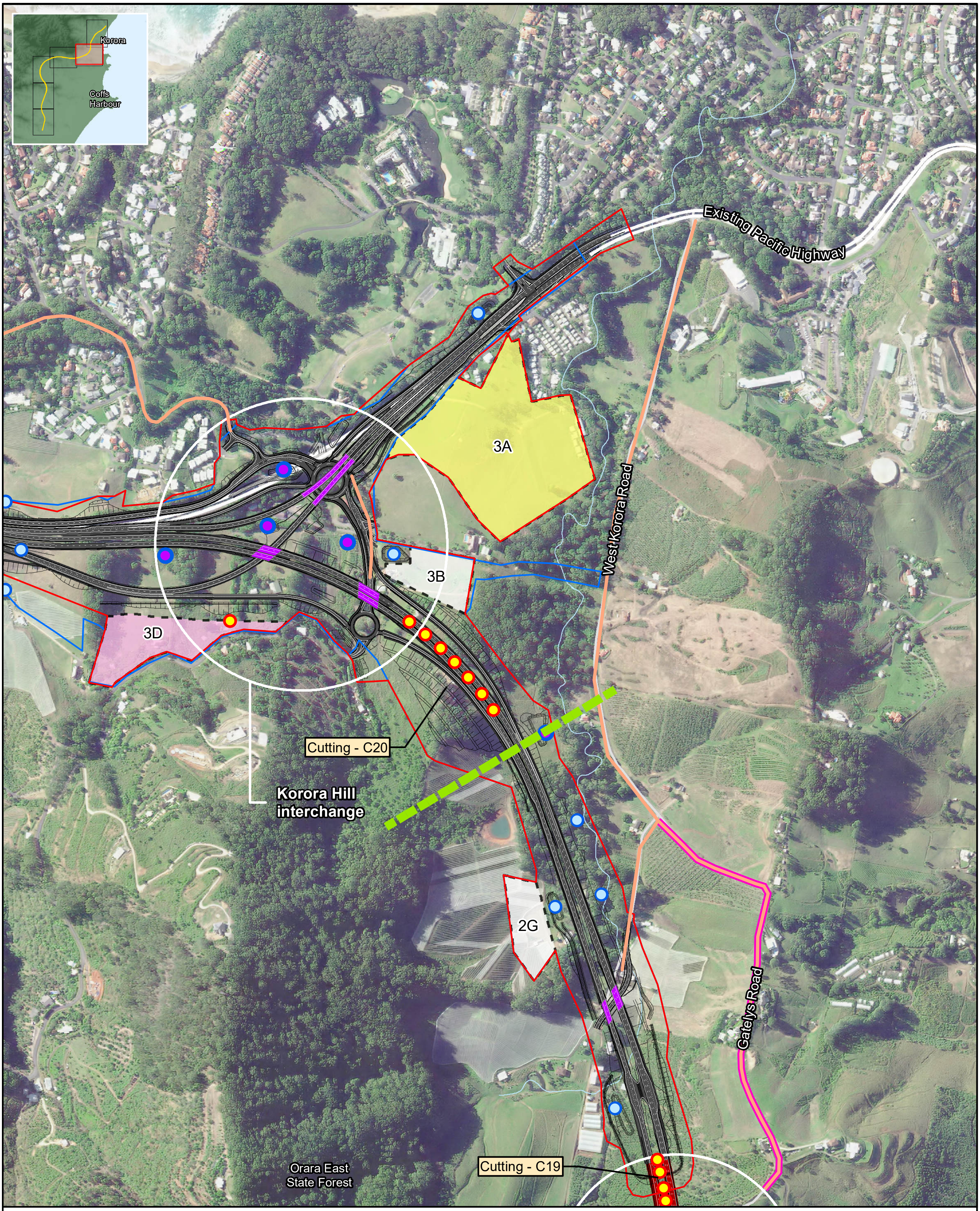
5.1.3 Zone 3 – Korora Hill to Sapphire

This construction zone covers the area of the project from south of Korora Hill interchange to the northern tie-in to the existing Pacific Highway at Sapphire. This construction zone is largely located along the existing Pacific Highway between Bruxner Park Road and the northern tie-in. It is located in a tightly constrained corridor, with key pinch points at the Kororo Nature Reserve and Kororo Public School. It comprises a continuation of the existing service road to the east (Solitary Islands Way, built as part of the Sapphire to Woolgoolga upgrade) from south of Sapphire to James Small Drive, and a local access road proposed to the west of the project to provide access to Old Coast Road and Seaview Close.

Key features of this construction zone are discussed in Table 41 and shown in Figure 17 and Figure 18.

Table 41: Zone 3 construction features

Key features	Comments
Zone length	• Around 3.4 km
Construction access	• Via the existing Pacific Highway and Bruxner Park Road • Via Old Coast Road • Via James Small Drive.
Earthworks	• Potential excess of material when comparing cut and fill volumes.
Korora Hill interchange	• Interchange located west of the existing Pacific Highway and provides a connection between the project and the existing Pacific Highway to the south (towards Coffs Harbour), Bruxner Park Road, James Small Drive and the proposed service road • Bridge over connection to roundabout intersection with Bruxner Park Road (BR17) • Bridge over northbound entry ramp from Coffs Harbour (BR18) • Twin bridges over grade separated roundabout (BR19)
Upgrade along existing Pacific Highway corridor	• Tightly constrained corridor between Kororo Nature Reserve and Kororo Public School • Existing Pacific Highway traffic to be managed during construction • Bridge over Pine Brush Creek (BR21). • Realignment of Pine Brush Creek and Williams Creek
Proximity to Kororo Public School	• Construction activities are likely to occur in Zone 3 over a three and half year period, including in areas next to the school.
Luke Bowen footbridge relocation (BR24)	• Existing pedestrian bridge to be replaced with a new pedestrian bridge to be built about 6 m south of the existing bridge, near Old Coast Road.
Kororo Public School bus interchange	• Existing bus interchange to be relocated, near Kororo Public School. Access to the bus interchange to be from new service road.
Local access underpass (BR22)	• Local access underpass, near Fernleigh Avenue, to provide access to Old Coast Road and Seaview Close.
Tie-in to existing dual carriageway at Sapphire	• Connects to the existing dual carriageway highway at Sapphire. • Service road east of the project connects directly to Solitary Islands Way.



Legend

- Construction footprint May 2020
- Alignment
- Construction zone
- Potential construction access
- Additional potential construction access
- Temporary access road
- Potential ancillary site
- Revised potential ancillary site
- Additional potential ancillary site
- Potential controlled blasting sites
- Additional potential controlled blasting sites
- Indicative construction sediment basin location
- Modified construction sediment basin location
- North Coast Railway
- Watercourse

Coffs Harbour Bypass
Proposed construction changes
Figure 17

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56

Legend

- Construction footprint May 2020
- Alignment
- Construction zone
- Potential construction access
- Additional potential construction access
- Temporary access road
- Potential ancillary site
- Revised potential ancillary site
- Additional potential ancillary site
- Potential controlled blasting sites
- Additional potential controlled blasting sites
- Indicative construction sediment basin location
- Modified construction sediment basin location
- North Coast Railway
- Watercourse

Coffs Harbour Bypass
Proposed construction changes
Figure 18

0 0.1 0.2 0.3 km
N
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56

5.1.4 Construction activities

Anticipated construction activities for the project are likely to involve conventional road construction equipment such as rock breakers, earth moving equipment, concreting equipment, paving plant, concrete and asphalt batching plant, cranes, and blasting.

These methods may be modified during the detailed design or construction stages to address site-specific environmental or engineering constraints. The typical pre-construction, construction and activities shown in Table 42 are based on standard construction practices and are informed by the concept design for the project.

The activities and typical construction plant and equipment listed in Table 42 have been used as the basis of assessment of the likely nature and extent of environmental impacts during construction. These activities are indicative and would be refined by the construction contractor based on the site constraints and in accordance with any conditions of approval.

Table 42: Typical construction activities and associated plant and equipment

Component	Typical activities	Typical plant and equipment
Pre-construction and site establishment	• Property acquisition and adjustments, including property access changes • Detailed investigations and survey work including investigative drilling, contamination investigations and excavations • Condition surveys • General site clearance, site establishment work, fencing and signage • Establishment of temporary ancillary facilities and compound sites including the site office • Temporary traffic management arrangements including construction of minor access roads • Progressive installation of environmental controls including temporary or permanent fencing, and erosion and sediment control measures • Construction of temporary drainage controls including temporary creek crossings • Clearing and removal of vegetation (non-threatened species) • Relocation and/or protection of utilities.	• Trucks • Generators • Light vehicles • Excavators • Chainsaws • Mulchers • Water carts • Cranes • Drilling rigs.
Site preparation and bulk earthworks	• Clearing and grubbing of vegetation • Mulching of vegetation for re-use in landscaping activities, where possible • Stripping topsoil and stockpiling it for reuse in landscaping • Excavation of cuttings, including processing, stockpiling or haulage of material, and stabilisation of batters • Drilling of blast holes • Establishment of crushing plant • Crushing and screening excavated material • Hauling materials from excavated cuttings, borrow sites and external sources to fill embankment locations • Construction of fill embankments and earth mounds, including foundation drainage • Benching and stabilising cut and fill batter slopes.	• Trucks • Bulldozers • Excavators • Compactors • Graders • Scrapers • Loaders • Water carts • Compactors • Vibratory rollers • Rock breakers/ hammers • Drilling and blasting equipment for hard rock cuttings.

Component	Typical activities	Typical plant and equipment
Drainage and structures	• Construction of drainage, including kerb and gutter (where required) • Installation of cross-drainage, including culverts and inlet and outlet work, such as channel diversions and scour protection • Installation of longitudinal and vertical drainage in cuttings and embankments • Construction of diversion and catch drains along the formation and sedimentation control basins or swales (where required) • Construction of subsurface drainage • Construction of any retaining walls • Installation of fauna connectivity structures.	• Trucks • Bulldozers • Excavators • Concrete pumps • Concrete trucks • Cranes.
Bridge work	• Preparation of bridge work areas including temporary piling pads, access platforms • Installation of rock caissons or cofferdams or temporary access roads across waterways • Installation of bridge foundations (driven or bored piles, pile caps and footings) • Construction of new bridge abutments and piers • Construction of bridge superstructure including deck and road surface work (cast in situ or precast bridge elements) • Construction of scour protection (where required) • Construction of noise walls (where required).	• Piling rigs • Concrete pumps • Concrete trucks • Cranes • Excavators • Trucks • Cherry pickers • Welding equipment.
Tunnel work	• Establishment of portal sites in preparation for tunnel excavation, including provision of temporary tunnel services • Excavation of tunnel portals • Excavation of mined tunnels using drilling and blasting equipment for hard rock • Excavation of cross passages • Finishing works in tunnel and provision of permanent tunnel services • Test tunnel plant and equipment.	• Drilling and blasting equipment for hard rock • Trucks • Excavators • Bulldozers • Graders • Paving machines • Light vehicles • Small cranes • Elevated working platform • Generators

Component	Typical activities	Typical plant and equipment
Demolition	• Demolition of bridges (Luke Bowen footbridge and northbound carriageway bridge over Pine Brush Creek) • Demolition of buildings (properties and sheds).	• Trucks • Bulldozers • Excavators • Light vehicles • Concrete saws • Jack hammers.
Road work and road surfacing	• Construction of temporary local traffic management diversions • Construction of base and select layers of materials • Construction of road surface layers • Construction of road surface drainage, including kerb and gutter (where required) • Construction of concrete barriers, wire rope fencing and guardrails • Installation of traffic lights, road markings, signposting, roadside furniture and lighting • Progressive landscaping and tree planting.	• Graders • Backhoes • Trucks • Water carts • Vibratory compactors • Bitumen sprayers • Rollers • Concrete trucks • Concrete pumps • Concrete saws • Compressors • Bitumen sprayers • Generators • Milling machines • Paving machines • Asphalt trucks • Curing machines.
Finishing work	• Remove temporary work • Restoration and landscaping of temporary sites • General site clean-up • Restoration of topsoil and revegetation of batters • Removal of temporary environmental controls • Site clean-up and demobilisation, including restoration of ancillary sites and construction access roads (where required).	• Trucks • Generators • Light vehicles • Cranes.

5.1.5 Ancillary Facilities

In order to build the project, ancillary facilities would be required including:

- Site Compounds
- Concrete batching plant
- Asphalt batching plant
- Crushing plant and screening
- Stockpile areas
- Precast facilities.

The ancillary facilities activities are presented below in Table 43 and their potential locations are shown in Figure 13 to Figure 18.

Table 43: Proposed use of ancillary facilities

Site no.	Proposed use					
	Main site compound	**Secondary site compound**	**Concrete batch plant**	**Asphalt batch plant**	**Crushing plant**	**Stockpile site**
1A	✓	✓	✓	✓	✓	✓
1C	✓	✓	✓	✓	✓	✓
1D	✓	✓		✓		✓
1G	✓	✓	✓	✓	✓	✓
1J	✓	✓	✓	✓	✓	✓
2A	✓	✓				✓
2B					✓	✓
2C		✓			✓	✓
2D		✓			✓	✓
2E		✓			✓	✓
2G		✓				✓
3A	✓	✓	✓	✓	✓	✓
3B	✓	✓			✓	✓
3D		✓				✓
3E		✓				✓
3F		✓				✓
3G						✓

[1] Site 3C has been removed since EIS

5.1.5.1 Changes to ancillary facilities when compared with the EIS

Four new construction ancillary facilities and two amended construction ancillary facilities have been proposed compared the sites described in the EIS. The new ancillary facilities include sites 1A, 1J, 3A and 3F and the amended ancillary facilities include sites 1C and 3D. In addition to the new and amended facilities, site 3C located off Bruxner Park Road has been removed due to be impacted by the amended Korora Hill interchange. The new and amended potential ancillary facilities are described in Table 43 and potential locations are shown in Figure 13 to Figure 18.

5.1.6 Construction timing

Subject to planning approval and the progress of property acquisition, construction of the project is anticipated to start in 2020 and take around four years. The actual timing of construction, opening to traffic and completion would depend on the availability of construction funding, the preferred procurement method and wet weather.

The construction program shown in Table 44 is indicative only and may change based on further work during detailed design and changes to construction methods and/or materials as well as wet weather periods. The community would be kept informed of timing as the construction program is refined after project approval.

Table 44: Indicative construction timeline

Principal activities	**Year 1**				**Year 2**				**Year 3**				**Year 4**			
Preliminary activities and site establishment[1]	■	■	■	■												
Site preparation and bulk earthworks		■	■	■	■	■	■	■	■	■						
Drainage and structures			■	■	■	■	■	■	■	■	■	■	■	■	■	
Bridges			■	■	■	■	■	■	■	■	■	■	■			
Tunnels				■	■	■	■	■	■	■	■					
Road work and road surfacing			■	■	■	■	■	■	■	■	■	■	■	■	■	
Finishing work					■	■	■	■	■	■	■	■	■	■	■	■

[1] Preliminary and site establishment activities would include property acquisition adjustment works including installation of property fencing, demolition and removal of buildings and relocation and adjustments of property utility connections including water supply, sewer, telecommunications and electricity

Construction works are anticipated to take place mostly within standard construction hours in accordance with the CNVG and the ICNG. However, construction works might need to be undertaken during evening and night-time periods due to special requirements (e.g. deliveries of oversized equipment, minimisation of traffic disruption, safety reasons, emergencies, reduction in construction timeframe).

The following are the categories of work that may be carried out outside the recommended standard hours:

- Delivery of oversized plant or structures that the police or other authorities determine require special arrangement to transport along public roads
- Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- Public infrastructure works that shorten the duration of construction and are supported by the affected community
- Work where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours.

Potential activities associated with the last category of work are summarised in Table 45 including likely locations in regard to the construction zones identified in Section 5.1.1, 5.1.2 and 5.1.3 and justification for the work. Most of these activities would be carried out in the Korora Hill to Sapphire section (Zone 3) due to the need to coordinate work with existing Pacific Highway traffic (about 30,000 vehicles per day at this location), Road Occupancy Licence (ROL) restrictions necessary to minimise road user delays and traffic queuing and the need to consider safety of construction personnel and road users.

Table 45: Proposed out of hours work

Activity	Location	Justification
Bridge construction	All zones	A number of bridges would require construction in close proximity to or over the existing Pacific Highway between Korora Hill to Sapphire. Activities would include lifting and setting bridge spans and girders. Due to the potential safety risks to road users and construction personnel associated with working near the existing heavily trafficked highway, this work would need to be carried out outside peak traffic hours or at night when there are lower traffic flows. Avoiding peak periods would also significantly minimise the disruption to traffic. In addition, it is likely that a number of bridges over local roads would also require to lifting and setting bridge spans and girders during out of hours to reduce the potential safety risks to road users and construction personnel. During construction of the bridge over the North Coast Railway, there may also be a need to undertake pier construction or lifting and setting bridge spans and girders outside of the recommended standard construction hours to minimise disturbance to railway operations. This work would also need to be in accordance with fixed Track Possession periods issued by Australian Rail Track Corporation when only certain works are permitted to occur with the rail corridor. This may include working over public holidays/long weekends, e.g. Easter when tracks are officially closed to rail traffic for a defined window so as to minimise impacts on rail freight and passenger traffic as well as the associated safety risks.
Bridge demolition	Zone 3	The existing Luke Bowen footbridge would require demolition as part of the project. It is expected the main bridge span would be required to be lifted out in a single piece, necessitating a full stoppage of the Pacific Highway and or detour of traffic. To avoid potential safety risks to road users and construction personnel associated with demolishing the existing bridge over live traffic, this work would need to be carried out at night when there are lower traffic flows. Avoiding peak periods would also minimise the disruption/delays to traffic.
Concrete paving and saw-cutting	All zones	TfNSW has specifications for concrete paving that relate to temperature and rainfall. For jointed concrete base, the specifications prohibit the placement of concrete during rain or when the ambient air temperatures are below 5ºC or above 32ºC. As hot weather affects the quality of the concrete surface, paving in the early evening and into the night is preferred as it takes advantage of cool night-time temperatures. In some places, the project would use plain concrete pavement, which is an unreinforced pavement. To manage cracking associated with drying and shrinkage, saw cutters are used to cut the pavement. The timing of concrete cutting is governed by the hydration rate of the concrete and may require cutting at any time within four and 24 hours after paving, with a 'cutting window' as short as 30 minutes. As the timing of the cutting is critical to the quality of the pavement and acceptance of the finished product, concrete saw-cutting may be needed at any time including outside standard construction hours. Concrete saw-cutting is a construction activity that is transient in nature, and each saw cut would be of a short duration.

Activity	Location	Justification
Structural concrete work	All zones	TfNSW has specifications for structural concrete work that relate to temperature and rainfall. For structures, the specifications prohibit the placement of concrete during rain or when the ambient air temperatures are below 5ºC or above 32ºC. During hydration of the concrete, significant temperatures can be generated. Additionally, for large size members (minimum dimension of 1 m), the maximum allowable internal temperature of the concrete must not exceed 70ºC. The temperature differential between the centre of the element and the surface must not exceed 25ºC. As hot weather affects the temperature of the concrete constituents and hence the mix, as well as the ambient conditions under which the work is exposed and ultimately the quality of the concrete, placing concrete at night and in the early morning is preferred as it takes advantage of the coolest part of the day. These would generally be concrete pours for specific, large sized critical elements of the project. Additionally, some bridge construction techniques, concrete work and stressing operations need to occur at times of the day when the temperature effects are relatively stable or minimised to achieve the required design intent.
Traffic management, tie-ins, line marking and traffic switches	All zones	Road surface work, including milling and re-sheeting with asphalt and the removal and replacement of concrete carried out on the existing Pacific Highway associated with traffic management, tie-ins, line marking and traffic switches would need to be coordinated with live traffic. While this work would be completed in stages, it may require lane closures to safely carry out the work. This work would need to occur during evening and night-time periods during periods of lower traffic volumes. Carrying out this work outside the recommended standard construction hours would reduce inconvenience to road users, avoid traffic delays during daytime or peak traffic periods and better manage the safety of construction personnel working on the existing highway. Similarly, traffic switches associated with the new alignment of Coramba Road would also need to be undertaken outside of the recommended standard construction hours to reduce inconvenience to road users, avoid traffic delays during daytime or peak traffic periods and better manage the safety of construction personnel. Intersection works including the installation and commissioning of traffic lights would also be programmed to occur outside peak traffic hours or at night when there are lower traffic flows. Avoiding peak periods would also significantly minimise the disruption to traffic.
Utility relocations and protection	All zones	Public utility providers typically require ‘cut over’ work to be carried out outside of peak demand periods to avoid or minimise potential disruptions for utility customers. This is also the case for utility supply to critical infrastructure. This would result in some utility work needing to be carried out outside of the recommended standard construction hours. In addition, carrying out utility relocations or protection near the existing Pacific Highway would require construction close to live traffic. Due to the potential safety risks to road users and construction personnel associated with working near the existing highway and to minimise the duration, this work would need to be carried out outside peak traffic hours or at night when there are lower traffic flows.

Activity	Location	Justification
General construction on or near the existing highway	Zone 1 Zone 3	A ROL would be required for all work on the existing Pacific Highway between Korora Hill and Sapphire and between the southern tie-in and Englands Road interchange. An ROL is required for any activity that would or is likely to cause delay including obstruct, restrict, close, interfere with, slow or stop the free flow of traffic on any lane or shoulder of the existing highway. Due to the importance of the existing Pacific Highway in the State road network and traffic volumes experienced (between 30,000 to 32,000 vehicles per day for the above locations), ROL requirements would likely restrict the majority of work outside peak traffic hours or at night when there are lower traffic flows. As such, a number of general construction activities would be required to be carried out outside of the standard construction hours for the Korora Hill to Sapphire section and southern tie-in to Englands Road interchange section of the project. This would include earthworks, drainage and structures, road work and finishing work (e.g. installation of road furniture). Additionally, some general construction activities directly next to the Korora Public School may be also be best carried out outside of school hours to minimise impacts on the operations of the school including the safe drop off and pick up of children.
Operation of construction ancillary facilities	All zones (ancillary sites only)	Operation of construction ancillary facilities would be required to support proposed out of hours work.
Deliveries to batching plants	All zones (batching plants only)	A number of batch plants are proposed as part of the project (see Section 5.8.3). In addition to normal daytime operation, the batch plants would need to operate in conjunction with paving work during the evening and night time. There may also be a need to cast some bridges in situ, which would require the plant to operate continuously for up to 24 hours. To keep up with the materials demand during these peak periods of concrete production, the batch plant would also require material deliveries outside normal working hours.
Refuelling operations and maintenance	All zones	Undertaking refuelling and maintenance activities outside of standard hours would maximise plant and machinery operations and therefore reduce the overall duration of the project. By reducing the overall duration of the project, the adjacent community would experience a reduced duration of amenity impacts and roads users would have the duration of construction traffic related impacts also reduced. Undertaking refuelling and maintenance activities outside of standard hours also allows for the improved management of safety risks to construction personnel. When undertaken outside of standard hours, the interaction of refuelling and maintenance activities with other main construction activities, e.g. bulk earthworks, is removed and a safer work environment provided. In addition, refuelling and maintenance activities have been typically undertaken outside of standard hours on Pacific Highway upgrade projects, e.g. Woolgoolga to Ballina project, and are effectively managed through the implementation of a Construction Noise and Vibration Management Plan and Out of Hours Work Procedure.

Activity	Location	Justification
Tunnel excavation	Zone 1 and Zone 2	To maximise program efficiency and reduce the overall duration of the project. Reducing the overall duration of the project would provide a benefit to the affected community by reducing exposure to potential construction related impacts such as noise and vibration. The majority of this work would be carried out within the tunnel excavation with acoustic sheds included around tunnel portals to shield noise from within the tunnel during evening and night periods to minimise impacts at nearby sensitive receivers. Tunnel excavation is proposed to be undertaken Monday to Saturday and is likely to be undertaken in 12-hour shifts based on a 24-hour work cycle, e.g. 6am to 6pm and 6pm to 6am.

Additional activities and/or locations for out of hours work (OOHW) may be required as further construction staging and methodologies are developed during detailed design. Out of hours work would occur in accordance with the project approval and notification requirements of any Environment Protection Licence for construction of the project. Specifically, this would be managed through an OOHW procedure which would be included as part of the CNVMP.

Table 46 summarises the anticipated construction scenarios and corresponding anticipated timing for the project.

Table 46: Indicative construction scenarios and timing

Scenario ID	**Scenario**	**Indicative duration[1] (months)**	**Hours of works**			
			Day (Standard)	**Day (OOH[2])**	**Evening**	**Night**
1	Preliminary activities and site establishment[3]	12	Yes	Yes	Yes	Yes
2	Site preparation and bulk earthworks	27	Yes	No[4]	No[4]	No[4]
3	Drainage and structures	39	Yes	Yes	Yes	Yes
4	Bridges	33	Yes	Yes	Yes	Yes
5	Tunnels	24	Yes	Yes	Yes	Yes
6	Road work and road surfacing	39	Yes	Yes	Yes	Yes
7	Finishing work	36	Yes	Yes	Yes	Yes

[1] Durations should be regarded as indicative and represent typical works. The durations will differ at the various sites and the longest duration is presented.

[2] OOH = Out of hours. During the daytime, this refers to the period on Saturday between 7am – 8am and 1pm – 6pm, on Sunday and public holidays between 8am – 6pm.

[3] Preliminary and site establishment activities would include property acquisition adjustment works including installation of property fencing, demolition and removal of buildings and relocation and adjustments of property utility connections including water supply, sewer, telecommunications and electricity

[4] No OOH works across Construction Zone 2, reduced construction activities during OOH across Construction Zone 1 and Zone 3

5.1.7 Construction traffic

The construction of the project will generate an increase in vehicle movements on the Pacific Highway and the collector road network (including the proposed identified construction access roads). Additional vehicle movements will be generated by:

- The arrival and departure of construction plant, equipment and vehicles; this is likely to require off-peak movement of construction plant and equipment to/from work areas
- The haulage and delivery of road work materials, and removal of waste to and from the construction zones
- The arrival and departure of construction workers at the start and end of each work day and night shift, which will result in an increased traffic demand and turning manoeuvres to and from the construction site access.

It is noted that a minor temporary realignment of Shephards Lane is also proposed to enable bridge construction. This realignment is not considered a significant diversion and is not expected to significantly alter the traffic noise impact in this location during construction.

Construction access roads have been identified in Table 47.

Table 47: Construction access roads

Construction zone	Construction access
Zone 1 – Englands Road to Roberts Hill	Englands Road North Boambee Road
Zone 2 – Roberts Hill ridge to Korora Hill	Coramba Road West High Street Buchanans Road Shephards Lane Bray Street Mackays Road
Zone 3 – Korora Hill to Sapphire	West Korora Road Gatelys Road Bruxner Park Road James Small Drive Old Coast Road Russ Hammond Close[1]

[1] Not a construction access road however, temporary connection required to maintain access to Kororo Public School and existing residential properties on Korora School Road

The construction access roads are shown on Figure 19.

5.1.7.1 Changes in construction traffic management and access when compared with the EIS

Two new construction access roads would be needed for the project. These new construction access roads are Buchanan Road and Gatelys Road (refer to Figure 19).

Buchanans Road would be needed for access to establish the Roberts Hill tunnel southern portal and early tunnelling and establishment works as well as to facilitate service relocations. The local road connects to the existing access track on land which is owned by TfNSW.

Gatelys Road would be needed for service relocations in this section of the project and is not required for to access to the project corridor.

During construction, access to Korora School Road from the existing Pacific Highway would need to be closed and a temporary connection required to maintain access to Kororo Public School and existing residential properties on Korora School Road. The temporary access is proposed via Russ Hammond Close and would involve providing a connection between the cul-de-sac to Korora School Road through TfNSW owned property.

Legend

- Construction footprint
- Alignment
- North Coast Railway
- Watercourse
- Construction zone
- Potential construction access
- Additional potential construction access

Coffs Harbour Bypass
Construction access routes
Figure 19

0 0.5 1 1.5 km

Scale @A4: 1:50,000
GDA 1994 MGA Zone 56

N

5.2 Construction noise

Consistent with the requirements of the CNVG, this assessment provides a 'realistic worst-case' noise impact assessment based on the required construction works within any 15-minute period. This is typically associated with works located nearest to a particular receiver. In reality, the potential construction noise impacts at any particular location can vary greatly depending on factors including the following:

- The position of the works within the site and distance to the nearest sensitive receiver
- The overall duration of the works
- The intensity of the noise levels
- The time at which the works are undertaken
- The character of the noise.

Noise levels at sensitive receivers can also be significantly lower than the worst-case scenario when the construction works move to a more distant location in a works area.

5.2.1 Construction activities and scenarios

In order to assess the likely noise impacts associated with the construction of the project, a number of scenarios comprising typical plant and equipment frequently used on similar road developments have been developed based on the current understanding of the project. The scenarios are based on the information contained in Section 5.1. The scenarios assessed in this report, including the construction activities and plant and equipment, are likely to change during the detailed design when additional information regarding construction activities, plant and equipment and staging is available.

The scenarios are presented in Table 48 are considered representative of the noisiest construction activities likely to occur across the project. Anticipated plant and equipment used during each of the scenarios is also provided, together with the associated sound power levels (L_W) which have been sourced from:

- AS2436: Guide to noise and vibration control on construction, demolition and maintenance sites [25]
- BS 5228-1 – 2009: Code of Practice for noise and vibration control on construction and open sites [26]
- Roads and Maritime Construction Noise Estimator Tool database [27]
- Construction Noise and Vibration Strategy, Transport for NSW, 2018 [28].

Sound power data provided includes an estimated time correction of the plant and equipment use in 15 minutes. A 5 dB penalty has also been included to the sound power levels of equipment identified as particularly annoying to nearby residents in accordance with the ICNG, such as jackhammers, rock breakers, power saws, rock drilling, vibratory rollers, milling and profiling machines and impact piling.

Table 48: Construction activities and equipment

Plant and equipment	Plant and equipment characteristics			Construction Activities																	
				Preliminary activities and site establishment/Earthworks				Bulk earthworks			Drainage and structures		Bridge works		Tunnel works		Demolition	Road work and road surfacing			Finishing works
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
				Mobilisation and Site Establishment	Utility, Property, service adjustment	Corridor Clearing	Construction Compound Site Establishment	Bulk Earthworks	Rock Crushing	Compounds	Drainage Infrastructure	Retaining walls/Noise walls	Bridge Works	Compounds	Tunnel works	Compounds	Demolition	Paving/asphalting (incl. concrete sawing)	Re-surfacing works	Compounds	Road Furniture Installation
	Plant item SWL, dB(A)	% of use in a 15-minute period1	Plant Item Max SWL, dB(A)	Installing construction boundary hoardings/fences and traffic barriers	Adjustment of property boundaries (where required); relocation of services	General land clearing, tree and stump removal, topsoil stripping, loading		Formation of road alignment. Excavation of soil and rock, hammering/rock breaking, drilling, loading, haulage, compaction of fill areas, grading	Crushing and screening of building waste/rock material for re-use on site	Deliveries. Plant and equipment. Maintenance. Office areas. Storage areas.	Excavation of trenches and pits; delivery and placement of precast pipes and pits; filling and compacting		Casting; concrete pours; placement of pre-cast elements; piling (mainly bored); and demolition	Deliveries. Plant and equipment. Maintenance. Office areas.		Deliveries. Plant and equipment. Maintenance. Office areas.	Demolition of existing structures	Delivery of raw materials. Placement of surface material. Saw cutting.	Milling the asphalt to expose the underlying concrete, then laying the new asphalt	Deliveries. Plant and equipment. Maintenance. Office areas. Storage areas. Batching plant	Signposting and line marking
Air track drill[1]	129	25	124									1									
Asphalt truck & sprayer	106	100	112															1	1		
Backhoe	106	50	111					1[5]													
Batching plant (Concrete)	115	100	118																		

Batching plant (Asphalt)	114	100	117																	1	
Bulldozer D9	116	100	120			1		1[6]	1												
Chainsaw 4-5hp	114	25	117			1															
Compactor	113	25	115					1										1	1		
Compressor	109	100	110				1						1	1		1				1	
Concrete pump	109	50	112									1	1								
Concrete saw[1]	122	25	122		1													1			
Concrete truck	109	50	112		1						1		1					1			
Concrete vibrator	113	100	115									1									
Crane (Fixed)	105	100	113																		
Crane (Franna 20t)	105	100	113	1	1						1		1		1						1
Crane (Mobile)	105	100	113									1									
Crushing Plant	118	100	124							1											
Daymakers	98	100	98																1		
Drill (Hydraulic)[1]	118	100	115					1							1						
Drill (Percussive)[1]	121	100	121																		
Excavator (tracked) 35t	100	100	110		1	1		1[6]	1		1	1					1				
Excavator (tracked) 35t + hydraulic hammer[1]	123	50	123					1[6]									1				
Front end loader 23t	113	100	115				1			1				1		1	1			1	
Grader	110	100	115					1[4]							1[4]			1[4]			
Light vehicles (e.g. 4WD)	103	100	108				3			3				3		3				3	
Line marking truck	108	100	108																		1
Pavement laying	110	100	114															1	1		
Pavement profiler[1]	118	100	117																1		
Piling rig - bored	108	50	112									1	1								
Piling rig - impact[1]	128	50	133																		

Pneumatic hammer	115	50	117					1[5]													
Power generator	103	100	105		1		1					1	1	1	1	1				1	
Rock crusher	115	100	118						1												
Scraper 651	110	100	116					1[4]													
Smooth drum roller	107	100	111															1	1		
Truck compressor	75	100	78								1										
Truck (Dump truck)	110	100	112		1	1		2[7]	1					1		1	1	1	1	1	
Truck (medium rigid)	108	100	110	1						1											
Truck (Road truck)	108	100	111	1			1				1										1
Truck (Vacuum truck)	109	100	111																		
Tub grinder/ mulcher 40-	116	100	118			1															
Vibratory roller[1]	114	100	113								1										
Water cart	107	100	108	1				1													
Welding equipment	105	100	110				1							1		1				1	
TOTAL NUMBER OF EQUIPMENT				5	6	5	8	10	4	6	6	7	6	8	4	8	4	8	7	9	4
TOTAL SWL				113	118	120	117	124[6]	118	120	116	124	114	117[3]	119[3]	117[3]	121	120	121	119	112
MAX SWL				113	122	120	115	123[6]	128	123	113	124	113	115	115	115	123	122	117	117	113

Note 1: A 5 dB penalty has been included to the sound power levels of equipment identified as particularly annoying to nearby residents in accordance with the ICNG (such as jackhammers, rock breakers, power saws, rock drilling, vibratory rollers, milling and profiling machines and impact piling).

Note 2: Correspond to an estimated time correction of the plant and equipment use in 15 minutes.

Note 3: Updated since EIS due to revised logarithmic addition

Note 4: Updated since EIS due to missing information

Note 5: Only during OOHW

Note 6: Only during Standard Hours of Work

Note 7: Only one (1) during OOHW

The predicted loudest construction activities likely to occur over the whole project include bulk earthworks, construction of retaining walls and pavement tie-ins and overlay, which are potentially occurring during the night-time period. Predicted loudest construction activities are also likely to occur during the construction of the bridges depending of the equipment to be used.

5.2.2 Construction noise impact assessment

Nine scenarios have been modelled in accordance with representative activities listed in Table 42. For all modelled scenarios, assessment during all periods has been undertaken. The indicative timing for construction scenarios, i.e. occurring during standard or out-of-hours is provided in Table 46.

The nine scenarios modelled are:

- Bulk earthworks (Activity ID5) – occurring over the whole length of the project[2], see Table 49
- Bridges construction (Activity ID10), see Table 50
- Tunnels construction (Activity ID12), see Table 51
- Road works (Activity ID 15) – occurring over the whole length of the project, see Table 52
- Site compounds activities (Activity ID4, ID 7, ID11, ID 13, ID 17) – modelled in accordance with Table 48, see Table 53
- Demolition (Activity ID14), see Table 54
- Drainage and structures (Activity ID8), see Table 55
- Finishing works (Activity ID18), see Table 56
- Utility works and relocation (Activity ID2), see Table 57.

Construction noise impacts have been modelled using the validated SoundPLAN 8.0 acoustic model developed for assessment of operational noise impacts from the project. Environmental noise emissions are predicted based on the ISO 9613-2:1996 algorithm.

Each of the three construction zones defined in Section 5.1 were divided into smaller construction areas in the acoustic model. The cumulative sound power level emitted by the smaller sub-construction areas was determined using the sound power level per activity in Table 48.

It is noted that in Table 48, the total SWL represents the total L_{Aeq} SWL radiated by an area within a construction zone. The max SWL correspond to the L_{Amax} SWL of one piece of equipment working at the closest location on the construction boundary from a receiver. The assessment presents the anticipated maximum noise impacts likely to be experienced at the nearest receivers for each scenario.

[2] No OOH works across Construction Zone 2, reduced construction activities during OOH across Construction Zone 1 and Zone 3

The precise locations and types of equipment that will be used to undertake the construction of the project is not known in detail at this stage. Furthermore, the typical construction plant and equipment provided in Table 48 are unlikely to operate at the same time but may be used sequentially across each part of the construction zones. The predicted construction noise impacts presented are therefore considered to be conservative and in practice for most construction activities, it is expected that the construction noise levels would frequently be lower than predicted as the noise levels presented in this report are based on a realistic worst-case assessment.

Appendix J summarises results tables and noise contour plots of construction noise impacts based on the scenarios and sound power levels summarised in Table 48. Tabulated results also identify exceedances of CNVG criteria and form the basis of recommendations for mitigation discussed in Section 5.5.

An overall summary of number of noise sensitive receivers that exceed NMLs per catchment area is provided in Table 49 to Table 56.

For all modelled scenarios, assessment during all periods has been undertaken.

Furthermore, the assessment includes buildings built and buildings not yet built (subdivisions identified in Section 4.3.1) as it is not known if those buildings will be built before or after construction of the project. The buildings have been differentiated in the tables of results as well as on the map in Appendix J.

Table 49: Summary of NML exceedances per catchment area for construction activity ID 5 (Bulk earthworks)

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID5 (Bulk earthworks)																	
	All Hours	Standard Hours			Outside of Standard Hours[3]												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Residential																		
NCA01.RES	3	7	0	0	2	6	0	0	15	7	5	0	0	4	18	5	27	24
NCA02.RES	0	7	5	0	6	4	3	0	1	8	4	0	0	8	4	1	12	5
NCA03.RES	0	7	0	0	11	2	0	0	9	7	0	0	0	20	0	0	10	0
NCA03.RES (unbuilt)	0	102	3	0	46	78	2	0	52	103	2	0	13	135	43	0	124	11
NCA05.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA06.RES	0	37	41	5	2	38	43	0	0	37	41	5	0	33	44	6	69	5
NCA06.RES (unbuilt)	0	81	102	4	2	124	61	0	0	81	102	4	0	66	115	6	162	4
NCA07.RES	0	0	4	1	0	3	1	1	0	3	1	1	0	3	2	0	4	1
NCA08.RES	0	0	7	0	0	0	7	0	0	0	7	0	0	0	7	0	7	0
NCA09.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[3] No OOH works across Construction Zone 2, reduced construction activities during OOH across Construction Zone 1 and Zone 3

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID5 (Bulk earthworks)																	
	All Hours	Standard Hours			Outside of Standard Hours[3]												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA10.RES	0	1	2	1	0	2	2	0	0	0	3	1	0	0	3	1	4	1
NCA11.RES	0	22	15	0	0	0	0	0	18	0	0	0	20	4	0	0	0	0
NCA12.RES	2	19	12	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA13.RES	1	37	84	10	0	0	0	0	43	0	0	0	52	7	0	0	0	0
NCA14.RES	0	22	85	3	0	0	0	0	32	0	0	0	32	0	0	0	0	0
NCA15.RES	0	7	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA16.RES	0	106	16	1	0	0	0	0	6	0	0	0	6	0	0	0	0	0
NCA16.RES (Unbuilt)	1	13	32	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA17.RES	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA18.RES	0	82	125	3	3	4	0	0	4	7	0	0	6	6	1	0	2	0
NCA19.RES	0	0	7	4	2	2	0	0	0	4	0	0	0	4	0	0	2	0
NCA20.RES	0	0	6	1	0	4	3	0	0	0	6	1	0	0	6	1	7	1
NCA21.RES	0	0	0	0	1	0	0	0	11	6	0	0	0	16	16	2	33	20
NCA22.RES	0	0	0	0	0	0	0	0	4	5	0	0	0	16	10	0	24	13
NCA22.RES (Unbuilt)	0	0	0	0	0	0	0	0	28	13	0	0	12	29	45	0	57	21

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID5 (Bulk earthworks)																	
	All Hours	Standard Hours			Outside of Standard Hours[3]												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA23.RES	0	7	3	0	2	6	2	0	0	5	5	0	0	4	4	2	8	2
NCA24.RES	0	30	5	0	10	29	0	0	17	65	21	0	19	81	34	5	70	20
NCA25.RES	0	47	7	0	40	34	4	0	65	93	19	0	38	132	71	7	133	28
NCA26.RES (Unbuilt)	0	0	0	0	1	0	0	0	14	3	0	0	0	40	2	0	10	0
NCA26.RES	3	29	6	0	35	20	3	0	50	62	13	0	7	86	59	8	116	34
NCA27.RES	1	3	1	0	5	2	0	0	17	16	1	0	2	43	13	1	27	7
NCA28.RES	2	17	0	0	10	11	0	0	50	35	11	0	12	99	26	2	129	64
NCA29.RES	0	6	0	0	3	4	0	0	2	5	4	0	0	2	8	1	11	8
Commercial																		
NCA02.COM	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA03.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA04.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.COM	0	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA07.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA11.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID5 (Bulk earthworks)																	
	All Hours	Standard Hours			Outside of Standard Hours[3]												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA18.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA19.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA21.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA22.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA23.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA24.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA25.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA27.COM	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA28.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Industrial																		
NCA04.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Hospital																		
NCA03.HOS	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.HOS	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID5 (Bulk earthworks)																	
	All Hours	Standard Hours			Outside of Standard Hours[3]												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Educational																		
NCA06.SCH	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA08.SCH	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.SCH	0	12	10	1	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Place of worship																		
NCA05.POW	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA06.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Child Care Facilities																		
NCA05.CCF	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA13.CCF	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

Table 50: Summary of NML exceedances per catchment area for construction activity ID10 (Bridge works)

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID10 (Bridge works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Residential																		
NCA01.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA02.RES	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
NCA03.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA03.RES (Unbuilt)	0	0	0	0	5	0	0	0	9	0	0	0	11	18	0	0	8	0
NCA05.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA06.RES	0	24	1	0	17	26	1	0	5	31	9	0	2	35	9	0	36	0
NCA06.RES (Unbuilt)	0	6	0	0	22	13	0	0	58	29	0	0	73	35	0	0	18	0
NCA07.RES	0	1	1	0	1	3	1	0	0	4	1	0	3	1	1	0	1	1
NCA08.RES	0	4	2	0	1	4	2	0	1	3	3	0	1	4	2	0	5	0
NCA09.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA10.RES	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
NCA11.RES	0	0	0	0	1	0	0	0	19	7	0	0	19	14	0	0	3	0

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID10 (Bridge works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA12.RES	0	11	0	0	7	12	0	0	11	17	6	0	11	17	8	0	15	0
NCA13.RES	0	7	0	0	27	10	0	0	29	95	6	0	7	117	7	0	79	0
NCA14.RES	0	1	0	0	1	2	0	0	76	7	0	0	76	7	0	0	4	0
NCA15.RES	0	4	1	0	5	4	1	0	4	7	3	0	4	7	3	0	6	0
NCA16.RES	0	15	0	0	25	16	0	0	8	41	6	0	8	41	6	0	25	0
NCA16.RES (Unbuilt)	0	17	16	0	4	20	16	0	10	19	25	2	10	19	25	2	48	9
NCA17.RES	0	2	0	0	1	2	0	0	0	3	0	0	0	3	0	0	2	0
NCA18.RES	0	4	1	0	3	5	1	0	15	6	3	0	31	8	3	0	8	0
NCA19.RES	0	4	3	0	0	5	3	0	1	4	4	0	1	4	4	0	8	0
NCA20.RES	0	0	1	0	6	0	1	0	0	6	1	0	0	6	1	0	3	0
NCA21.RES	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
NCA22.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA22.RES (Unbuilt)	0	0	0	0	0	0	0	0	0	0	0	0	6	26	0	0	18	0
NCA23.RES	0	1	0	0	1	1	0	0	2	1	1	0	4	3	1	0	2	0

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID10 (Bridge works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA24.RES	0	0	0	0	0	0	0	0	5	18	0	0	10	25	0	0	23	0
NCA25.RES	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0
NCA26.RES (Unbuilt)	0	0	0	0	0	0	0	0	2	0	0	0	22	5	0	0	3	0
NCA26.RES	0	3	0	0	6	8	0	0	17	18	0	0	39	38	16	0	47	9
NCA27.RES	0	1	0	0	0	1	0	0	4	2	1	0	15	15	2	0	10	2
NCA28.RES	0	0	0	0	0	0	0	0	13	8	0	0	17	53	5	0	46	14
NCA29.RES	0	0	0	0	1	0	0	0	1	2	0	0	0	2	2	0	4	1
Commercial																		
NCA02.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA03.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA04.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA07.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA11.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA18.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID10 (Bridge works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA19.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA21.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA22.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA23.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA24.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA25.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA27.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA28.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Industrial																		
NCA04.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Hospital																		
NCA03.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID10 (Bridge works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Educational																		
NCA06.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA08.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Place of worship																		
NCA05.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA06.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Child Care Facilities																		
NCA05.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA13.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

Table 51: Summary of NML exceedances per catchment area for construction activity ID11 (Tunnel works)

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID11 (Tunnel works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Residential																		
NCA01.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA02.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA03.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA03.RES (Unbuilt)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA05.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA06.RES	0	2	0	0	56	4	0	0	35	42	0	0	19	60	0	0	0	0
NCA06.RES (Unbuilt)	0	30	0	0	56	59	0	0	57	103	0	0	53	115	0	0	1	0
NCA07.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA08.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA09.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA10.RES	0	1	1	0	2	1	1	0	0	3	1	0	0	3	1	0	2	0
NCA11.RES	0	2	0	0	14	2	0	0	10	22	1	0	6	26	2	0	12	0

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID11 (Tunnel works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA12.RES	0	0	0	0	1	0	0	0	8	5	0	0	12	7	0	0	0	0
NCA13.RES	0	0	0	0	26	0	0	0	53	78	0	0	9	122	0	0	2	0
NCA14.RES	0	0	0	0	39	0	0	0	45	65	0	0	45	65	0	0	0	0
NCA15.RES	0	2	0	0	3	3	0	0	5	7	0	0	5	7	0	0	2	0
NCA16.RES	0	12	1	0	14	16	1	0	34	31	2	0	34	31	2	0	9	0
NCA16.RES (Unbuilt)	0	47	0	0	6	49	0	0	0	47	9	0	0	47	9	0	40	0
NCA17.RES	0	0	2	0	0	0	2	0	0	1	1	1	0	1	1	1	2	0
NCA18.RES	0	48	1	0	74	60	1	0	46	132	3	0	47	141	4	0	70	0
NCA19.RES	0	5	4	0	1	6	4	0	0	6	4	1	0	6	4	1	7	1
NCA20.RES	0	1	0	0	4	1	0	0	2	5	0	0	1	6	0	0	0	0
NCA21.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA22.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA22.RES (Unbuilt)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA23.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID11 (Tunnel works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA24.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA25.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA26.RES (Unbuilt)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA26.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA27.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA28.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA29.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Commercial																		
NCA02.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA03.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA04.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA07.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA11.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA18.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID11 (Tunnel works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA19.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA21.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA22.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA23.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA24.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA25.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA27.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA28.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Industrial																		
NCA04.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Hospital																		
NCA03.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID11 (Tunnel works)																	
	All Hours	**Standard Hours**			**Outside of Standard Hours**												**Sleep Disturbance**	
		Daytime			**Daytime**				**Evening**				**Night**				**Night**	
	Highly noise affected >75dB(A)	**Clearly audible <NML+10**	**Moderately intrusive <=NML+20**	**Highly intrusive >NML+20**	**Noticeable <NML+5**	**Clearly audible <NML+15**	**Moderately intrusive <=NML+25**	**Highly intrusive >NML+25**	**Noticeable <NML+5**	**Clearly audible <NML+15**	**Moderately intrusive <=NML+25**	**Highly intrusive >NML+25**	**Noticeable <NML+5**	**Clearly audible <NML+15**	**Moderately intrusive <=NML+25**	**Highly intrusive >NML+25**	**Screening criterion RBL+15**	**Awakening criterion >65 dB(A)**
Educational																		
NCA06.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA08.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Place of worship																		
NCA05.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA06.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Child Care Facilities																		
NCA05.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA13.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

Table 52: Summary of NML exceedances per catchment area for construction activity ID14 (Road Works)

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID14 (Road Works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Residential																		
NCA01.RES	0	6	0	0	3	7	0	0	14	9	4	0	0	3	18	6	27	10
NCA02.RES	0	5	1	0	6	6	1	0	3	7	3	0	0	8	5	0	13	5
NCA03.RES	0	0	0	0	13	0	0	0	8	7	0	0	0	20	0	0	0	0
NCA03.RES (Unbuilt)	0	40	0	0	59	56	0	0	44	95	0	0	15	151	24	0	101	0
NCA05.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA06.RES	0	19	27	0	23	19	27	0	18	20	44	0	14	25	41	3	53	0
(Unbuilt)	0	87	31	0	51	97	31	0	19	108	60	0	8	114	65	0	131	0
NCA07.RES	0	3	2	0	0	3	2	0	0	3	2	0	0	4	1	0	5	1
NCA08.RES	0	1	6	0	0	1	6	0	0	1	6	0	0	4	3	0	7	0
NCA09.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA10.RES	0	3	1	0	0	3	1	0	0	2	2	0	0	2	2	0	4	0
NCA11.RES	0	24	0	0	3	33	0	0	0	21	16	0	0	13	24	0	33	0

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID14 (Road Works)																			
	All Hours	Standard Hours			Outside of Standard Hours														Sleep Disturbance	
		Daytime			Daytime				Evening				Night						Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25			Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA12.RES	0	22	13	4	0	22	13	4	0	3	24	12	0	0	26	13			39	4
NCA13.RES	0	106	23	2	0	106	23	2	0	9	112	10	0	0	118	13			131	3
NCA14.RES	0	106	4	0	0	106	4	0	0	63	47	0	0	63	47	0			103	0
NCA15.RES	0	9	5	0	2	9	5	0	0	7	8	1	0	7	8	1			15	0
NCA16.RES	0	38	5	0	47	60	5	0	24	100	17	1	24	100	17	1			49	0
NCA16.RES (Unbuilt)	0	27	29	0	0	27	29	0	0	13	32	11	0	13	32	11			56	3
NCA17.RES	0	1	2	0	0	1	2	0	0	1	1	1	0	1	1	1			3	0
NCA18.RES	0	166	6	0	27	174	6	0	9	174	32	1	3	158	52	3			122	1
NCA19.RES	0	2	8	1	0	2	8	1	0	0	6	5	0	0	6	5			11	1
NCA20.RES	0	4	3	0	0	4	3	0	0	0	7	0	0	0	7	0			7	0
NCA21.RES	0	0	0	0	2	0	0	0	8	12	0	0	0	10	20	4			26	4
NCA22.RES	0	0	0	0	0	0	0	0	4	6	0	0	0	15	11	0			12	0
NCA22.RES (Unbuilt)	0	0	0	0	0	0	0	0	37	11	0	0	10	25	51	0			54	0
NCA23.RES	0	6	1	0	1	8	1	0	0	5	5	0	0	3	6	1			9	1

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID14 (Road Works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA24.RES	0	29	0	0	13	30	0	0	21	64	24	0	19	78	37	6	56	0
NCA25.RES	0	30	4	0	35	38	4	0	52	110	19	1	29	143	71	6	112	6
NCA26.RES (Unbuilt)	0	0	0	0	2	0	0	0	23	3	0	0	0	39	3	0	7	0
NCA26.RES	0	20	1	0	38	23	1	0	53	69	10	0	5	82	68	5	111	9
NCA27.RES	0	1	0	0	4	2	0	0	17	16	1	0	2	42	15	0	25	2
NCA28.RES	1	2	0	0	18	2	0	0	51	42	2	0	12	99	27	1	69	20
NCA29.RES	0	2	0	0	5	2	0	0	2	7	2	0	0	2	7	2	11	2
Commercial																		
NCA02.COM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA03.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA04.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.COM	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA07.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA11.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID14 (Road Works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA18.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA19.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA21.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA22.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA23.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA24.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA25.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA27.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA28.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Industrial																		
NCA04.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID14 (Road Works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Hospital																		
NCA03.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Educational																		
NCA06.SCH	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA08.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.SCH	0	14	8	1	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Place of worship																		
NCA05.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA06.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Child Care Facilities																		
NCA05.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA13.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

Table 53: Summary of NML exceedances per catchment area for construction activity ID4, ID 7, ID11, ID 13, ID 17 (Ancillary Sites)

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID4, ID 7, ID11, ID 13, ID 17 (Ancillary Sites)																		
	All Hours	Standard Hours			Outside of Standard Hours													Sleep Disturbance	
		Daytime			Daytime				Evening				Night					Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Residential																			
NCA01.RES	0	0	0	0	0	0	0	0	0	0	0	0	24	3	0	0	0	0
NCA02.RES	0	1	0	0	3	3	0	0	6	3	0	0	0	9	1	0	0	0
NCA03.RES	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0
NCA03.RES (Unbuilt)	0	0	0	0	63	4	0	0	48	35	0	0	59	105	0	0	0	0
NCA05.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA06.RES	0	34	32	0	14	36	32	0	4	36	43	0	1	36	46	0	37	0
NCA06.RES (Unbuilt)	0	102	53	0	23	111	53	0	1	106	80	0	0	92	95	0	64	0
NCA07.RES	2	0	3	2	0	0	3	2	0	0	3	2	0	0	3	2	5	2
NCA08.RES	0	0	6	1	0	0	6	1	0	0	6	1	0	0	6	1	2	1
NCA09.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA10.RES	0	0	0	0	1	2	0	0	0	4	0	0	0	4	0	0	0	0
NCA11.RES	0	0	0	0	16	0	0	0	4	31	0	0	2	35	0	0	5	0

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID4, ID 7, ID11, ID 13, ID 17 (Ancillary Sites)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA12.RES	0	14	0	0	21	16	0	0	0	37	2	0	0	35	4	0	15	0
NCA13.RES	0	57	16	2	33	66	16	2	2	73	47	9	0	56	62	13	102	14
NCA14.RES	0	79	29	1	0	80	29	1	0	17	92	1	0	17	92	1	102	1
NCA15.RES	0	3	6	1	2	4	6	1	1	5	6	3	1	5	6	3	9	1
NCA16.RES	0	28	0	0	57	38	0	0	33	106	3	0	33	106	3	0	0	0
NCA16.RES (Unbuilt)	0	26	0	0	9	28	0	0	12	26	15	0	12	26	15	0	17	0
NCA17.RES	0	2	0	0	0	3	0	0	0	2	1	0	0	2	1	0	1	0
NCA18.RES	0	128	65	2	6	135	65	2	8	92	111	5	5	72	130	9	139	2
NCA19.RES	0	4	5	1	1	4	5	1	0	2	7	2	0	2	7	2	10	1
NCA20.RES	1	0	6	1	0	0	6	1	0	0	5	2	0	0	3	4	7	1
NCA21.RES	4	0	0	0	3	4	0	0	16	12	6	0	0	0	24	10	34	14
NCA22.RES	0	0	0	0	0	0	0	0	18	0	0	0	0	4	22	0	6	0
NCA22.RES (Unbuilt)	0	0	0	0	0	0	0	0	21	0	0	0	10	41	27	0	30	0
NCA23.RES	0	2	3	0	2	2	3	0	2	5	3	0	0	5	4	1	7	3

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID4, ID 7, ID11, ID 13, ID 17 (Ancillary Sites)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA24.RES	0	1	0	0	19	1	0	0	21	56	0	0	29	70	20	0	27	0
NCA25.RES	0	0	0	0	0	0	0	0	39	0	0	0	124	100	0	0	0	0
NCA26.RES (Unbuilt)	0	0	0	0	0	0	0	0	0	0	0	0	27	8	0	0	1	0
NCA26.RES	0	1	0	0	11	2	0	0	22	16	0	0	36	75	14	0	34	0
NCA27.RES	0	0	0	0	4	2	0	0	4	9	0	0	12	16	8	0	14	5
NCA28.RES	0	0	0	0	2	0	0	0	10	3	0	0	40	26	3	0	14	3
NCA29.RES	0	0	0	0	0	0	0	0	2	0	0	0	0	3	0	0	4	0
Commercial																		
NCA02.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA03.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA04.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.COM	0	3	2	0	1	4	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA07.COM	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA11.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA18.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID4, ID 7, ID11, ID 13, ID 17 (Ancillary Sites)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA19.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA21.COM	0	1	5	0	0	6	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA22.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA23.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA24.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA25.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA27.COM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA28.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Industrial																		
NCA04.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Hospital																		
NCA03.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID4, ID 7, ID11, ID 13, ID 17 (Ancillary Sites)																
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Educational																		
NCA06.SCH	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA08.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Place of worship																		
NCA05.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA06.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Child Care Facilities																		
NCA05.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA13.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

Table 54: Summary of NML exceedances per catchment area for construction activity ID 14 (Demolition)

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID14 (Demolition)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Residential																		
NCA01.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0	0	1	0
NCA02.RES	0	1	0	0	4	2	0	0	7	3	0	0	1	11	1	0	5	0
NCA03.RES	0	0	0	0	12	0	0	0	9	5	0	0	0	20	0	0	2	0
NCA03.RES (Unbuilt)	2	70	3	2	34	78	3	2	31	85	14	2	11	86	60	4	110	41
NCA05.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA06.RES	0	47	14	0	19	49	14	0	5	53	25	0	1	53	29	0	45	0
NCA06.RES (Unbuilt)	0	150	1	0	19	167	1	0	1	170	16	0	0	163	24	0	101	0
NCA07.RES	1	0	4	1	0	0	4	1	0	0	4	1	0	0	4	1	5	2
NCA08.RES	0	2	5	0	0	2	5	0	0	1	6	0	0	2	5	0	7	1
NCA09.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA10.RES	0	3	1	0	0	3	1	0	0	0	4	0	0	0	4	0	4	0
NCA11.RES	0	22	15	0	0	22	15	0	0	1	31	5	0	0	28	9	37	4

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID14 (Demolition)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA12.RES	3	5	26	8	0	5	26	8	0	0	22	17	0	0	20	19	39	15
NCA13.RES	0	7	124	0	0	7	124	0	0	0	110	21	0	0	55	76	131	0
NCA14.RES	1	0	97	13	0	0	97	13	0	0	61	49	0	0	61	49	110	19
NCA15.RES	0	3	12	1	0	3	12	1	0	1	10	5	0	1	10	5	16	1
NCA16.RES	0	95	47	0	0	95	47	0	0	24	114	4	0	24	114	4	132	0
NCA16.RES (Unbuilt)	2	0	46	10	0	0	46	10	0	0	23	33	0	0	23	33	56	35
NCA17.RES	0	0	2	1	0	0	2	1	0	0	2	1	0	0	2	1	3	1
NCA18.RES	1	51	163	2	0	51	163	2	0	14	177	25	0	11	173	32	208	2
NCA19.RES	1	0	5	6	0	0	5	6	0	0	2	9	0	0	2	9	11	4
NCA20.RES	0	0	4	3	0	0	4	3	0	0	2	5	0	0	0	7	7	3
NCA21.RES	0	0	0	0	0	0	0	0	2	0	0	0	0	31	3	0	6	0
NCA22.RES	0	0	0	0	0	0	0	0	13	0	0	0	0	1	25	0	9	0
NCA22.RES (Unbuilt)	0	0	0	0	0	0	0	0	15	33	0	0	0	27	59	0	61	13
NCA23.RES	0	6	3	1	0	6	3	1	0	2	6	2	0	0	7	3	10	2

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID14 (Demolition)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA24.RES	0	41	10	0	42	45	10	0	22	77	46	1	0	49	77	20	111	20
NCA25.RES	0	51	7	0	88	61	7	0	23	175	49	2	0	93	138	18	195	34
NCA26.RES (Unbuilt)	0	0	0	0	26	2	0	0	7	35	0	0	0	10	32	0	42	0
NCA26.RES	17	35	12	9	60	46	12	9	21	104	19	14	0	27	104	29	152	52
NCA27.RES	2	9	1	1	10	10	1	1	15	30	10	1	0	21	33	5	53	15
NCA28.RES	0	0	0	0	7	2	0	0	18	65	2	0	10	50	38	0	80	21
NCA29.RES	0	1	0	0	2	1	0	0	0	3	1	0	1	6	4	0	4	3
Commercial																		
NCA02.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA03.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA04.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.COM	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA07.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA11.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID14 (Demolition)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA18.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA19.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA21.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA22.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA23.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA24.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA25.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA27.COM	0	7	5	0	5	7	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA28.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Industrial																		
NCA04.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID14 (Demolition)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Hospital																		
NCA03.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.HOS	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	N/A	N/A
Educational																		
NCA06.SCH	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA08.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.SCH	0	9	14	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Place of worship																		
NCA05.POW	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	N/A	N/A
NCA06.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Child Care Facilities																		
NCA05.CCF	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA13.CCF	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

Table 55: Summary of NML exceedances per catchment area for construction activity ID 8 (Drainage and structures)

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID8 (Drainage and structures)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Residential																		
NCA01.RES	0	0	0	0	3	3	0	0	3	7	0	0	0	19	8	0	27	20
NCA02.RES	0	5	0	0	1	5	0	0	6	4	1	0	0	8	5	0	9	4
NCA03.RES	0	0	0	0	0	0	0	0	5	0	0	0	7	12	0	0	2	0
NCA03.RES (Unbuilt)	0	5	0	0	55	5	0	0	68	23	0	0	55	114	3	0	80	5
NCA05.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA06.RES	0	33	17	0	19	42	17	0	8	40	35	0	5	37	41	0	44	0
NCA06.RES (Unbuilt)	0	101	20	0	36	118	20	0	16	122	49	0	13	118	56	0	98	0
NCA07.RES	0	4	1	0	0	4	1	0	0	4	1	0	0	4	1	0	2	1
NCA08.RES	0	5	2	0	0	5	2	0	0	4	3	0	0	6	1	0	6	0
NCA09.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA10.RES	0	2	1	0	0	3	1	0	0	2	2	0	0	2	2	0	2	0

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID8 (Drainage and structures)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA11.RES	0	19	0	0	11	23	0	0	0	26	11	0	0	18	19	0	28	0
NCA12.RES	0	10	10	2	13	14	10	2	0	21	13	5	0	20	11	8	35	11
NCA13.RES	0	91	15	0	2	114	15	0	0	48	76	7	0	25	94	12	131	22
NCA14.RES	0	84	13	0	4	93	13	0	0	93	17	0	0	93	17	0	64	1
NCA15.RES	0	8	2	0	3	10	2	0	0	10	6	0	0	10	6	0	12	1
NCA16.RES	0	25	1	0	45	31	1	0	50	81	10	0	50	81	10	0	29	0
NCA16.RES (Unbuilt)	0	18	22	4	6	24	22	4	0	21	27	8	0	21	27	8	56	23
NCA17.RES	0	0	2	0	1	0	2	0	0	1	2	0	0	1	2	0	2	1
NCA18.RES	0	141	6	0	33	163	6	0	12	184	17	1	8	173	33	1	98	1
NCA19.RES	0	4	7	0	0	4	7	0	0	1	8	2	0	1	8	2	11	2
NCA20.RES	0	4	3	0	0	4	3	0	0	3	4	0	0	3	4	0	7	1
NCA21.RES	0	0	0	0	0	0	0	0	3	2	0	0	0	28	6	0	31	16
NCA22.RES	0	0	0	0	0	0	0	0	3	0	0	0	1	20	5	0	23	6
NCA22.RES (Unbuilt)	0	0	0	0	0	0	0	0	5	0	0	0	6	53	13	0	45	9

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID8 (Drainage and structures)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA23.RES	0	2	1	0	1	4	1	0	2	6	2	0	0	7	3	0	6	2
NCA24.RES	0	9	0	0	15	11	0	0	34	32	5	0	22	63	26	0	45	13
NCA25.RES	0	9	0	0	13	10	0	0	38	59	7	0	62	105	22	1	102	15
NCA26.RES (Unbuilt)	0	0	0	0	0	0	0	0	2	0	0	0	23	17	0	0	3	0
NCA26.RES	0	8	0	0	11	10	0	0	37	26	4	0	21	102	21	2	81	22
NCA27.RES	0	1	0	0	0	1	0	0	7	6	1	0	19	30	3	1	20	4
NCA28.RES	0	1	0	0	5	1	0	0	13	22	1	0	36	69	18	0	99	49
NCA29.RES	0	0	0	0	3	1	0	0	2	7	0	0	0	4	7	0	11	7
Commercial																		
NCA02.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA03.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA04.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA05.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA07.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID8 (Drainage and structures)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA11.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA18.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA19.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA21.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA22.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA23.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA24.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA25.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA26.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA27.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
NCA28.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
Industrial																		
NCA04.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID8 (Drainage and structures)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Hospital																		
NCA03.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Educational																		
NCA06.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA08.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.SCH	0	5	7	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Place of worship																		
NCA05.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA06.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Child Care Facilities																		
NCA05.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA13.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

Table 56: Summary of NML exceedances per catchment area for construction activity ID 18 (Finishing Works)

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID18 (Finishing works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Residential																		
NCA01.RES	0	0	0	0	1	0	0	0	3	6	0	0	0	20	7	0	11	1
NCA02.RES	0	2	0	0	2	3	0	0	0	5	0	0	6	6	1	0	5	0
NCA03.RES	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0
NCA03.RES (Unbuilt)	0	0	0	0	8	0	0	0	23	1	0	0	59	56	0	0	0	0
NCA05.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA06.RES	0	32	0	0	2	43	0	0	1	39	6	0	1	35	10	0	23	0
NCA06.RES (Unbuilt)	0	42	0	0	30	53	0	0	39	79	0	0	45	83	0	0	26	0
NCA07.RES	0	2	0	0	1	4	0	0	1	3	1	0	3	2	0	0	1	0
NCA08.RES	0	6	0	0	0	7	0	0	0	7	0	0	1	6	0	0	0	0
NCA09.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA10.RES	0	1	0	0	1	1	0	0	1	2	1	0	1	2	1	0	1	0
NCA11.RES	0	1	0	0	7	2	0	0	11	24	0	0	2	33	1	0	3	0

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID18 (Finishing works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA12.RES	0	10	9	0	16	11	9	0	0	25	10	4	0	23	12	4	14	0
NCA13.RES	0	34	8	0	56	45	8	0	0	112	19	0	0	89	39	3	30	0
NCA14.RES	0	5	0	0	48	16	0	0	16	94	0	0	16	94	0	0	3	0
NCA15.RES	0	5	0	0	6	6	0	0	0	11	3	0	0	11	3	0	5	0
NCA16.RES	0	7	0	0	15	9	0	0	43	26	1	0	43	26	1	0	9	0
NCA16.RES (Unbuilt)	0	29	3	0	14	32	3	0	1	30	25	0	1	30	25	0	30	0
NCA17.RES	0	1	1	0	1	1	1	0	0	2	1	0	0	2	1	0	2	0
NCA18.RES	0	9	1	0	83	10	1	0	86	90	4	0	64	124	4	0	7	0
NCA19.RES	0	8	2	0	1	8	2	0	0	4	7	0	0	4	7	0	8	0
NCA20.RES	0	4	0	0	2	5	0	0	0	5	2	0	0	4	3	0	4	0
NCA21.RES	0	0	0	0	0	0	0	0	4	2	0	0	2	23	9	0	6	0
NCA22.RES	0	0	0	0	0	0	0	0	0	0	0	0	3	23	0	0	0	0
NCA22.RES (Unbuilt)	0	0	0	0	0	0	0	0	0	0	0	0	11	57	0	0	0	0
NCA23.RES	0	1	0	0	4	1	0	0	3	5	1	0	1	8	1	0	1	0

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID18 (Finishing works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA24.RES	0	2	0	0	15	3	0	0	13	30	0	0	38	42	18	0	12	0
NCA25.RES	0	6	0	0	1	6	0	0	35	38	4	0	58	92	7	0	13	0
NCA26.RES (Unbuilt)	0	0	0	0	0	0	0	0	0	0	0	0	30	5	0	0	0	0
NCA26.RES	0	2	0	0	8	2	0	0	19	17	0	0	46	79	13	0	17	0
NCA27.RES	0	0	0	0	0	0	0	0	7	3	0	0	20	17	2	0	3	0
NCA28.RES	0	0	0	0	1	0	0	0	10	13	0	0	51	42	2	0	13	1
NCA29.RES	0	0	0	0	1	0	0	0	3	4	0	0	2	7	2	0	5	0
Commercial																		
NCA02.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA03.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA04.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.COM	0	4	0	0	1	3	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA07.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA11.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA18.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID18 (Finishing works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA19.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA21.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA22.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA23.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA24.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA25.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA27.COM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA28.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Industrial																		
NCA04.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Hospital																		
NCA03.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID18 (Finishing works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Educational																		
NCA06.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA08.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.SCH	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Place of worship																		
NCA05.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA06.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Child Care Facilities																		
NCA05.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA13.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

Table 57: Summary of NML exceedances per catchment area for construction activity ID 2 (Utility works and relocation)

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID18 (Finishing works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Residential																		
NCA01.RES	0	1	0	0	2	4	0	0	6	8	0	0	0	18	9	0	27	27
NCA02.RES	0	5	0	0	4	5	0	0	8	3	2	0	0	8	5	0	13	8
NCA03.RES	0	0	0	0	5	0	0	0	11	1	0	0	5	15	0	0	18	1
NCA03.RES (Unbuilt)	2	17	0	2	65	29	0	2	56	64	0	2	40	129	8	2	163	70
NCA05.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA06.RES	0	15	42	0	17	23	42	0	3	36	40	4	1	37	40	5	83	21
NCA06.RES (Unbuilt)	0	105	50	0	20	117	50	0	0	114	73	0	0	107	80	0	187	23
NCA07.RES	1	2	1	2	0	2	1	2	0	0	3	2	0	3	0	2	5	2
NCA08.RES	0	0	7	0	0	0	7	0	0	0	6	1	0	0	7	0	7	4
NCA09.RES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCA10.RES	0	3	1	0	0	3	1	0	0	2	2	0	0	2	2	0	4	1
NCA11.RES	0	24	4	0	5	27	4	0	0	16	19	2	0	9	26	2	37	8

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID18 (Finishing works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA12.RES	2	20	10	9	0	20	10	9	0	6	20	13	0	3	23	13	39	17
NCA13.RES	0	91	38	1	0	92	38	1	0	3	113	15	0	1	106	24	131	71
NCA14.RES	0	105	5	0	0	105	5	0	0	65	45	0	0	65	45	0	110	10
NCA15.RES	0	11	2	0	1	12	2	0	1	12	3	0	1	12	3	0	16	2
NCA16.RES	0	36	1	0	60	46	1	0	23	106	11	0	23	106	11	0	94	1
NCA16.RES (Unbuilt)	0	35	16	5	0	35	16	5	0	27	22	7	0	27	22	7	56	24
NCA17.RES	0	1	2	0	0	1	2	0	0	1	1	1	0	1	1	1	3	2
NCA18.RES	0	95	29	0	48	124	29	0	14	138	61	2	5	137	71	2	208	18
NCA19.RES	0	6	3	0	1	7	3	0	0	2	9	0	0	2	9	0	11	3
NCA20.RES	0	3	3	1	0	3	3	1	0	0	6	1	0	0	5	2	7	5
NCA21.RES	1	1	0	0	1	1	0	0	10	10	2	0	0	8	24	2	34	33
NCA22.RES	0	0	0	0	0	0	0	0	6	1	0	0	0	17	9	0	26	21
NCA22.RES (Unbuilt)	0	0	0	0	0	0	0	0	16	1	0	0	7	37	30	0	80	44
NCA23.RES	0	4	2	0	4	4	2	0	0	5	5	0	0	4	4	2	10	5

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID18 (Finishing works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA24.RES	0	18	2	0	14	19	2	0	43	36	18	0	23	69	29	6	126	32
NCA25.RES	0	12	2	0	32	14	2	0	43	74	12	1	64	125	43	5	212	54
NCA26.RES (Unbuilt)	0	0	0	0	0	0	0	0	5	0	0	0	5	37	0	0	40	0
NCA26.RES	0	15	3	0	17	15	3	0	34	45	9	0	17	94	38	7	146	63
NCA27.RES	1	1	0	0	3	1	0	0	10	12	1	0	15	30	12	1	53	17
NCA28.RES	1	3	0	0	13	3	0	0	40	29	3	0	21	84	26	1	144	110
NCA29.RES	0	2	0	0	3	2	0	0	1	6	2	0	0	3	6	2	11	9
Commercial																		
NCA02.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA03.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA04.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.COM	0	4	0	0	4	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA07.COM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA11.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA18.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID18 (Finishing works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
NCA19.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA21.COM	0	6	0	0	0	6	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA22.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA23.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA24.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA25.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA27.COM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA28.COM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Industrial																		
NCA04.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.IND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Hospital																		
NCA03.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA05.HOS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

NCAs and receiver types	Number of receivers exceeding NMLs and sleep disturbance criteria – Construction Activity ID18 (Finishing works)																	
	All Hours	Standard Hours			Outside of Standard Hours												Sleep Disturbance	
		Daytime			Daytime				Evening				Night				Night	
	Highly noise affected >75dB(A)	Clearly audible <NML+10	Moderately intrusive <=NML+20	Highly intrusive >NML+20	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Noticeable <NML+5	Clearly audible <NML+15	Moderately intrusive <=NML+25	Highly intrusive >NML+25	Screening criterion RBL+15	Awakening criterion >65 dB(A)
Educational																		
NCA06.SCH	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA08.SCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA26.SCH	0	6	8	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Place of worship																		
NCA05.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA06.POW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
Child Care Facilities																		
NCA05.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A
NCA13.CCF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A	N/A

Results show significant exceedances are expected to occur during all construction activities, particularly if those activities are to be undertaken during night-time. This is largely due to the proximity of residences to the construction work sites, which extend along the length of the project area.

Also note that in the project description, impact piling rig might be used during the construction of the bridges. The use of an impact piling rig instead of a bored piling rig would greatly increase noise impacts (approximately 20 dB(A)) at the nearest receivers and is therefore not recommended where possible. Demolition of existing bridges is also considered as part of the noise impacts related to construction of bridges.

Sound insulating ‘acoustic sheds’ at each of the tunnel portals are recommended to be installed as soon as site establishment works at the facilities are completed to reduce noise impacts from tunnel construction related activities.

The noise impact of the construction of the project to nearby receivers depends on the level of noise, distance to the nearest receiver, and the duration of the works. The assessment has been based on representative worst case scenarios and noise levels at nearby receivers are likely to be lower than predicted. Noise levels will be greater when plant and equipment are working close to a sensitive receiver and will decrease when plant and equipment moves away from the sensitive receiver. Some activities/scenarios are also likely to be undertaken simultaneously (i.e. activities that use the ancillary facilities) which also have the potential to increase noise levels at nearby receivers.

Actual impact durations are likely to vary depending on site conditions. Finalised construction methodology will be considered in the CNVMP to be developed for the project. All feasible and reasonable construction noise mitigation strategies are considered for the project and discussed in Section 5.5

Bulk earthworks

These activities would be carried out using conventional cut and fill techniques in which material is carted from each cut using excavators and trucks to fill areas requiring additional material. Mechanical excavation and hydraulic rock breakers are likely the required equipment which contributes the most to the noise impacts related to this activity.

Earthworks activities will be occurring over the whole length of the project. It is expected that the staged approach to construction will stagger the noise impacts at the most affected noise sensitive receivers. As construction progresses the noise impacts from earthworks activities are expected to move across the future corridor. As such, it is not expected that noise impacts are affecting all NCAs simultaneously.

Earthworks activities are expected to be carried out largely during the first two years of the construction program. No out of hours works are expected across Construction Zone 2 and reduced construction activities during out of hours across Construction Zone 1 and Zone 3, this is expected to reduce the noise impacts outside of standard hours of works.

While earthworks noise impacts are expected to exceed the NMLs at all NCAs, these are predicted to present moderately to highly intrusive exceedances particularly in NCAs in greenfield areas (NCA06 to NCA20) during standard hours of works. During out of hours works, only the NCAs closest to the existing Pacific Highway (NCA01 to NCA06 and NCA20 to NCA29) are expected to experience generally moderately intrusive exceedances of the NML.

Bridges construction

Construction of bridges includes construction of bridge foundations and substructures including piles, pile caps, piers and abutments. Some bridge superstructures would be constructed using the precast construction techniques. A crane would be used to lift in the bridge girders directly onto the abutments and pier headstocks once the bridge bearings have been constructed.

The type of piling strategy used by the contractor will largely determine the magnitude of noise impact from piling activities. The use of an impact piling rig instead of a bored piling rig would greatly increase noise impacts. Operation of cranes is likely to be the most significant impact of bridge construction activities as it is expected to be in operation during extended periods of time. Depending on the construction activities sequence determined by the contractor, noise impacts are also expected from operation of concrete pumps however, these are expected to be shorter-term impacts only contributing when required on site.

Bridge construction activities are expected to occur across several locations however, unlike earthworks or roadworks, these are expected to be contained to a smaller area of impact, i.e. the most affected noise sensitive receivers are expected to be those closest to each bridge location. The duration of bridge construction at each location will vary significantly depending on factors ranging from terrain topography to extent of the bridge and construction methodology.

Receivers part of NCA16 are likely the closest to bridge construction works and expected to perceive highly intrusive noise impacts particularly for activities that require out of hours works. Generally, the impacts are expected to be audible during standard hours of works and out of hours works and moderately intrusive on a smaller proportion during out of hours works.

Tunnels construction

It is anticipated the tunnels would be excavated using controlled drill and blast methods. Blasting impacts are discussed in Section 5.4. Construction impacts of tunnels are largely driven by drilling activities and are expected to be most noticeable at the beginning of the construction process.

The airborne noise impacts are expected to reduce as the construction progresses considering most of the activities required will be shielded by the terrain itself during the construction process. Sound insulating ‘acoustic sheds’ at each of the tunnel portals are recommended to be installed as soon as site establishment works at the facilities are completed to reduce noise impacts from tunnel construction related activities during out of hours works.

Tunnels are proposed to cross the major ridgelines at Roberts Hill, Shephards Lane and at Gatelys Road. These locations are across existing greenfield areas with two of them proposed north of the North Coast Railway line.

Not more than one noise sensitive receiver is expected to perceive highly intrusive exceedances of the NML at NCA17 and NCA19. Generally, audible exceedances of the NML are expected at NCAs across greenfield areas and in particular at noise sensitive receivers which are closest to the proposed locations of tunnel portals.

Road works

Road works and road surfacing activities will involve activities such as excavating existing materials, placing and compacting the road base and road surface layer, cutting and grading concrete where required for constructing kerbs and gutters. Equipment which will cause the greatest noise impacts during road works is expected to be concrete saw, while other equipment such as the compactor, grader and pavement laying machines are expected to have a similar noise impact on noise sensitive receivers.

Road works will be occurring over the whole length of the project and are expected to be staggered across the four-year indicative construction timeline. It is expected that the staged approach to construction will stagger the noise impacts at the most affected noise sensitive receivers, i.e. as construction progresses the noise impacts from roadworks activities are expected to move across the future corridor. As such, it is not expected that noise impacts are affecting all NCAs simultaneously.

Generally, the noise impacts are expected to be audible across the project area and moderately intrusive when occurring across green field areas during standard hours of work. When night-time out of hours works are required, NCA12, NCA13 and NCA16 are predicted to have between 11 and 13 noise sensitive receivers which may be exposed to highly intrusive exceedances of the NML. All NCAs are expected to perceive moderately intrusive exceedances of the NML when road works are occurring nearest to each NCA.

Site compounds activities

A range of construction related facilities would be required to build the project. These ancillary facilities would include some or all of the following:

- Site compounds including workshops and maintenance sheds
- Concrete batching plant
- Asphalt batching plant
- Crushing plant
- Stockpile areas
- Precast facilities.

Depending on the use of the site, the noise impacts will vary based on the equipment relevant to the proposed use. Each site has considered the uses proposed in Table 43. The crushing plant is likely to generate the greatest noise impacts, concrete and asphalt batching plants as well as pre-casting facilities and stockpile sites are expected to present a similar noise impact.

The location of main ancillary sites has been considered and co-located with batch plant near major construction sites to minimise construction traffic. Secondary sites are located near tunnels to support tunnelling activities. Additional secondary sites are expected to support bridge works and tunnel portals and are expected to be operational only for the duration of specific construction activities.

Most main site compounds are located across Construction Zone 1 away from large numbers of sensitive receivers and secondary sites are distributed across all three zones as required to best serve each construction zone.

Construction activities required to be carried out during night-time out of hours works are predicted to present highly intrusive exceedances of the NML at less than 50 receivers across the project with the most affected residential area being NCA13 predicted to have 13 receivers exceeding the out of hours night-time NML. Generally, audible to moderately intrusive exceedances are expected across greenfield areas during out of hours works when required. Audible exceedances of the NML are expected across greenfield areas during standard hours of work particularly at NCA06 and NCA12 to NCA18.

Demolition

The following existing structures require demolition during the construction of the project: the Luke Bowen footbridge, the existing northbound bridge over Pine Brush Creek and around 110 buildings including residential buildings, sheds and other structures (such as utilities and redundant services). It is expected that the greatest noise impacts are caused by the use of excavators and hydraulic hammers to carry out the structure demolition.

All demolition works are expected to be completed during the first year of the indicative four-year construction timeline as part of the preliminary activities and site establishment construction stage. As demolition works progress, this will allow moving forward with other activities such as earthworks in a staged approach.

It is expected that the noise impacts will be largely limited to the surrounding area around where the structure being demolished is located. Most of the structures being demolished are located across greenfield areas at locations within the proposed construction footprint for the project.

The construction noise impacts during out of hours works are generally expected to be moderately intrusive exceedances of the NML across greenfield areas during daytime and night-time works when required. Areas that are predicted to experience highly intrusive exceedances of the NML during night-time out of hours works at more than 30 receivers include NCA13, NCA14, NCA16 and NCA18.

Drainage and structures

Drainage structures (including pits, pipes, culverts and open drains/swales) may be built progressively in conjunction with bulk earthworks and road work. Construction activities would vary depending on the type of drainage facility and would be installed to enable continuity of natural watercourses and hydrological processes.

Construction activities involving cranes and vibratory rollers are expected to contribute the most to the overall noise impacts. These are expected to occur in conjunction with earthworks and roadworks however, these are likely to present the least contribution to the combined noise impact.

Drainage and structure construction activities will be occurring over the whole extent of the project. It is expected that the staged approach to construction will stagger the noise impacts at the most affected noise sensitive receivers, i.e. as construction progresses the noise impacts from drainage and structures construction activities are expected to move across the future corridor. As such, it is not expected that noise impacts are affecting all NCAs simultaneously.

Less than 13 noise sensitive receivers are expected to experience highly intrusive noise impacts during out of hours works at any NCA. Generally, construction noise impacts are predicted to be audible particularly across green field areas both during standard construction hours of work and out of hours works.

Finishing works

Finishing works are tasks required before the opening of the project. These activities are expected to cause the least noise impact relative to all other construction activities proposed for the project. The use of trucks and cranes are expected to cause the greatest noise contribution.

Most activities related to finishing works are not expected to cause long term or excessive noise impacts, these include:

- Installation of lighting, street furniture, traffic barriers, noise wall, pedestrian balustrades, etc
- Remove temporary work structures, ancillary facilities and general site clean up
- Restoration of temporary sites including ancillary sites
- Landscaping works including the restoration of topsoil and revegetation of batters
- Removal of erosion and sediment control measures.

Finishing works are expected to be required across the entire extent of the project. Less than 5 receivers are expected to experience highly intrusive exceedances of the NML at NCA12 and NCA13. Noticeable or audible exceedances of the NML are predicted at all NCAs during out of hours works where required. Less than 10 moderately intrusive exceedances of the NML are predicted at NCAs across greenfield areas during standard hours of works.

Utility works and relocation

Utility works and relocation of services is part of the activities required as part of the pre-construction and site establishment construction stage. The purpose of these activities would be to prepare the site for the main construction activities (earthworks, roadworks, etc.). These would occur before the main construction activities begins as these are activities considered to be low impact. Depending on the construction methodology by the contractor, the use of tools such as concrete saw could cause increased noise impacts relative to other site establishment activities.

Utility works and relocation construction activities are expected to occur across the extent of the project in the first year of the indicative four-year construction timeline. This will enable other construction activities to progress simultaneously.

Moderately intrusive exceedances of the NML are predicted to generally occur across all NCAs during out of hours works where required. Audible exceedances are expected across all NCAs during standard hours of works. The extent of noise impacts will vary based on the construction methodology proposed by the contractor however, a staged approach is expected to stagger the noise impacts across the NCAs as construction works progress.

Where reasonable and feasible, at-property operational noise mitigation measures will be implemented during the pre-construction and early construction phases of the project. Priority to at-property treatment would be given where receivers are predicted to have high level of exceedances, i.e. those closest to the construction footprint, including receivers close to construction ancillary facilities. This would assist in reducing noise impacts associated with construction (including out of hours work).

5.2.2.1 Changes in construction noise impact assessment

- Additional construction scenarios for drainage, finishing and demolition works have been assessed to detail the typical construction noise impacts in addition to the worst-case construction noise impacts included for the EIS
- The source noise levels algorithm used for the construction noise assessment was changed for the assessment of road works, earthworks and ancillary sites to provide a more conservative assessment of potential construction noise impacts and to provide consistency in the assessment of all construction scenarios.

5.2.3 Cumulative construction noise impact assessment

Cumulative construction noise impacts are associated with the project related noise emissions from activities undertaken concurrently as well as the cumulative noise emissions of all the developments occurring in the same area and within the same timeframe as the project.

Major developments potentially creating additional construction noise and vibration impacts to nearby receivers within the same timeframe as the project have been identified as follows:

- Moonee Beach Residential Subdivision (Involving the construction of 159 residential lots, 12 public streets and associated public infrastructure) – Not yet approved
- Korora Urban Release Area (no available information regarding the number of subdivisions) – Not yet approved
- Sunset Ridge Estate in NCA16 (Involving construction of 57 residential lots for Stage 2, Stage 1 under construction. 18 residential properties have been completed as of February 2020)
- Senior Housing, Arthur Street (Involving construction of 120 bed residential facility, 183 self-contained dwellings, community centre) – Project approved, exact construction period not known
- Coffs Central Shopping centre extension (Involving the construction of an 80-room hotel with restaurant, pool and commercial/retail area) – currently under construction and close to completion
- Coffs Harbour Hospital Campus Extension (Involving the refurbishment of parts of the existing hospital building and construction of new acute services building) – Not yet approved
- Elements Estate in NCA03 (Stages 1 and 2 under construction, 17 completed residential dwellings, 202 vacant lots)
- North Boambee Valley East Masterplan Urban Release Area in NCA06 (Involving construction of 2 estates, the Lakes estate with 198 residential lots and the Highlands Estate with 25 vacant residential lots, 3 currently under construction, 38 complete)
- North Boambee Valley (West) residential Investigation area (no available information regarding the number of subdivisions) – Not yet approved
- Woolgoolga to Ballina Pacific Highway Upgrade (Involving the upgrade of 155 km of highway) – currently under construction and works area expected to be complete by 2020.

5.2.3.1 Noise impacts from the project

The project construction will occur in stages; one activity is likely to occur at one location while another activity is likely to occur at another location. Depending on the nature of the activities and locations, noise impacts from one activity might dominate over the noise generated by another activity (without increasing noise levels) or, noise levels emitted from both activities might add up. Detailed staging of the project is unknown at this stage.

From a general perspective, construction works for the project will occur over a certain number of days at one particular location then move over to another location for another period of time and so on across the whole length of the project.

However, sensitive receivers located in the vicinity of the ancillary sites are likely to experience construction impacts noise for longer periods as the ancillary sites will be used for different activities during the construction of the project.

5.2.3.2 Cumulative noise impacts from the construction of approved nearby developments

Construction start date and end date and details on construction staging for the approved nearby developments listed in Section 4.3.1 is unknown at this stage. If construction of those developments is overlapping with the construction of the project, increase in noise levels at nearest receivers is likely to occur.

In addition, haulage roads are likely to be shared between the project and major developments if occurring within the same timeframe. Nearby receivers are likely to notice an increase in noise levels on local roads identified in Section 5.1.7.

5.2.4 Construction ground-borne noise

Ground-borne noise levels are calculated using Transport Research Laboratory Report 429: "*Ground-borne vibration caused by mechanised construction works*" (2000) [19], Equation 24.

$$v_{res} = 180 \cdot r^{-1.3}$$

where:

- r is the slope (shortest) distance (m) from the vibration source to the measurement location
- v_{res} is the predicted upper bound resultant peak particle velocity (mm/s).

Similarly, for the prediction of ground-borne noise:

$$L_p = 127 - 54 \log_{10} r$$

Where L_p is the predicted ground-borne noise level in dB(A).

This provides a useful first estimate of the likely noise and vibration levels generated by future mechanised tunnelling works.

It is predicted that the ground-borne noise levels would be below the criteria established in Section 3.2.3 for receivers further than 41 m from the point of emission during daytime and 51 m during night-time. These buffer nets are depicted in Appendix J5.

These distances have been calculated to establish relevant screening buffer zones around the tunnelling sites. These limits are indicative only and will need to be confirmed by the construction contractor.

5.2.5 Construction traffic noise assessment

Construction traffic will generate noise over a relatively wide area and beyond the construction site itself. It would be expected that traffic noise would be greatest where there is a concentration of vehicle movements, such as at ancillary sites, batching plant locations and where construction is occurring at a given time.

Relative increases in road traffic noise impacts are not expected to be significant for haulage routes that use established arterial roads such as the existing Pacific Highway. For sub-arterial roads located within the project assessment area an analysis has been undertaken of expected change in overall traffic volumes due to construction of the project.

Existing traffic and projected increases in traffic volumes due to construction have been derived from a traffic study undertaken for the project and taking into account the haulage routes shown in Figure 19.

Table 58 and Table 59 present a summary of the daily average existing traffic volumes and expected peak daily construction traffic volumes over the duration of construction activities across the construction area based on the following assumptions respectively:

- For works in greenfield areas and not on the Pacific Highway, 90% of predicted daily peak construction traffic would travel along construction access roads during the daytime and 10% during night-time (for deliveries), and
- For works on the existing Pacific Highway, 100% of daily peak construction traffic are expected during night-time on the existing Pacific Highway.

The assessment was undertaken using the CoRTN algorithm to predict potential increases in road traffic noise as well as potential overall noise level along the haulage routes due to construction of the project. For existing traffic flows, a range from lowest to highest number of vehicles is presented due to varying capacity per road link.

As defined in the CNVG, an initial screening test was applied to evaluate whether noise levels were predicted to increase by more than 2 dB(A) due to construction traffic. Where increases of more than 2 dB(A) were predicted, the predicted overall noise levels were assessed against the RNP criteria for sub-arterial roads summarised in Table 19. The minimum distance at which the RNP assessment criteria are met was then calculated. Noise sensitive receivers within this buffer zone have the potential to exceed noise assessment criteria.

Table 58 and Table 59 summarise the results of the assessment for each construction scenario.

Table 58: Construction traffic noise assessment

Road Name	Speed	Daytime							Night-time						
		Traffic volumes[1]				Noise level increase (dB)	Relative increase screening criterion exceeded?	Minimum distance from the road at which the daytime RNP criterion is met (m)	Traffic volumes[1]				Noise level increase (dB)	Relative increase screening criterion exceeded?	Minimum distance from the road at which the daytime RNP criterion is met (m)
		Existing		Existing + Construction Traffic					Existing		Existing + Construction Traffic				
		Total number of vehicles	% Heavy vehicles	Total number of vehicles	% Heavy vehicles				Total number of vehicles	% Heavy vehicles	Total number of vehicles	% Heavy vehicles			
Englands Road	50	203	8.6	265	13.3	2.4	Yes	85	82	7.1	94	9.7	1.4	No	N/A[2]
	50	16	3.5	78	23.4	11.7	Yes	45	8	2.8	19	18.2	9.9	Yes	33
North Boambee Road	50	240	1.5	287	7.9	3.4	Yes	71	94	1.4	103	4.7	2.0	No	N/A[2]
	50	12	8.2	60	34.0	11.5	Yes	48	6	5.4	15	26.2	11.2	Yes	34
Coramba Road	70	350	7.6	432	14.4	2.3	Yes	145	153	6.0	168	9.4	1.2	No	N/A[2]
	70	404	6.7	487	12.9	2.1	Yes	155	178	5.2	193	8.2	1.1	No	N/A[2]
West High Street	50	603	3.2	721	10.5	3.2	Yes	150	283	2.4	305	5.6	1.7	No	N/A[2]
	40	392	3.1	511	13.4	4.4	Yes	130	186	2.4	208	7.1	2.4	Yes	50
Shephards Lane	50	54	2.6	64	8.0	2.8	Yes	22	24	2.0	26	4.6	2.7	Yes	21
	40	0	0	10	37.3	57.3	Yes	12	0	0.0	2	37.3	50.5	Yes	6
Bray Street	50	640	4.3	700	4.5	0.4	No	N/A[2]	234	4.4	245	4.5	0.2	No	N/A[2]
	50	361	3.3	421	3.7	0.9	No	N/A[2]	140	3.2	151	3.4	0.4	No	N/A[2]
Mackays Road	50	72	6.7	82	10.3	1.7	No	N/A[2]	31	6.2	33	7.9	0.9	No	N/A[2]
	40	14	13.5	24	23.1	4.3	Yes	20	6	10.6	8	16.7	3.0	Yes	9
West Korora Road	50	11	7.8	41	38.5	11.1	Yes	39	4	5.0	10	30.4	11.6	Yes	27
	40	0	0	31	49.2	63.2	Yes	36	0	0.0	6	49.2	56.9	Yes	29

Road Name	Speed	Daytime							Night-time						
		Traffic volumes[1]				Noise level increase (dB)	Relative increase screening criterion exceeded?	Minimum distance from the road at which the daytime RNP criterion is met (m)	Traffic volumes[1]				Noise level increase (dB)	Relative increase screening criterion exceeded?	Minimum distance from the road at which the daytime RNP criterion is met (m)
		Existing		Existing + Construction Traffic					Existing		Existing + Construction Traffic				
		Total number of vehicles	% Heavy vehicles	Total number of vehicles	% Heavy vehicles				Total number of vehicles	% Heavy vehicles	Total number of vehicles	% Heavy vehicles			
Bruxner Park Road	50	26	4.2	82	20.3	9.1	Yes	44	11	5.0	22	15.9	6.1	Yes	33
	50	26	5.0	82	20.5	8.8	Yes	44	11	5.9	22	16.3	5.7	Yes	34
James Small Drive	50	193	1.0	201	1.6	0.5	No	N/A[2]	71	2.8	72	3.1	0.2	No	N/A[2]
Old Coast Road	60	60	1.7	64	2.9	2.1	Yes	21	22	0.0	23	2.9	1.3	No	N/A[2]
Buchanans Road	40	26	3.3	41	13.9	6.0	Yes	45	12	4.8	15	10.0	3.1	Yes	N/A[2]
Gatelys Road	40	11	4.0	17	9.8	4.8	Yes	N/A[3]	4	2.5	5	6.2	0.9	No	N/A[2]
Russ Hammond Close[4]	40	22	9.0	43	4.7	1.0	No	N/A[2]	9	21.4	13	15.3	0.3	No	N/A[2]
Pacific Highway (South of Englands Road)	60	1650	9.5	1711	10.1	0.3	No	N/A[2]	703	12.0	714	12.3	0.1	No	N/A[2]
	60	1303	11.2	1364	11.9	0.3	No	N/A[2]	499	16.5	510	16.8	0.1	No	N/A[2]
Pacific Highway (South of West Korora Road)	60	1882	8.4	1913	9.0	0.2	No	N/A[2]	743	11.8	749	12.1	0.1	No	N/A[2]
	60	1875	8.4	1906	9.0	0.2	No	N/A[2]	741	11.8	746	12.1	0.1	No	N/A[2]
Pacific Highway (South of Bruxner Park Road)	80	1846	8.5	1902	9.1	0.2	No	N/A[2]	731	11.9	741	12.1	0.1	No	N/A[2]
	80	1652	9.4	1708	10.0	0.2	No	N/A[2]	665	13.1	675	13.3	0.1	No	N/A[2]
Pacific Highway (South of Opal Boulevard)	80	1660	9.3	1716	9.9	0.2	No	N/A[2]	669	12.8	679	13.0	0.1	No	N/A[2]
	80	1598	9.5	1654	10.1	0.2	No	N/A[2]	648	13.1	659	13.4	0.1	No	N/A[2]

[1] Average hourly flow
[2] Relative increase screening criteria not exceeded therefore overall assessment of noise impact not required in accordance with CNVG
[3] Predicted traffic noise level is below the RNP criteria for sub arterial roads due to very low traffic volumes
[4] Not a construction access road however, temporary connection required to maintain access to Kororo Public School and existing residential properties on Korora School Road

Table 59: Construction traffic noise assessment for Pacific Highway works

Road Name	Speed	Night-time						
		Traffic volumes[1]				Noise level increase (dB)	Relative increase screening criterion exceeded?	Minimum distance from the road at which the daytime RNP criterion is met (m)
		Existing		Existing + Construction Traffic				
		Total number of vehicles	% Heavy vehicles	Total number of vehicles	% Heavy vehicles			
Pacific Highway (South of Englands Road)	60	703	12.0	817	14.3	1.1	No	N/A[2]
Pacific Highway (North of Englands Road)	60	499	16.5	612	18.8	1.3	No	N/A[2]
Pacific Highway (South of West Korora Road)	60	743	11.8	800	14.4	0.9	No	N/A[2]
Pacific Highway (North of West Korora Road)	60	741	11.8	797	14.5	0.8	No	N/A[2]
Pacific Highway (South of Bruxner Park Road)	80	731	11.9	834	13.9	0.9	No	N/A[2]
Pacific Highway (North of Bruxner Park Road)	80	665	13.1	769	15.0	0.9	No	N/A[2]
Pacific Highway (South of Opal Boulevard)	80	669	12.8	773	14.8	1.0	No	N/A[2]
Pacific Highway (North of Opal Boulevard)	80	648	13.1	752	15.1	1.0	No	N/A[2]

[1] Average hourly flow

[2] Relative increase screening criteria not exceeded therefore overall assessment of noise impact not required in accordance with CNVG

Table 58 shows that a 2 dB increase is predicted on the existing collector road network in areas remote from the existing Pacific Highway. Noise sensitive receivers situated within the minimum offset distances identified also have the potential to exceed RNP noise criteria for existing roads.

Table 59 shows that for construction works on or near the existing Pacific Highway, increases in road traffic noise due to construction traffic are expected to remain below 2 dB.

A detailed construction traffic noise impact assessment would be carried out during detailed design once the contractor has a more detailed understanding of haulage routes, staging and scheduling, and specific construction traffic volumes assessment is available.

Feasible and reasonable noise mitigation measures are summarised in Section 5.5.2 to reduce construction noise impacts due to construction traffic to nearby residential receivers.

5.2.5.1 Changes in construction traffic noise impacts compared with the EIS

Changes in potential construction traffic noise impacts compared with the EIS include:

- Assessment of additional construction traffic noise impacts of haulage on West High Street, Bray Street, Buchanans Road and Gatelys Road
- Assessment of additional traffic noise impacts of temporary access to Kororo Public School and existing residential properties on Korora School Road via Russ Hammond Close.

5.3 Construction vibration

5.3.1 Safe working distances

The CNVG provides, as a guide, minimum working distances from sensitive receivers for typical items of vibration intensive plant. The minimum working distances are reproduced in Table 60.

Table 60: CNVG recommended minimum working distances for vibration intensive plant

Plant Item	Rating/Description	Safe Working Distance	
		Cosmetic Damage (BS 7385)	**Human Response (NSW EPA Vibration Guideline)**
Vibratory Roller	< 50 kN (Typically 1-2t)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4t)	6 m	20 m
	< 200 kN (Typically 4-6t)	12 m	40 m
	< 300 kN (Typically 7-13t)	15 m	100 m
	> 300 kN (Typically 13-18t)	20 m	100 m
	> 300 kN (Typically > 18t)	25 m	100 m

Plant Item	Rating/Description	Safe Working Distance	
		Cosmetic Damage (BS 7385)	Human Response (NSW EPA Vibration Guideline)
Small Hydraulic Hammer	300 kg - 5 to 12t excavator	2 m	7 m
Medium Hydraulic Hammer	900 kg - 12 to 18t excavator	7 m	23 m
Large Hydraulic Hammer	1600 kg - 18 to 34t excavator	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Hand held	1 m (nominal)	2 m

The minimum distances in Table 60 are quoted for both “cosmetic” damage (as per BS 7385) and for human comfort (as per EPA Assessing vibration – a technical guideline). It is noted that more stringent conditions may apply to heritage or other sensitive structures and would need to be treated on a case by case basis. Appendix J4 shows a worst-case screening buffer for safe working distances. Safe working distances do not relate to heritage sites; however, they have been identified on the aerial maps for reference.

The minimum working distances for cosmetic damage should be complied with at all times. Because the minimum working distances in Table 60 are indicative only and will vary depending on the particular item of plant and local geotechnical conditions, vibration monitoring is recommended to confirm the minimum working distances at specific sites with specific geotechnical conditions.

In relation to human comfort (response), the minimum working distances in Table 60 relate to continuous vibration. For most construction activities, vibration emissions are intermittent in nature and for this reason higher vibration levels, occurring over shorter periods are considered allowable. Table 61 presents a summary of receivers within each NCA which may experience potential construction vibration impacts. The number of affected receivers provided in Table 61 is a conservative estimate based on the number of receivers located within a 100 m boundary around the construction footprint and does not consider exact use locations of vibration intensive equipment.

Mitigation will need to be considered where sensitive receivers are located within the safe working distances. This information should be read in conjunction with maps provided in Appendix J4.

Table 61: Potential construction vibration impacts

NCA	Potential impacts
1	There are 27 residential receivers located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at some receivers.
2	Five residential receivers are located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at two receivers.
3	There are no receivers within the 100 m boundary around construction activities. It is not expected receivers would perceive vibration levels from construction activities.
4	A commercial and an industrial receiver are located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers.
5	There are 19 commercial receivers are located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at receivers closest to the construction footprint.
6	There are 11 residential receivers located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at receivers closest to the construction footprint.
7	Two residential receivers and a commercial receiver are located within the 100 m boundary around construction activities. It is possible that these receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at the receiver closest to the construction footprint around the ancillary site.
8	A residential receiver is located within the 100 m boundary around construction activities. It is not expected receivers would perceive vibration levels from construction activities.
10	A residential receiver is located within the 100 m boundary around construction activities. It is possible that this receiver may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers.

NCA	Potential impacts
11	Four residential receivers are located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at receiver closest to the construction footprint.
12	There are 12 residential receivers located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at receivers closest to the construction footprint.
13	There are 58 residential receivers located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at receivers closest to the construction footprint.
14	There are 10 residential receivers located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at a receiver closest to the construction footprint.
15	Two residential receivers are located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers.
16	There are no receivers within the 100 m boundary around construction activities. It is not expected receivers would perceive vibration levels from construction activities.
17	A residential receiver is located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers.
18	Nine residential receivers are located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at a receiver closest to the construction footprint.
19	Seven residential receivers are located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at a receiver closest to the construction footprint.

NCA	Potential impacts
20	Three residential receivers are located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at a receiver closest to the construction footprint.
21	There are 29 residential receivers located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at receivers closest to the construction footprint.
22	There are 16 residential receivers and three commercial receivers located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at a receiver closest to the construction footprint.
23	Four residential receivers are located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at a receiver closest to the construction footprint.
24	There are 29 residential receivers located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at receivers closest to the construction footprint.
25	There are 37 residential receivers and a commercial receiver located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at receivers closest to the construction footprint.
26	There are 37 residential receivers, an education facility and a commercial receiver are located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at receivers closest to the construction footprint.

NCA	Potential impacts
27	There are 12 residential receivers and 20 commercial receivers located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at receivers closest to the construction footprint or the timber bridge heritage structure
28	There are 85 residential receivers located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at receivers closest to the construction footprint.
29	Eight residential receivers are located within the 100 m boundary around construction activities. It is possible that some receivers may perceive the construction vibration above the human comfort level when construction activities include the use of equipment including heavy vibratory rollers or large hydraulic hammers. Depending on the type of equipment used, the cosmetic damage vibration criteria could be exceeded at receivers closest to the construction footprint.

5.3.2 Safe working distances - Heritage Structures

Heritage structures in the vicinity of the project have been identified below and are shown in Appendix B.

- Two timber bridges located on Old Coast Road and located adjacent to the construction footprint
- The North Coast Railway (including the dry argillite retaining wall and embankment) crossing the construction area near Shephards Lane.

No other heritage buildings have been identified in the vicinity of the project.

It is noted that while the North Coast Railway has been identified as a heritage item, it is not considered sensitive to potential vibration damage; vibration created by operation of trains are likely to be greater than vibration created by construction works.

The timber bridges are likely to be impacted by vibration activities due to their proximity to the construction works. Vibration from vehicles traversing the bridges is likely to generate a more significant vibration impact than those created by construction works.

Notwithstanding, heritage structures are to be considered on a case by case basis, and detailed inspections of heritage listed structures should be undertaken for each potentially affected heritage structure prior to the commencement of works.

The heritage structures should not (unless it is structurally unsound) be assumed to be more sensitive. However, if those structure are considered to be sensitive to damage from vibration following inspection, it is recommended to reduce the vibration criteria. As an initial screening criterion, it is possible to implement the screening limits summarised in Section 3.2.5.2, noting that these screening criteria are particularly conservative.

Therefore, the structural integrity of the heritage structures should be confirmed at detailed design by a suitably qualified structural engineer and results from inspection will be used to verify the applicable vibration criteria and associated impacts, and potentially feasible and reasonable mitigation options to be implemented.

5.3.3 Safe working distances - Other vibration sensitive receivers

Vibration impacts to other species (e.g. horses at the Boambee Equestrian Centre) have been considered under the same criteria as that established for human comfort. These are not expected to result in adverse impacts provided that horses are being kept/trained outside of the human comfort buffer zone in Table 60.

5.4 Blasting

Calculations have been undertaken based on methodologies provided in AS 2187.2 to determine potential ground-borne vibration and air blast overpressure from proposed blasting. In lieu of detailed information, average conditions as recommended in the standard have been assumed. In order to inform distances to nearest potentially affected sensitive receivers, the extents of excavation have been used as a guide and will need to be confirmed once detailed methodologies have been defined by the contractor.

5.4.1 Ground-borne vibration

Ground-borne vibration levels from blasting have been calculated using the formula:

$$V = K_g \cdot (\frac{R}{Q^{1/2}})^{-B}$$

Where:

V is the ground vibration as vector peak particle velocity, mm/s
R is the distance between charge and point of measurement, m|
Q is the maximum instantaneous charge (effective mass per delay), kg
Kg and *B* are constants related to site and rock properties for estimation purposes.

For the purposes of assessment, the following average conditions have been assumed:

$$Kg = 1140$$

$$B = 1.6$$

The following Maximum Instantaneous Charge (effective charge mass per delay) have been calculated to achieve the relevant assessment criteria at the nearest affected vibration sensitive receiver locations. These limits are indicative only and will need to be confirmed by the construction contractor.

Table 62: Indicative maximum instantaneous charge limits for ground-borne vibration

Cutting ID	Noise Catchment Area	Nearest affected Receiver ID	Type	Distance (m)	PPV Criterion (mm/s)	Max MIC (kg)
C1	NCA02	NCA02.RES.0006.01	Residential	41	10	5
C2	NCA03	NCA03.RES.0114.01[1]	Residential	27	10	2
C2	NCA03	NCA03.RES.0011.01	Residential	295	10	234
C2	NCA04	NCA04.COM.0003.01	Commercial	214	25	386
C3	NCA07	NCA07.RES.0005.01[2]	Residential	36	10	3
C3	NCA07	NCA07.RES.0001.01	Residential	228	10	140
C3	NCA05	NCA05.IND.0001.01	Industrial	221	25	412
C3	NCA05	NCA05.COM.0116.01	Commercial	80	25	54
C4	NCA06	NCA06.RES.0163.01[1]	Residential	110	10	32
C4	NCA06	NCA06.RES.0315.01	Residential	546	10	800
C5	NCA10	NCA10.RES.0003.01[2]	Residential	97	5	11
C5	NCA10	NCA10.RES.0002.01	Residential	232	5	61
C6	NCA11	NCA11.RES.0025.01[2]	Residential	90	10	22
C6	NCA11	NCA11.COM.0001.01	Commercial	345	25	1004
C7	NCA12	NCA12.RES.0025.01[2]	Residential	32	10	3
C7	NCA12	NCA12.RES.0030.01	Residential	73	10	14
C7	NCA13	NCA13.CCF.0001.01	Child Care Facility	500	10	671
C8	NCA12	NCA12.RES.0035.01	Residential	139	10	52
C9	NCA14	NCA14.RES.0106.01	Residential	190	10	97
C10	NCA15	NCA15.RES.0002.01	Residential	57	10	9
C11	NCA14	NCA14.RES.0103.01	Residential	137	10	50
C12	NCA16	NCA16.RES.0194.01[1]	Residential	33	5	1
C12	NCA16	NCA16.RES.0144.01	Residential	55	5	3
C13	NCA16	NCA16.RES.0158.01	Residential	133	5	20
C14	NCA16	NCA16.RES.0106.01	Residential	173	5	34
C15	NCA17	NCA17.RES.0001.01	Residential	84	5	8
C17	NCA18	NCA18.RES.0117.01	Residential	98	5	11
C18	NCA19	NCA19.RES.0001.01	Residential	241	5	66
C19	NCA19	NCA19.RES.0007.01	Residential	157	5	28
C20	NCA20	NCA20.RES.0007.01	Residential	128	5	18
C20	NCA21	NCA21.COM.0011.01	Commercial	412	25	1432
C20a	NCA23	NCA23.COM.0015.01	Commercial	379	25	1212
C20a	NCA23	NCA23.RES.0007.01	Residential	37	5	2
C23	NCA28	NCA28.RES.0031.01	Residential	15	10	<1

[1] Property part of an unbuilt approved DA subdivision

[2] TfNSW owned property

5.4.2 Air blast overpressure

Air blast overpressure levels have been calculated using the formula:

$$P = K_a \cdot \left(\frac{r}{Q^{1/3}}\right)^a$$

Where:

P is the calculated pressure, kPa
Q is the mass of the explosive charge, kg
r is the distance from the explosive charge, m
K_a is the site constant
a is the site exponent

For the purposes of assessment, the following average conditions have been assumed:

$$A = -1.45$$

$$K_a = 100$$

The following Maximum Instantaneous Charge (effective charge mass per delay) have been calculated to achieve the relevant assessment criteria at the nearest vibration sensitive receiver locations. These limits are indicative only and will need to be confirmed by the construction contractor.

Table 63: Indicative maximum instantaneous charge limits for air blast overpressure

Cutting ID	Noise Catchment Area	Nearest affected Receiver ID	Type	Distance (m)	Overpressure Criterion (dBL)	Max MIC (kg)
C1	NCA02	NCA02.RES.0006.01	Residential	41	120	<1
C2	NCA03	NCA03.RES.0114.01[1]	Residential	27	120	<1
C2	NCA03	NCA03.RES.0011.01	Residential	295	120	67
C2	NCA04	NCA04.COM.0003.01	Commercial	214	125	84
C3	NCA07	NCA07.RES.0005.01[2]	Residential	36	120	<1
C3	NCA07	NCA07.RES.0001.01	Residential	228	120	31
C3	NCA05	NCA05.IND.0001.01	Industrial	221	125	93
C3	NCA05	NCA05.COM.0116.01	Commercial	80	125	4
C4	NCA06	NCA06.RES.0163.01[1]	Residential	110	120	3
C4	NCA06	NCA06.RES.0315.01	Residential	546	120	424
C5	NCA10	NCA10.RES.0003.01[2]	Residential	97	115	<1
C5	NCA10	NCA10.RES.0002.01	Residential	232	115	10
C6	NCA11	NCA11.RES.0025.01[2]	Residential	90	120	2
C6	NCA11	NCA11.COM.0001.01	Commercial	345	125	352
C7	NCA12	NCA12.RES.0025.01[2]	Residential	32	120	<1
C7	NCA12	NCA12.RES.0030.01	Residential	73	120	1
C7	NCA13	NCA13.CCF.0001.01	Child Care Facility	500	120	326
C8	NCA12	NCA12.RES.0035.01	Residential	139	120	7
C9	NCA14	NCA14.RES.0106.01	Residential	190	120	18
C10	NCA15	NCA15.RES.0002.01	Residential	57	120	<1
C11	NCA14	NCA14.RES.0103.01	Residential	137	120	7
C12	NCA16	NCA16.RES.0194.01[1]	Residential	33	115	<1
C12	NCA16	NCA16.RES.0144.01	Residential	55	115	<1
C13	NCA16	NCA16.RES.0158.01	Residential	133	115	2
C14	NCA16	NCA16.RES.0106.01	Residential	173	115	4
C15	NCA17	NCA17.RES.0001.01	Residential	84	115	<1
C17	NCA18	NCA18.RES.0117.01	Residential	98	115	<1
C18	NCA19	NCA19.RES.0001.01	Residential	241	115	11
C19	NCA19	NCA19.RES.0007.01	Residential	157	115	3
C20	NCA20	NCA20.RES.0007.01	Residential	128	115	2
C20	NCA21	NCA21.COM.0011.01	Commercial	412	125	600
C20a	NCA23	NCA23.COM.0015.01	Commercial	379	125	467
C20a	NCA23	NCA23.RES.0007.01	Residential	37	115	<1
C23	NCA28	NCA28.RES.0031.01	Residential	15	10	<1

[1] Property part of an unbuilt approved DA subdivision

[2] TfNSW owned property

Note that blasting should not be ruled out on the basis of the closeness of the receivers. Blasting can be undertaken at very close distances from receivers.

In the event that blasting is to be undertaken at locations less than 50 m away from the receivers and that blasting would significantly reduce construction timeframe, it is recommended to seek advice from a blasting professional consultant.

5.4.3 Changes in blasting impacts compared with the EIS

Changes in potential ground-borne vibration and air blast overpressure impacts compared with the EIS include:

- Assessment of additional blasting sites
- Removed assessment of cutting C8 as blasting is no longer required
- Updated airblast overpressure and ground-borne vibration assessment against relevant criteria based on the NCAs where blasting is forecasted to last longer than 12 months or involve operations with more than 20 blasts
- Included assessment to additional nearest affected receivers where the most affected receiver identified in the EIS is not built yet or has been identified as TfNSW property.

5.5 Construction noise and vibration mitigation

The following sections discuss noise and vibration mitigation measures to ameliorate exceedances of CNVG criteria. The mitigation measures discussed are considered to represent all feasible and reasonable options available for the project.

The ICNG acknowledges that due to the nature of construction activities it is inevitable that there will be noise impacts from construction sites. The NMLs identified in this report have been applied to determine measures for the control of potential construction noise impacts at the nearest affected noise sensitive receivers.

All feasible and reasonable work practices should be applied to meet the project NMLs where possible. This includes informing all potentially impacted residents of the nature of works to be carried out, the expected noise levels, duration of noise generating construction works, and to provide contact details during construction.

A Construction Environmental Management Plan (CEMP) should be prepared during the detailed design phase. A Construction Noise and Vibration Management Plan (CNVMP) would be included in the CEMP to provide the framework and mechanisms for the management and mitigation of all potential noise and vibration impacts from the project.

5.5.1 Standard noise and vibration mitigation measures

Appendix B of the CNVG details a number of standard actions and mitigation measures to be implemented on all construction projects where NML exceedances are predicted. These are reproduced in Table 64.

Table 64: CNVG Standard noise mitigation measures

Action Required	Applies to	Details
Management Measures		
Implementation of any project specific mitigation measures required	Airborne noise	Implementation of any project specific mitigation measures required.
Implement community consultation or notification measures	Airborne noise Ground-borne noise and vibration	Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night time period, any operational noise benefits from the works (where applicable) and contact telephone numbers. Notification should be a minimum of 7 calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required.
Site inductions	Airborne noise Ground-borne noise and vibration	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: All project specific and relevant standard noise and vibration mitigation measures relevant, licence and approval conditions, permissible hours of work, any limitations on high noise generating activities, location of nearest sensitive receivers, employee parking areas, designated loading/unloading areas and procedures site opening/closing times (including deliveries) environmental incident procedures
Behavioural practices	Airborne noise	No unnecessary shouting or loud stereos/radios onsite. No dropping of materials from height, throwing of metal items and slamming of doors.
Verification	Airborne noise Ground-borne noise and vibration	Where specified, a noise verification programme is to be carried out for the duration of the works in accordance with the Construction Noise and Vibration Management Plan (CNVMP) and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration	Where required attended vibration measurements should be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.

Action Required	Applies to	Details
Update Environmental Management Plans	Airborne noise Ground-borne noise and vibration	The CNVMP must be regularly updated to account for changes in noise and vibration management issues and strategies.
Building condition surveys	Vibration Blasting	Undertake building condition surveys on all buildings located within the buffer zone prior to commencement of activities with the potential to cause property damage.
Source Controls		
Construction hours and scheduling	Airborne noise Ground-borne noise and vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.
Construction respite periods during normal hours and out-of-hours work	Ground-borne noise and vibration Airborne noise	Use of respite measures
Equipment selection.	Airborne noise Ground-borne noise and vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits. Ensure plant, including the silencer, is well maintained.
Rental plant and equipment.	Airborne noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used onsite unless compliant with the criteria in Table 2 of the CNVG.
Use and siting of plant.	Airborne noise	The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently is to be throttled down or shut down. Noise-emitting plant is to be directed away from sensitive receivers. Only have necessary equipment onsite.

Action Required	Applies to	Details
Plan worksites and activities to minimise noise and vibration	Airborne noise Ground-borne vibration	Locate compounds away from sensitive receivers discourage access from local roads Plan traffic flow, parking and loading / unloading areas to minimise reversing movements within the site. Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible. Very noisy activities should be scheduled for normal working hours. If the work cannot be undertaken during the day it should be completed before 11:00pm. Where practicable, work should be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher educational semesters. If programmed night work is postponed, the work should be re-programmed and the approaches in the CNVMP apply again.
Reduced equipment power	Airborne noise Ground-borne vibration	Use only the necessary size and power
Non-tonal and ambient sensitive reversing alarms	Airborne noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used onsite and for any out-of-hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.
Minimise disturbance arising from delivery of goods to construction sites.	Airborne noise	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. Avoid or minimise out-of-hours movements where possible.

Action Required	Applies to	Details
Blasting regime	Airborne noise Ground-borne vibration	The noise and vibration impacts of blasting operations can be minimised by: • Choosing the appropriate blast charge configurations • Ensuring appropriate blast-hole preparation • Optimising blast design, location, orientation and spacing • Selecting appropriate blast times, ad • Utilising knowledge of prevailing meteorological conditions AS 2187.2 Explosives-Storage, transport and use, Part 2: Use of Explosives provides more detailed advice on ground vibration and air blast overpressure impact minimisation options.
Engine compression brakes	Construction vehicles	Limit the use of engine compression brakes at night and in residential areas. Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.
Path Controls		
Shield stationary noise sources such as pumps, compressors, fans etc.	Airborne noise	Stationary noise sources should be enclosed or shielded where feasible and reasonable whilst ensuring that the occupational health and safety of workers is maintained. Appendix D of AS 2436: 2010 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities	Airborne noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.
Receptor Controls		
Structural surveys and vibration monitoring	Ground-borne vibration	Pre-construction surveys of the structural integrity of vibration sensitive buildings may be warranted. At locations where there are high risk receptors, vibration monitoring should be conducted during the activities causing vibration.

Further mitigation measures to be considered include:

- Contact potentially noise affected neighbours at the earliest possible time before any site work begins and keep up to date with works progress
- Inform potentially noise affected neighbours about the nature of the construction stages and the duration of noisier activities – for example, blasting, excavation, rock-breaking and piling

- Provide contact details on a site board at the front of the site, maintain a complaints register suited to the scale of works, and maintain a copy of the noise management plan
- Turn off plant that is not being used
- Examine, and implement where feasible and reasonable, alternative work practices which generate less noise or silenced equipment
- Ensure plant is regularly maintained, and repair or replace equipment that becomes noisy
- Where possible, conduct jackhammering or excavation during the middle of the day when noise sensitivity is not as high
- Keep staff who receive telephone complaints informed regarding current and upcoming works and the relevant contacts for these works
- Where there are complaints about noise from an identified work activity, review and implement, where feasible and reasonable, actions additional to those described above to minimise noise output.
- Undertake building of noise barriers as early as possible to provide shielding of noise construction noise
- Where possible, provide at-property treatments prior to project opening where possible to assist with amelioration of construction noise
- Replace impact drilling with bore drilling
- Use hydraulic drills instead of percussive drills
- Consider reducing the construction timeframe by using blasting method instead of excavation method if possible and in consultation with community and potentially a blasting expert
- Schedule activities in consultation with nearby developments
- Provide shielding of noisy plant on ancillary plant if possible or orientate plant away from nearest receivers
- Carry out a detailed inspection and a written and photographic report to document the condition of buildings and structures, including the Old Coast Road Bridge Number 1 and Old Coast Road Bridge Number 2. Provided a copy of the report to the relevant land owner or land manager.
- Erect sound insulating ‘acoustic sheds’ at each of the tunnel portals as soon as site establishment works at the facilities are completed to reduce noise impacts from tunnel construction related activities.

5.5.2 Construction traffic noise mitigation

Management of construction related traffic noise should as a minimum include the following controls:

- Scheduling and routing of vehicle movements
- Driver behaviour and avoidance of the use of engine compression brakes
- Ensuring vehicles are adequately silenced before allowing them to access the site.

5.5.3 Out of hours works noise impact categories

The project would require several activities to be carried out outside the recommended standard construction hours for day, evening and night-time periods. In acknowledgment of the extent of out of hours work proposed, at-property noise treatments will be implemented during the pre-construction phase of the project before the main construction activities begin. This would include at-property treatments to reduce potential noise impacts associated with construction (including out of hours work (OOHW)). In addition, an Out of Hours Work Procedure would include specific management measures to minimise or mitigate potential noise impacts and consider the need to balance the out of hours work with periods of receiver respite.

A risk assessment process will be adopted for the application of the Out of Hours Work Procedure to identify the risk of intrusive noise impacts at sensitive receivers where construction noise levels are predicted to exceed the Noise Management Level (NML). The noise impact category (A to E) is defined by calculated noise levels and broadly identifies the potential for intrusive noise impacts. The noise impact levels also guide the level of consultation and noise mitigation measures required to manage these impacts at sensitive receivers.

Considering experience on other Pacific Highway upgrade projects, the rating background level (RBL) and the highly noise affected criterion in the CNVG of 75 dB(A), the noise impact categories in Table 65 have been adopted for determining the applicability of OOHW mitigation measures.

Table 65: Noise impact categories for OOHW

OOHW Category	Noise level	Potential for intrusive noise impacts
A	No exceedance above the NML	Very low
B	1-5 dBA above NML	Low
C	6-15 dBA above NML	Medium
D	16-25 dBA above NML	High
E	>25 dBA above NML	Very high

Depending on the applicable noise impact category, the relevant mitigation measures will be assessed and implemented where reasonable and feasible.

Feasible work practices are practical to implement, while reasonable work practices consider the balance of costs and benefits and community views.

There are a number of additional mitigation measures that could be applied to manage OOHW noise impacts from the project. These mitigation measures will be implemented where reasonable and feasible and will directly relate to the extent of noise impact of the proposed. The higher the noise impact from the proposed activities, the greater the level of mitigation and consultation required for the proposed works. OOHW mitigation measures to be applied are outlined in Table 66.

An adaptive management approach will be applied to the implementation of mitigation measures to minimise impacts on the community. It should be noted that there may be personal circumstances among the sensitive receivers where the below approach to specific additional mitigation measures is not best suited.

Table 66: OOHW mitigation measures

Mitigation measure	OOHW Category				
	A	B	C	D	E
Scheduling of noise intensive or high noise impact work to evening periods where feasible		X	X	X	X
Use of alternative plant and equipment and/or construction techniques to minimise noise		X	X	X	X
Notification and consultation requirements including preparation of a six-month 'look ahead' program for likely out of hours work	X	X	X	X	X
Use of temporary noise barriers			X	X	X
Acoustic sheds will be included around tunnel portals to shield noise from within the tunnel during evening and night periods to minimise noise impacts at nearby noise sensitive receivers			X	X	X
Respite periods				X	X
Representative noise monitoring					X
Offers of reasonable and temporary alternative accommodation or an act of good will					X
Use of negotiated agreements					X

6 Conclusion

Noise and vibration from the construction and operation of the proposed Coffs Harbour bypass project has been assessed in accordance with the Secretary's Environmental Assessment Requirements.

Operational noise modelling indicates that up to 1591 out of 2347 noise sensitive receivers within the project study area will exceed operational road noise criteria under the Roads and Maritime NCG. Of those affected properties, 1401 noise sensitive receivers have been identified as qualifying for consideration of additional mitigation in accordance with the Roads and Maritime NMG.

An analysis of 'feasible and reasonable' noise mitigation options was undertaken in accordance with the Roads and Maritime Services NMG. An investigation of low noise pavement alternative was explored for the future bypass between chainages CH9700 and CH23650, excluding the extents of road surface inside tunnels. 1129 receivers still exceed NCG criteria with these extents of low noise pavement in place.

Further reductions in operational noise impact were investigated via installation of noise barriers. A full barrier analysis was undertaken in accordance the NMG in a total of 10 locations. Recommended design heights as calculated in accordance with the NMG have been provided at a total of 8 locations following investigation of feasible and reasonable analysis.

A total of 619 remaining noise sensitive receiver locations, out of which 11 are non-residential noise sensitive receivers, still qualify for consideration of additional mitigation with final design mitigation measures in place and have been identified as requiring investigation into appropriate at-property treatment.

Key features such as steep gradients, changes in speed, and changes in geometry have been qualitatively analysed to identify potential change in maximum noise impacts due to the project. Noise monitoring data obtained during the environmental noise surveys was also analysed to quantify existing maximum noise level exposure. It should be noted that the maximum noise assessment should be used as a tool to help prioritise and rank mitigation strategies but should not be applied as a decisive criterion in itself.

An industrial noise assessment has been undertaken for the bus interchange at Kororo Public School, the Coramba Road bus stop, Gatelys Road and Shephards Lane tunnels. The predicted noise levels at the nearest noise sensitive receivers from the in-tunnel fans for the were found to be generally in compliance with the project criteria.

No development is proposed to the existing North Coast Railway as a part of the project. However, noise level changes due to the changes in the surrounding terrain after construction of the project were assessed against a criterion of 2 dB change in noise level, representing what could be just noticeable difference in noise level. There are no instances of changes greater than 2 dB expected to the train noise levels at nearest affected noise sensitive receivers due to the introduction of the project.

The construction noise and vibration assessment has been based on constructability information provided by the design team and Roads and Maritime. Noise management level exceedances and corresponding noise mitigation strategies have been provided. Construction ground-borne noise has also been assessed to determine indicative distances at which the predicted noise levels are below the criteria.

An analysis was undertaken of existing and future increase in traffic on the existing road network during construction of the project. Areas with greater than 2 dB increase have been identified and predictions against RNP existing road criteria have been made. Reasonable and feasible mitigation measures have been provided to be implemented by the contractor once further detail is available for haulage routes and construction vehicle staging.

Construction ground-borne noise has also been assessed to estimate of potential structure-borne noise levels generated by future mechanised tunnelling works. This assessment provided indicative distances at which the predicted noise levels are expected to be below the criteria. Detailed requirements are recommended to be confirmed by the construction contractor.

Where blasting is required for the project, there is a potential that ground vibration and air blast overpressure will adversely impact noise sensitive receivers. This is a function of proximity to the proposed blasting works and would need to be controlled via reduction in maximum instantaneous charges used. It is noted that blasting should not be ruled out on the basis of the closeness of the receivers. In the event that blasting is to be undertaken at close distances to receivers and that blasting would significantly reduce construction timeframe, it is recommended to seek advice from a blasting professional consultant.

Vibration from the construction work, and particularly from blasting works have the potential to adversely impact on sensitive receivers. Safe working distances provided should be observed at all times and confirmed via condition surveys and monitoring strategy.

Construction work will generally be undertaken during standard hours however, some work may be required during evening and night-time periods due to technical, safety and/or community amenity reasons. Detailed construction noise and vibration management plans will be required to be prepared by the construction contractor for each stage of works.

Appendix A

Glossary

Ambient Noise Level

The ambient noise level is the overall noise level measured at a location from multiple noise sources. When assessing noise from a particular development, the ambient noise level is defined as the remaining noise level in the absence of the specific noise source being investigated. For example, if a fan located on a city building is being investigated, the ambient noise level is the noise level from all other sources without the fan running. This would include sources such as traffic, birds, people talking and other nearby fans on other buildings.

Background Noise Level

The background noise level is the noise level that is generally present at a location at all or most times. Although the background noise may change over the course of a day, over shorter time periods (e.g. 15 minutes) the background noise is almost-constant. Examples of background noise sources include steady traffic (e.g. motorways or arterial roads), constant mechanical or electrical plant and some natural noise sources such as wind, foliage, water and insects.

Assessment Background Level (ABL)

A single-number figure used to characterise the background noise levels from a single day of a noise survey. ABL is derived from the measured noise levels for the day, evening or night time period of a single day of background measurements. The ABL is calculated to be the tenth percentile of the background L_{A90} noise levels – i.e. the measured background noise is above the ABL 90% of the time.

Rating Background Level (RBL / min$L_{A90,1hour}$)

A single-number figure used to characterise the background noise levels from a complete noise survey. The RBL for a day, evening or night time period for the overall survey is calculated from the individual Assessment Background Levels (ABL) for each day of the measurement period and is numerically equal to the median (middle value) of the ABL values for the days in the noise survey. This parameter is denoted RBL in NSW, and min$L_{A90,1hour}$ in QLD.

Decibel

The decibel scale is a logarithmic scale which is used to measure sound and vibration levels. Human hearing is not linear and involves hearing over a large range of sound pressure levels, which would be unwieldy if presented on a linear scale. Therefore, a logarithmic scale, the decibel (dB) scale, is used to describe sound levels.

An increase of approximately 10 dB corresponds to a subjective doubling of the loudness of a noise. The minimum increase or decrease in noise level that can be noticed is typically 2 to 3 dB.

dB(A)

dB(A) denotes a single-number sound pressure level that includes a frequency weighting ("A-weighting") to reflect the subjective loudness of the sound level.

The frequency of a sound affects its perceived loudness. Human hearing is less sensitive at low and very high frequencies, and so the A-weighting is used to account for this effect. An A-weighted decibel level is written as dB(A).

Some typical dB(A) levels are shown below.

Sound Pressure Level dB(A)	Example
130	Human threshold of pain
120	Jet aircraft take-off at 100 m
110	Chain saw at 1 m
100	Inside nightclub
90	Heavy trucks at 5 m
80	Kerbside of busy street
70	Loud stereo in living room
60	Office or restaurant with people present
50	Domestic fan heater at 1m
40	Living room (without TV, stereo, etc)
30	Background noise in a theatre
20	Remote rural area on still night
10	Acoustic laboratory test chamber
0	Threshold of hearing

L_{10}

The L_{10} statistical level is often used as the "average maximum" level of a sound level that varies with time.

Mathematically, the L_{10} level is the sound level exceeded for 10% of the measurement duration. L_{10} is often used for road traffic noise assessment. As an example, 63 dB $L_{A10,18hr}$ is a sound level of 63 dB(A) or higher for 10% of the 18-hour measurement period.

L_{90}

The L_{90} statistical level is often used as the "average minimum" or "background" level of a sound level that varies with time.

Mathematically, L_{90} is the sound level exceeded for 90% of the measurement duration. As an example, 45 dB $L_{A90,15min}$ is a sound level of 45 dB(A) or higher for 90% of the 15-minute measurement period.

L_{eq}

The ‘equivalent continuous sound level’, L_{eq}, is used to describe the level of a time-varying sound or vibration measurement.

L_{eq} is often used as the “average” level for a measurement where the level is fluctuating over time. Mathematically, it is the energy-average level over a period of time (i.e. the constant sound level that contains the same sound energy as the measured level). When the dB(A) weighting is applied, the level is denoted dB L_{Aeq}. Often the measurement duration is quoted, thus $L_{Aeq,15\ min}$ represents the dB(A) weighted energy-average level of a 15-minute measurement.

L_{max}

The L_{max} statistical level can be used to describe the “absolute maximum” level of a sound or vibration level that varies with time.

Mathematically, L_{max} is the highest value recorded during the measurement period. As an example, 94 dB L_{Amax} is a highest value of 94 dB(A) during the measurement period.

Since L_{max} is often caused by an instantaneous event, L_{max} levels often vary significantly between measurements.

Frequency

Frequency is the number of cycles per second of a sound or vibration wave. In musical terms, frequency is described as “pitch”. Sounds towards the lower end of the human hearing frequency range are perceived as “bass” or “low-pitched” and sounds with a higher frequency are perceived as “treble” or “high pitched”.

Peak Particle Velocity (PPV)

Peak Particle Velocity (PPV) is the highest velocity of a particle (such as part of a building structure) as it vibrates. Most sound level meters measure *root mean squared* (RMS) values; it is common to approximate the PPV based on an RMS measurement.

PPV is commonly used as a vibration criterion, and is often interpreted as a PPV based on the L_{max} or $L_{max,spec}$ index.

Sound Power and Sound Pressure

The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source. The sound pressure level (L_p) varies as a function of distance from a source. However, the sound power level is an intrinsic characteristic of a source (analogous to its mass), which is not affected by the environment within which the source is located.

Structure-borne Noise

The transmission of noise energy as vibration of building elements. The energy may then be re-radiated as airborne noise. Structure-borne noise is controlled by structural discontinuities, i.e. expansion joints and floating floors.

Vibration

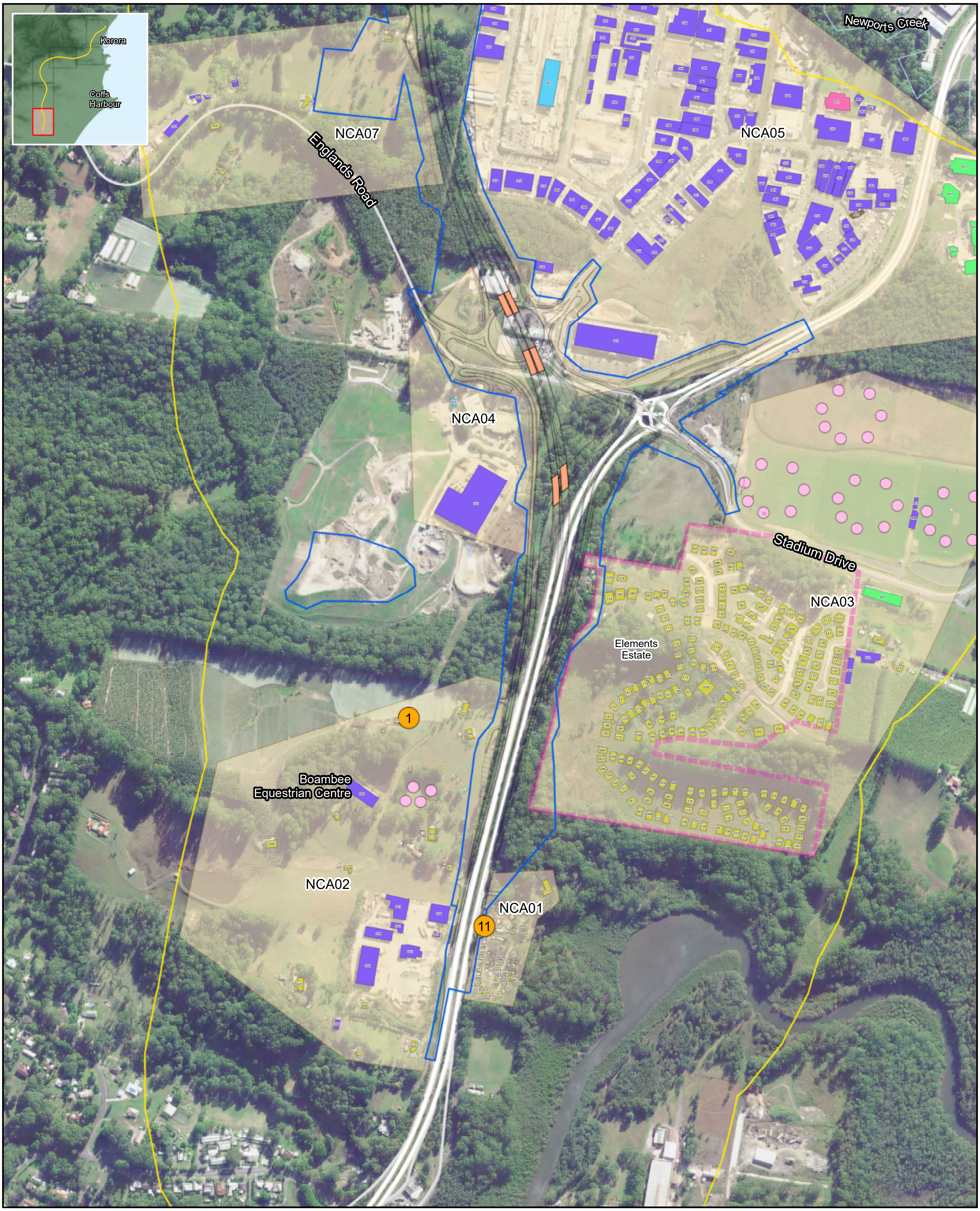
Waves in a solid material are called “vibration”, as opposed to similar waves in air, which are called “sound” or “noise”. If vibration levels are high enough, they can be felt; usually vibration levels must be much higher to cause structural damage.

A vibrating structure (e.g. a wall) can cause airborne noise to be radiated, even if the vibration itself is too low to be felt. Structure-borne vibration limits are sometimes set to control the noise level in a space.

Vibration levels can be described using measurements of displacement, velocity and acceleration. Velocity and acceleration are commonly used for structure-borne noise and human comfort. Vibration is described using either metric units (such as mm, mm/s and mm/s^2) or else using a decibel scale.

Appendix B

Receiver and noise monitoring locations



Legend

- Construction footprint
- Alignment
- Bridge
- Tunnel
- Study Area
- Noise catchment area
- Approved DA subdivision
- Noise monitoring location (validation)
- Noise monitoring location (baseline)
- Noise monitoring location (attended only)

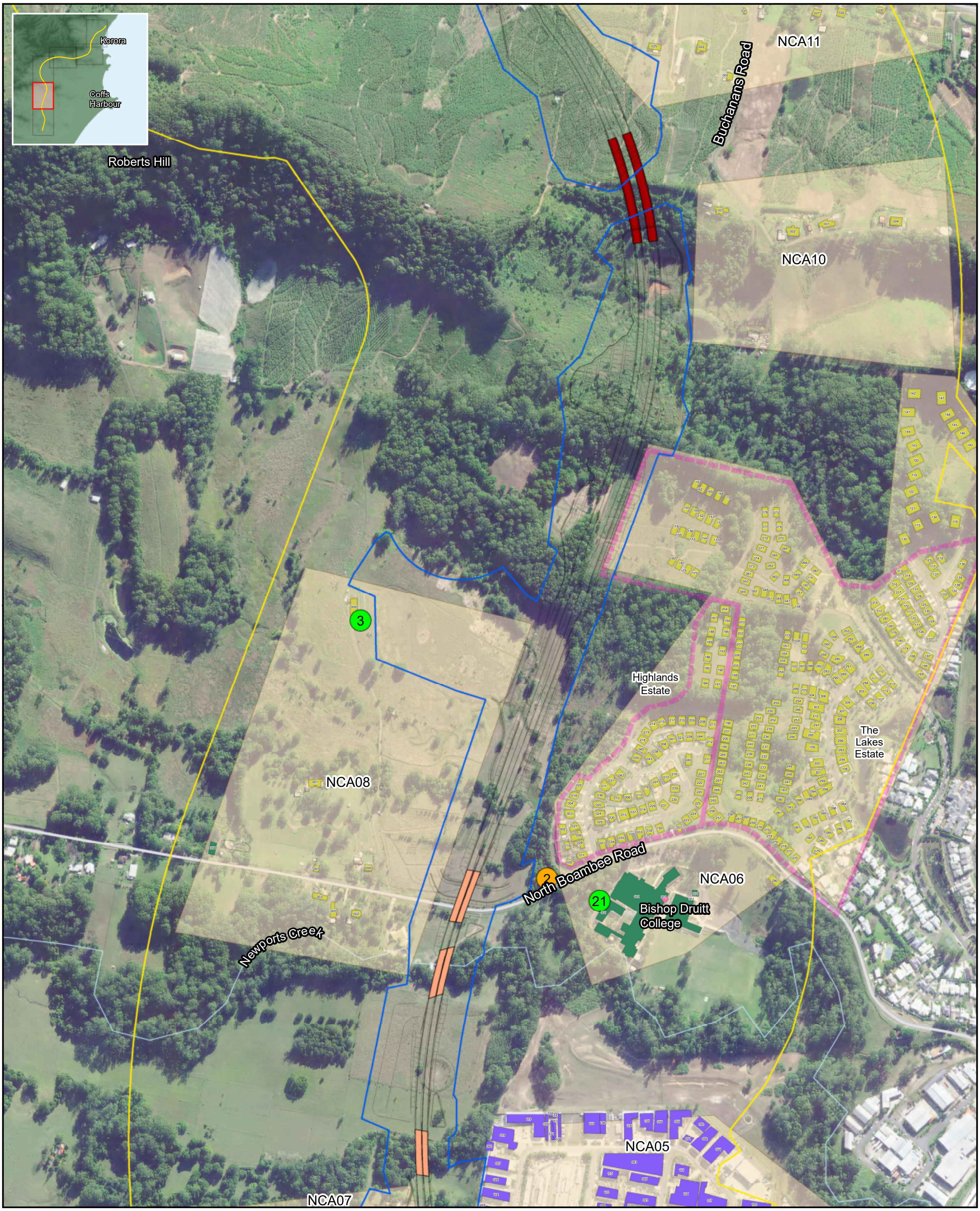
Building Classification

- Active Recreation
- Passive Recreation
- Child care facility
- Commercial
- Places of worship
- Hospital
- Industrial
- Residential
- School

Note: the identifier NCA09 has not been used for any of the noise sensitive receivers

Coffs Harbour Bypass
Noise catchment areas, sensitive land uses and noise monitoring locations
Map page - 01

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N



Legend

- Construction footprint
- Alignment
- Bridge
- Tunnel
- Study Area
- Noise catchment area
- Approved DA subdivision
- Noise monitoring location (validation)
- Noise monitoring location (baseline)
- Noise monitoring location (attended only)

Building Classification

- Active Recreation
- Passive Recreation
- Child care facility
- Commercial
- Places of worship
- Hospital
- Industrial
- Residential
- School

Note: the identifier NCA09 has not been used for any of the noise sensitive receivers

Coffs Harbour Bypass
Noise catchment areas, sensitive land uses and noise monitoring locations
Map page - 02

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N

Legend

- Construction footprint
- Alignment
- Bridge
- Tunnel
- Study Area
- Noise catchment area
- Approved DA subdivision
- Noise monitoring location (validation)
- Noise monitoring location (baseline)
- Noise monitoring location (attended only)

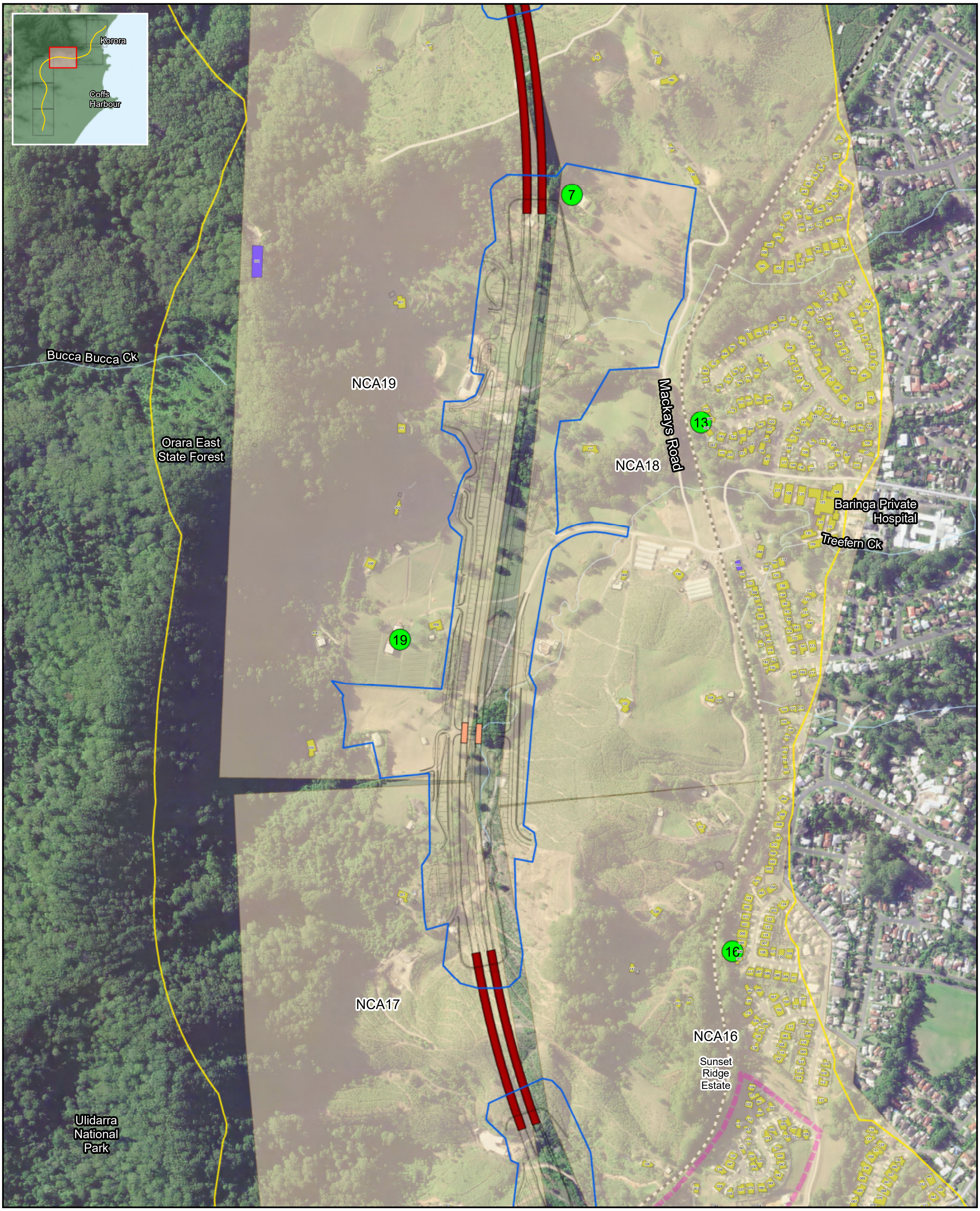
Building Classification

- Active Recreation
- Passive Recreation
- Child care facility
- Commercial
- Places of worship
- Hospital
- Industrial
- Residential
- School

Note: the identifier NCA09 has not been used for any of the noise sensitive receivers

Coffs Harbour Bypass
Noise catchment areas, sensitive land uses and noise monitoring locations
Map page - 03

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N



Legend

- Construction footprint
- Alignment
- Bridge
- Tunnel
- Study Area
- Noise catchment area
- Approved DA subdivision
- Noise monitoring location (validation)
- Noise monitoring location (baseline)
- Noise monitoring location (attended only)

Building Classification

- Active Recreation
- Passive Recreation
- Child care facility
- Commercial
- Places of worship
- Hospital
- Industrial
- Residential
- School

Note: the identifier NCA09 has not been used for any of the noise sensitive receivers

Coffs Harbour Bypass
Noise catchment areas, sensitive land uses and noise monitoring locations
Map page - 04

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N

Legend

Construction footprint
Alignment
Bridge
Tunnel
Study Area
Noise catchment area
Approved DA subdivision
Noise monitoring location (validation)
Noise monitoring location (baseline)
Noise monitoring location (attended only)

Building Classification

Active Recreation
Passive Recreation
Child care facility
Commercial
Places of worship
Hospital
Industrial
Residential
School

Note: the identifier NCA09 has not been used for any of the noise sensitive receivers

Coffs Harbour Bypass
Noise catchment areas, sensitive land uses and noise monitoring locations
Map page - 05

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N

Legend

Construction footprint
Alignment
Bridge
Tunnel
Study Area
Noise catchment area
Approved DA subdivision
Noise monitoring location (validation)
Noise monitoring location (baseline)
Noise monitoring location (attended only)

Building Classification

Active Recreation
Passive Recreation
Child care facility
Commercial
Places of worship
Hospital
Industrial
Residential
School

Note: the identifier NCA09 has not been used for any of the noise sensitive receivers

Coffs Harbour Bypass
Noise catchment areas, sensitive land uses and noise monitoring locations
Map page - 06

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N

Appendix C

Noise survey summaries

Noise Monitoring Location:	Validation 1			
Noise Monitoring Address:	498C-498D Pacific Highway, Boambee NSW 2450			
Noise Logger Type:	ARL Ngara Type 1			
Noise Logger Serial Number:	8780D0			
Noise Monitoring Period:	22/06/2016	To	30/06/2016	

- Main noise source is combined traffic from the Pacific Highway,
- Industrial noise can be heard from the industrial development north of the measurement location ~400m away maximum levels of 68 dB.
- Background noise environment is characterized by insects and birds noises.
- The main noise source are heavy vehicles driving by on Pacific Highway. Maximum noise levels between 55-60dB from compression breaking.
- Heavy vehicles driving on Pacific Highway cause maximum noise levels of 68-75dB.

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	47	45	39
L_{Aeq}	55	53	51

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	54	52
Weekend L_{Aeq}	53	48
Weekly L_{Aeq}	54	51

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
22/06/2016	3:45PM	15 minutes	52	54	69
23/06/2016	12:15AM	15 minutes	41	50	61

Photo of Noise Monitoring Location

Noise Monitoring Location:	Validation 2		
Noise Monitoring Address:	North Boambee Road, North Boambee Valley NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	8780E6		
Noise Monitoring Period:	22/06/2016	To	28/06/2016

Map of Noise Monitoring Location

- Main noise source is the traffic on N Boambee Road.
- Motor vechicles driving on N Boambee Road cause peaks of ~65dB.
- Compression breaking can be heard causing noise levels ~40 dB.
- At ~30m from N Boambee Road, light vehicles caused a measured Leq ~ 61 dB and heavy vechicles ~65 dB.
- At ~380m of N Boambee Road, a motor bike caused a noise level of ~56 dB and heavy vehicles measure around 40-50 dB.

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	32	32	31
L_{Aeq}	54	45	44

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	53	44
Weekend L_{Aeq}	51	43
Weekly L_{Aeq}	53	44

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
22/06/2016	5:30PM	15 minutes	37	49	69
23/06/2016	1:02AM	15 minutes	33	36	52

Photo of Noise Monitoring Location

Noise Monitoring Location:	Baseline 3		
Noise Monitoring Address:	170 North Boambee Road, North Boambee Valley NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	8780D3		
Noise Monitoring Period:	28/11/2016	To	12/12/2016

- Distant traffic from N.Boambee Rd with occassional truck pass by.
- Cicadas in background
- Occassional bird noise (faint)
- Distant announcement from PA.
- Constant cricket and cicada noise >40 dB
- Tree rustle distant, thunder in distance
- Dog barks

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	42	40	38
L_{Aeq}	54	57	46

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	57	52
Weekend L_{Aeq}	55	48
Weekly L_{Aeq}	56	51

Attended Noise Measurement Results

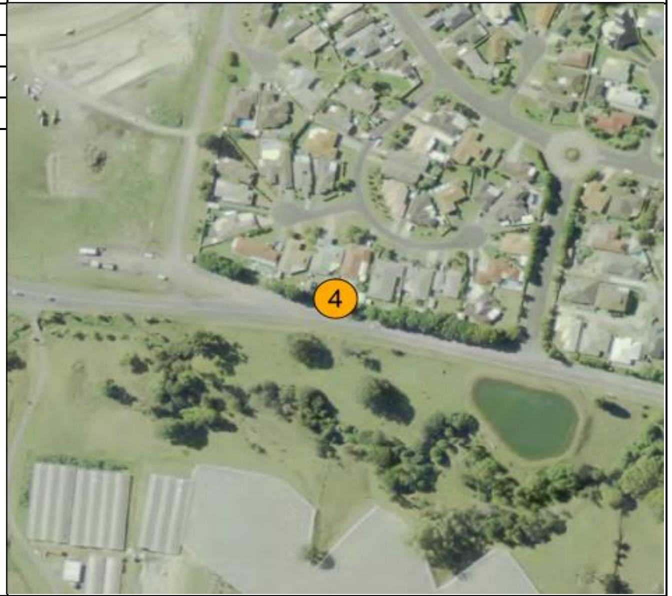
Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
28/11/2016	3:00PM	15 minutes	41	43	55
29/11/2016	10:30PM	15 minutes	42	48	74

Photo of Noise Monitoring Location

Noise Monitoring Location:	Validation 4		
Noise Monitoring Address:	12 Tamora Close, Coffs Harbour NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	8780E5		
Noise Monitoring Period:	21/06/2016	To	28/06/2016

- A solid lightweight barrier limits the property boundary and separates the backyard from Coramba Road.
- Main noise nource at the location during daytime is the traffic of heavy and light vehicles on Coramba Road. Maximum noise levels from heavy traffic are measured at 72 - 75 dB(A).
- Residential mechanical services equipment generates intermittent loud peaks of noise.
- Distant traffic noise is audible but indistinguishable. Light vehicles cause maximum noise levels between 65 - 72 dB(A).

Map of Noise Monitoring Location



Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	39	32	27
L_{Aeq}	60	56	52

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	59	52
Weekend L_{Aeq}	58	51
Weekly L_{Aeq}	59	52

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
21/06/2016	1:00PM	15 minutes	41	59	74
22/06:2016	12:15AM	15 minutes	33	49	72

Photo of Noise Monitoring Location

Noise Monitoring Location:	Validation 5		
Noise Monitoring Address:	20 Bennetts Road, Coffs Harbour NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	87807F		
Noise Monitoring Period:	21/06/2016	To	23/06/2016

- Main noise nource at the location is the traffic of heavy and light vehicles on Coramba Road.
- Maximum noise levels from heavy traffic on Coramba Road register 52 - 57 dB(A).
- At least 2 distant plane flyovers were registered during the attended measurement.
- Background noise is characterized by local fauna.
- A train pass-by was heard in the distance during attended measurement.

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	37	31	30
L_{Aeq}	48	43	42

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	47	41
Weekend L_{Aeq}	-	-
Weekly L_{Aeq}	47	41

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
21/06/2016	12:01PM	15 minutes	38	46	58
21/06/2016	11:31PM	15 minutes	33	38	54

Photo of Noise Monitoring Location

Noise Monitoring Location:	Baseline 6
Noise Monitoring Address:	263c Shephards Lane, Coffs Harbour NSW 2450
Noise Logger Type:	ARL Ngara Type 1
Noise Logger Serial Number:	87809E
Noise Monitoring Period:	22/06/2016 To 29/06/2016

- Local traffic and fauna are characteristic of the background noise consistent of rural areas.
- Occasional dog barking was observed with peak levels 46 – 50 dB (A).
- Tyre squeal was observed to originate from the south east with peak levels of 53 dB(A).
- Continuous propellar noise from an aircraft in the distance was observed from 6:40 PM – 6:43 PM, with noise levels of 40-45 dB(A).
- Attended measurement of background noise ranging from 32 - 33 dB(A).
- Occasional compression braking was observed in the distance from the east, contributing to peak noise levels of 35 dB(A).
- Truck engine noise from the residential area to the south east resulted in occasional peaks of 40 dB(A).

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	28	28	28
L_{Aeq}	47	47	47

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	47	48
Weekend L_{Aeq}	47	46
Weekly L_{Aeq}	47	47

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
22/06/2016	6:30PM	15 minutes	30	36	65
22/06/2016	11:30PM	15 minutes	32	34	42

Photo of Noise Monitoring Location

Noise Monitoring Location:	Baseline 7
Noise Monitoring Address:	191 Mackays Road, Coffs Harbour NSW 2450
Noise Logger Type:	ARL Ngara Type 1
Noise Logger Serial Number:	878012
Noise Monitoring Period:	22/06/2016 To 30/06/2016

- Traffic noise generally east of location measured at 37dB(A). Occasional vehicle noise on gravel driveway was observed from the neighbouring property to the west at 40dB(A).
- Occasional peaks of 70-76 dB(A) were recorded from a dog barking
- Attended measurement of background noise generally between 32 -35 dB(A)
- Occasional traffic noise from the residential area to the south east, resulting in levels of 38 dB(A).
- The dominant noise source was mid to high frequencies consistent with tyre noise. Distant low frequency (80Hz and below) noise was observed, arriving from the east.
- Occasional animal noises in the surrounding area introduce peak levels of 43 dB(A).
- Freight train travelling west on the railway to the south. Three minutes of train noise was observed ranging from 45-50 dB(A) with a peak of 57 dB(A) corresponding to an air horn blast.

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	28	30	28
L_{Aeq}	46	40	38

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	45	41
Weekend L_{Aeq}	45	36
Weekly L_{Aeq}	45	40

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
22/06/2016	3:30PM	15 minutes	35	52	77
22/06/2016	10:15PM	15 minutes	33	42	63

Photo of Noise Monitoring Location

Noise Monitoring Location:	Validation 8		
Noise Monitoring Address:	429A-429B Pacific Highway North, Coffs Harbour NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	878060		
Noise Monitoring Period:	29/11/2016	To	6/12/2016

- Constant traffic noise from pacific hwy
- Truck pass-by
- Crickets in background
- High number of truck pass-bys

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	65	59	40
L_{Aeq}	75	74	71

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	75	72
Weekend L_{Aeq}	74	68
Weekly L_{Aeq}	75	71

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
29/11/2016	10:45AM	15 minutes	65	74	95
30/11/2016	1:00PM	15 minutes	44	70	87

Photo of Noise Monitoring Location

Noise Monitoring Location:	Validation 9		
Noise Monitoring Address:	25 Fern Tree Place, Korora NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	878079		
Noise Monitoring Period:	21/06/2016	To	29/06/2016

- The main noise source was traffic on the Pacific Highway and included tyre noise from light vehicles (generally 58 -61 dB (A)) as well as engine noise from heavy vehicles generally 65-70 dB (A) predominantly from southbound traffic .
- A peak noise level of 76 dB (A) was recorded from a southbound heavy vehicle.
- Peak levels of 74 and 77 dB (A) were recorded from heavy vehicles in the southbound lanes.
- Attended measurements observed peak levels from heavy vehicles generally 64-68 dB(A).
- A peak level of 72 dB(A) was recorded from a heavy vehicle in the southbound lane.
- Compression braking was observed from heavy vehicles travelling northbound (62 – 67 dB(A)).
- Ambient noise consisted of traffic to the north.
- Additional attended measurement observed typical noise levels from heavy vehicles of 65 – 73 dB(A).

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	48	40	34
L_{Aeq}	57	56	54

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	58	55
Weekend L_{Aeq}	56	50
Weekly L_{Aeq}	57	54

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
21/06/2016	6:00PM	15 minutes	49	58	76
22/06/2016	12:30AM	15 minutes	41	54	72

Photo of Noise Monitoring Location

Noise Monitoring Location:	Validation 10		
Noise Monitoring Address:	1 Coachmans Close, Sapphire Beach NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	8780EA		
Noise Monitoring Period:	21/06/2016	To	29/06/2016

- The main noise source is traffic on the Pacific Highway with a greater proportion of heavy vehicles with maximum noise levels ranging from 75-80 dB (A).
- Heavy vehicles generally peaked 77-78 dB (A) in both directions
- Peak recorded, 84 dB (A), from a semi trailer in the Northbound centre lane.
- Compression braking was observed with a truck slowing towards a right hand turning lane (northbound) to the north. Peak of 76 dB (A).
- Tyre noise from light vehicles was generally at 60 – 65 dB (A) with heavy vehicles typically at 64 – 68 dB (A).
- Peak levels of 69 and 70 dB (A) were recorded from heavy vehicles travelling in the North bound lanes.
- 82 dB (A) was recorded from a heavy vehicle travelling along the northbound lanes.
- A peak level of 82 dB(A) was due to heavy vehicle compression braking travelling in the southbound lane.

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	60	50	42
L_{Aeq}	68	67	64

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	68	65
Weekend L_{Aeq}	67	61
Weekly L_{Aeq}	68	65

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
21/06/2016	11:45AM	15 minutes	61	69	84
21/06/2016	11:45PM	15 minutes	45	65	82

Photo of Noise Monitoring Location

Noise Monitoring Location:	Validation 11		
Noise Monitoring Address:	539 Pacific Highway, Boambee NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	87807B		
Noise Monitoring Period:	22/06/2016	To	28/06/2016

- The main noise source is vehicle traffic on Pacific Highway. Heavy vehicle causes maximum noise levels at around 74-80 dB.
- Vibration from heavy vehicles can be perceived at the noise monitoring location.
- Background noise is influenced by noise of cars driving away from the measurement location and a constant traffic hum is part of the noise environment.
- The road surface in front of the caravan park is concrete.
- During night-time attended measurements, Pacific Highway is the main noise source with truck pass-bys causing maximum noise levels at 70-75dB.

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	58	51	39
L_{Aeq}	65	64	61

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	65	62
Weekend L_{Aeq}	64	58
Weekly L_{Aeq}	65	61

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
22/06/2016	1:00PM	15 minutes	56	63	80
22/06/2016	11:30PM	15 minutes	47	62	76

Photo of Noise Monitoring Location

Noise Monitoring Location:	Baseline 12		
Noise Monitoring Address:	19 Gillon Street, Coffs Harbour NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	8780C7		
Noise Monitoring Period:	22/06/2016	To	28/06/2016

- Background noise was characterized by animal sounds (insects and domestic animals from the neighbouring properties).
- Maximum noise levels registered were caused by the neighbouring property's dog barking.
- Traffic is heard as a constant distant hum.
- Background noise environment was generally quiet with seldom insect, bird noises and distant dog barks
- A train pass-by was recorded during the night-time attended measurement causing maximum noise levels of 52dB

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	28	30	30
L_{Aeq}	44	43	42

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	45	43
Weekend L_{Aeq}	43	41
Weekly L_{Aeq}	45	42

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
22/06/2016	11:00AM	15 minutes	29	39	66
22/06/2016	10:15PM	15 minutes	36	41	52

Photo of Noise Monitoring Location

Noise Monitoring Location:	Baseline 13
Noise Monitoring Address:	15 Jenson Close, Coffs Harbour NSW 2450
Noise Logger Type:	ARL Ngara Type 1
Noise Logger Serial Number:	8780E8
Noise Monitoring Period:	21/06/2016 To 28/06/2016

- Background noise is characterized by birds chirping and distant dog barks.
- A bus driving alongside the rail tracks caused a maximum noise level of 56 dB(A)
- Freight train caused peaks of 73 dB(A).
- The landowner reported an average of 3 passenger trains and 5 freight trains during the day.

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	31	31	29
L_{Aeq}	48	45	48

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	48	48
Weekend L_{Aeq}	46	47
Weekly L_{Aeq}	48	48

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
21/06/2016	3:16PM	15 minutes	34	42	60
22/06/2016	1:30AM	15 minutes	35	52	71

Photo of Noise Monitoring Location

Noise Monitoring Location:	Validation 14		
Noise Monitoring Address:	675 Pacific Highway, Korora NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	8780E6		
Noise Monitoring Period:	28/11/2016	To	12/12/2016

- Truck pass-by 74 dB.
- Main noise source - traffic on pacific highway.
- Cicadas in background
- Truck passby 80 dBA
- Truck passbys coasting down hill
- High number of truck pass-bys

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	55	51	42
L_{Aeq}	65	65	62

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	66	64
Weekend L_{Aeq}	65	59
Weekly L_{Aeq}	65	63

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
28/11/2016	4:00PM	15 minutes	60	67	80
29/11/2016	11:30PM	15 minutes	45	63	79

Photo of Noise Monitoring Location

Noise Monitoring Location:	Validation 15			
Noise Monitoring Address:	3 Korora School Road, Korora NSW 2450			
Noise Logger Type:	ARL Ngara Type 1			
Noise Logger Serial Number:	8780D0			
Noise Monitoring Period:	29/11/2016	To	12/12/2016	

Map of Noise Monitoring Location

- Constant traffic noise from Pacific Highway over noise barrier.
- Insects in background - constant
- Heavy vehical pass-bys - frequent.
- Car pass-by on school access road.
- Kids playing in distance.
- Seldom compression brake burst.
- Mechanical noise for building intermitant (pulsating), audible only when not masked by traffic noise from Pacific Highway.

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	52	46	37
L_{Aeq}	59	59	55

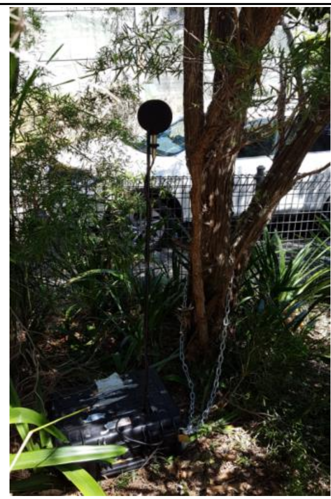
Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	60	57
Weekend L_{Aeq}	57	52
Weekly L_{Aeq}	59	56

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
29/11/2016	10:00AM	15 minutes	53	57	69
30/11/2016	12:00AM	15 minutes	36	55	73

Photo of Noise Monitoring Location



Noise Monitoring Location:	Baseline 16		
Noise Monitoring Address:	19 Rigoni Cresent, Coffs Harbour NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	8780D1		
Noise Monitoring Period:	21/06/2016	To	27/06/2016

- Background noise is characterised by local fauna and residential occupancy.
- Presumably the main noise source are trains passing at the back of the property.
- There is direct line of sight to the rail tracks east of the property.
- Hardly any road traffic noise was heard.

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	27	27	25
L_{Aeq}	51	51	53

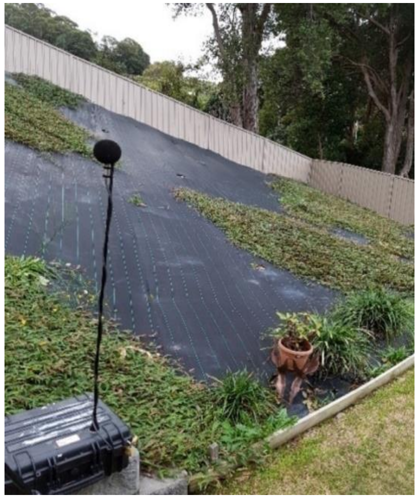
Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	52	53
Weekend L_{Aeq}	49	53
Weekly L_{Aeq}	52	53

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
21/06/2016	4:15PM	15 minutes	30	50	71
22/06/2016	1:00AM	15 minutes	31	34	47

Photo of Noise Monitoring Location



Noise Monitoring Location:	Baseline 17		
Noise Monitoring Address:	170 West Korora Road, Coffs Harbour NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	878042		
Noise Monitoring Period:	22/06/2016	To	27/06/2016

- Background noise typical of rural areas
- Background noise levels ranging from 52 – 56 dB(A)
- Traffic noise is not significant. Car pass by on Korora Road peaks at 38-40 dB

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	30	37	30
L_{Aeq}	55	45	42

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	51	44
Weekend L_{Aeq}	41	35
Weekly L_{Aeq}	49	42

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
23/06/2016	12:15AM	15 minutes	32	36	56
27/06/2016	5:15PM	15 minutes	42	49	57

Photo of Noise Monitoring Location

Noise Monitoring Location:	Baseline 18
Noise Monitoring Address:	111 Bruxner Park Rd (FROM GOOGLE EARTH)
Noise Logger Type:	ARL Ngara Type 1
Noise Logger Serial Number:	878000
Noise Monitoring Period:	21/06/2016 To 28/06/2016

- The main noise source is traffic from the Pacific Highway to the north east and south east.
- Light vehicle tyre noise was audible however heavy vehicle engine noise contributed most to typical peak noise levels, 52-53 dB (A) and peak level of 57 dB (A).
- Peak levels of 62 and 64 dB (A) were recorded from light vehicles travelling along Bruxner Park road.
- Attended measurements at this location observed maximum levels of 52-54 dB from heavy vehicles travelling along northbound lanes on the Pacific Highway.

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	43	38	34
L_{Aeq}	51	47	46

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	50	46
Weekend L_{Aeq}	49	44
Weekly L_{Aeq}	50	45

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
21/06/2016	7:30PM	15 minutes	43	48	65
22/06/2016	1:15AM	15 minutes	37	44	56

Photo of Noise Monitoring Location

Photograph not available

Noise Monitoring Location:	Baseline 19
Noise Monitoring Address:	133B Mackays Road, Coffs Harbour NSW 2450
Noise Logger Type:	ARL Ngara Type 1
Noise Logger Serial Number:	878061

Noise Monitoring Period:	22/06/2016	To	30/06/2016

- Noise sources include heavy vehicles (servicing a banana plantation) on unsealed roads 600m to the west 40-44 dB(A).
- Generally the ambient noise is consistent with rural areas and occasional traffic noise.
- Peak noise levels from heavy vehicle using compression brakes – 49-53 dB(A) ~600m from the west.
- Occaisional peak noise levels from traffic to the south ranged from 40-44 dB(A).
- A freight train travelling west along the railway was observed for 3 minutes, with constant levels ranging 47-50 dB(A) and a peak level of 59 dB(A). The low and mid frequencies were dominant on approach, with increasing high frequency content over time due to wheel screech as the track bends to the south east and south west of the location. After the locomotive has passed, frequent transients of carriage wheels on the tracks are occasionally heard.

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	26	29	28
L_{Aeq}	56	37	45

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	55	46
Weekend L_{Aeq}	44	37
Weekly L_{Aeq}	54	45

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
22/06/2016	4:46PM	15 minutes	36	41	53
22/06/2016	10:45PM	15 minutes	31	42	59

Photo of Noise Monitoring Location

Noise Monitoring Location:	Baseline 20		
Noise Monitoring Address:	18 Anniversary Place, Coffs Harbour NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	87809F		
Noise Monitoring Period:	22/06/2016	To	28/06/2016

- The background noise is consistent of rural areas.
- Tolling bells were heard in the distance causing noise levels of 41 dB.
- Occasional vehicle driving on Anniversary Plaza caused noise levels up to 59 dB.
- Distant traffic noise from heavy vechicles cause noise levels between 40-45 dB.

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	31	30	30
L_{Aeq}	44	38	39

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	45	40
Weekend L_{Aeq}	42	36
Weekly L_{Aeq}	45	39

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
22/06/2016	12:00PM	15 minutes	32	39	59
22/06/2016	11:00PM	15 minutes	36	39	49

Photo of Noise Monitoring Location

Noise Monitoring Location:	Baseline 21		
Noise Monitoring Address:	18 Anniversary Place, Coffs Harbour NSW 2450		
Noise Logger Type:	ARL Ngara Type 1		
Noise Logger Serial Number:	8780D1		
Noise Monitoring Period:	28/11/2016	To	11/12/2016

- Cicadas in the background peak
- Traffic noise is rarely heard (masked by the wind), nearest road is North Boambee.
- Truck passby - 60 dB
- Only about 3-5 vehicles passed by during measurement.
- Distant truck noises

Map of Noise Monitoring Location

Ambient Noise Logging Results – CNVG Defined Time Periods

Noise Level (dBA)	Time Period		
	Daytime (0700 - 1800)	Evening (1800 - 2200)	Night-Time (2200 - 0700)
RBL	41	38	35
L_{Aeq}	58	62	52

Ambient Noise Logging Results – RNP Defined Time Periods

Noise Level (dBA)	Time Period	
	Daytime (0700 - 2200)	Night-Time (2200 - 0700)
Weekday L_{Aeq}	60	57
Weekend L_{Aeq}	58	51
Weekly L_{Aeq}	60	56

Attended Noise Measurement Results

Date	Start Time	Duration	Noise Level (dBA)		
			L_{A90}	L_{Aeq}	L_{Amax}
28/11/2016	1:00PM	15 minutes	51	59	74
29/11/2016	10:00PM	15 minutes	37	43	66

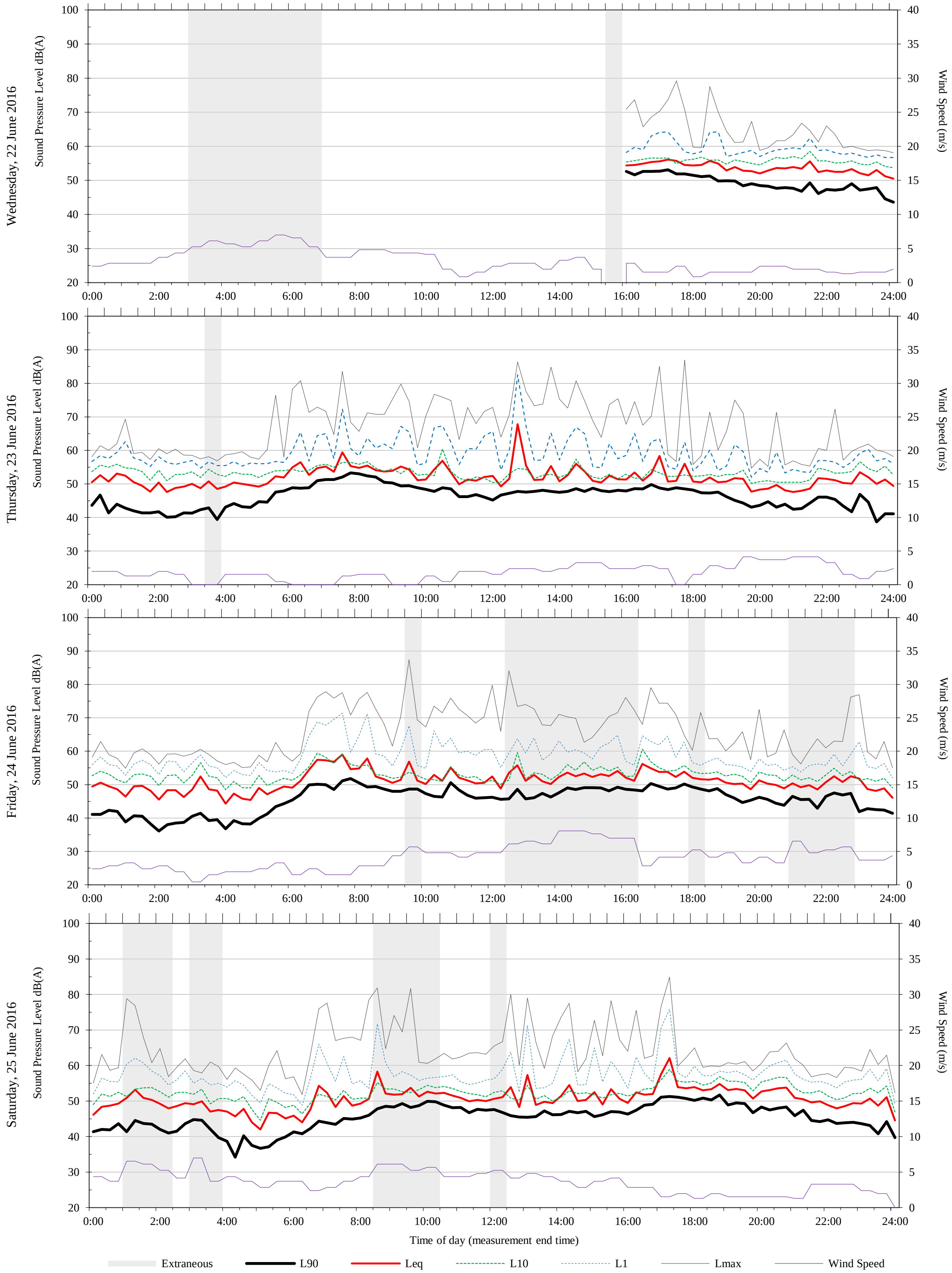
Photo of Noise Monitoring Location

Appendix D

Noise monitoring graphs

Unattended monitoring: 1 - Validation (Free Field)

ARUP



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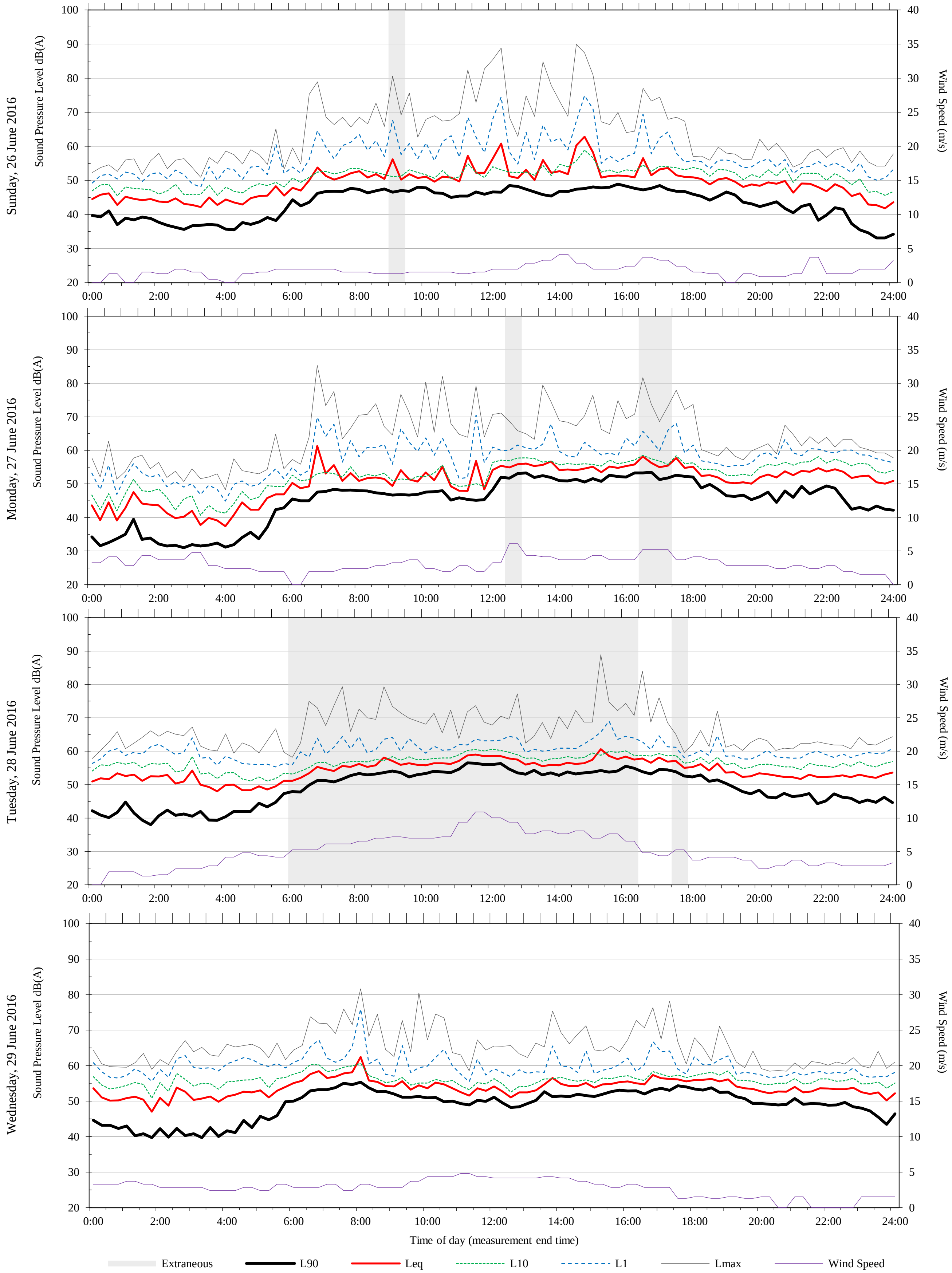

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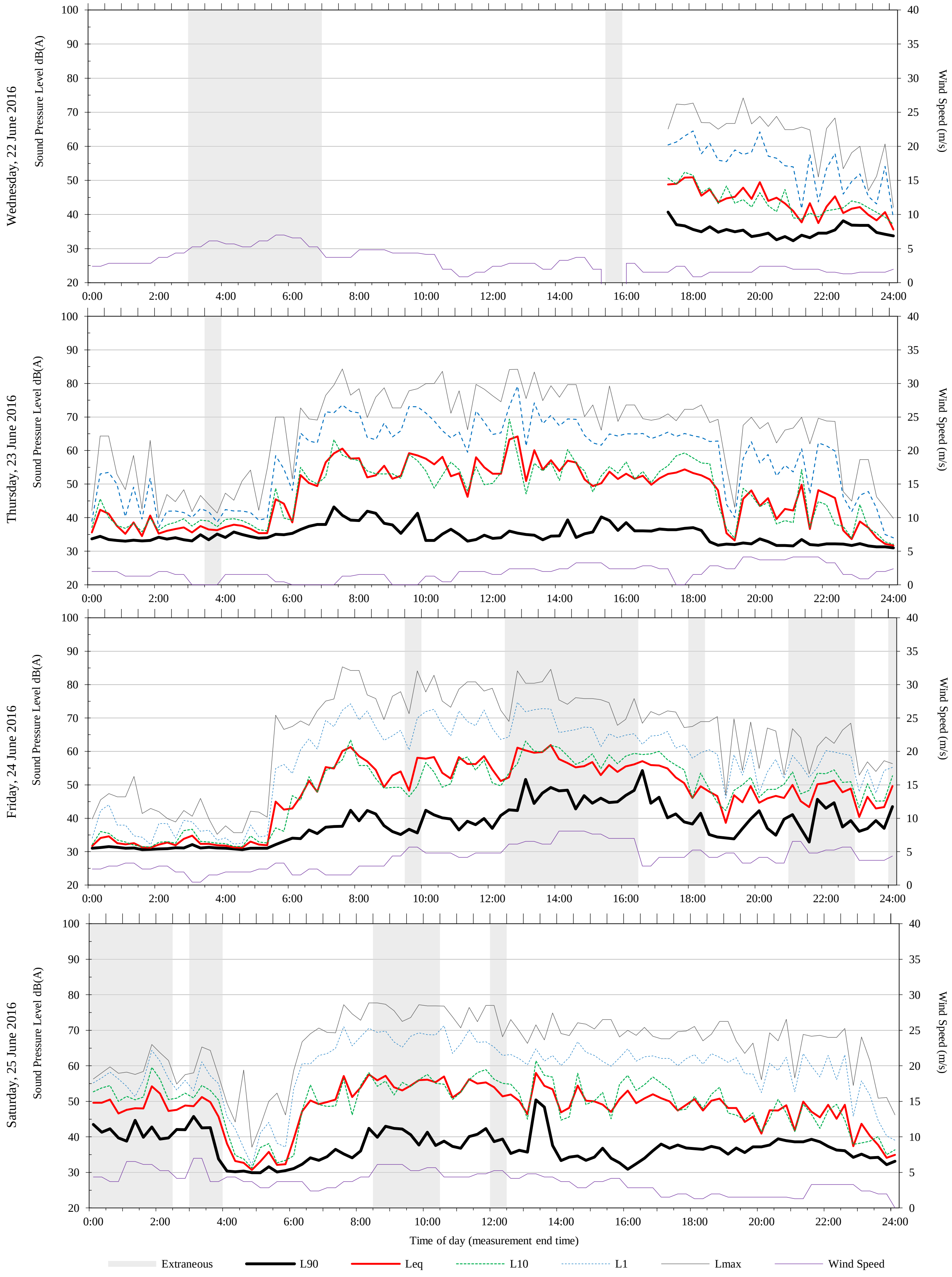

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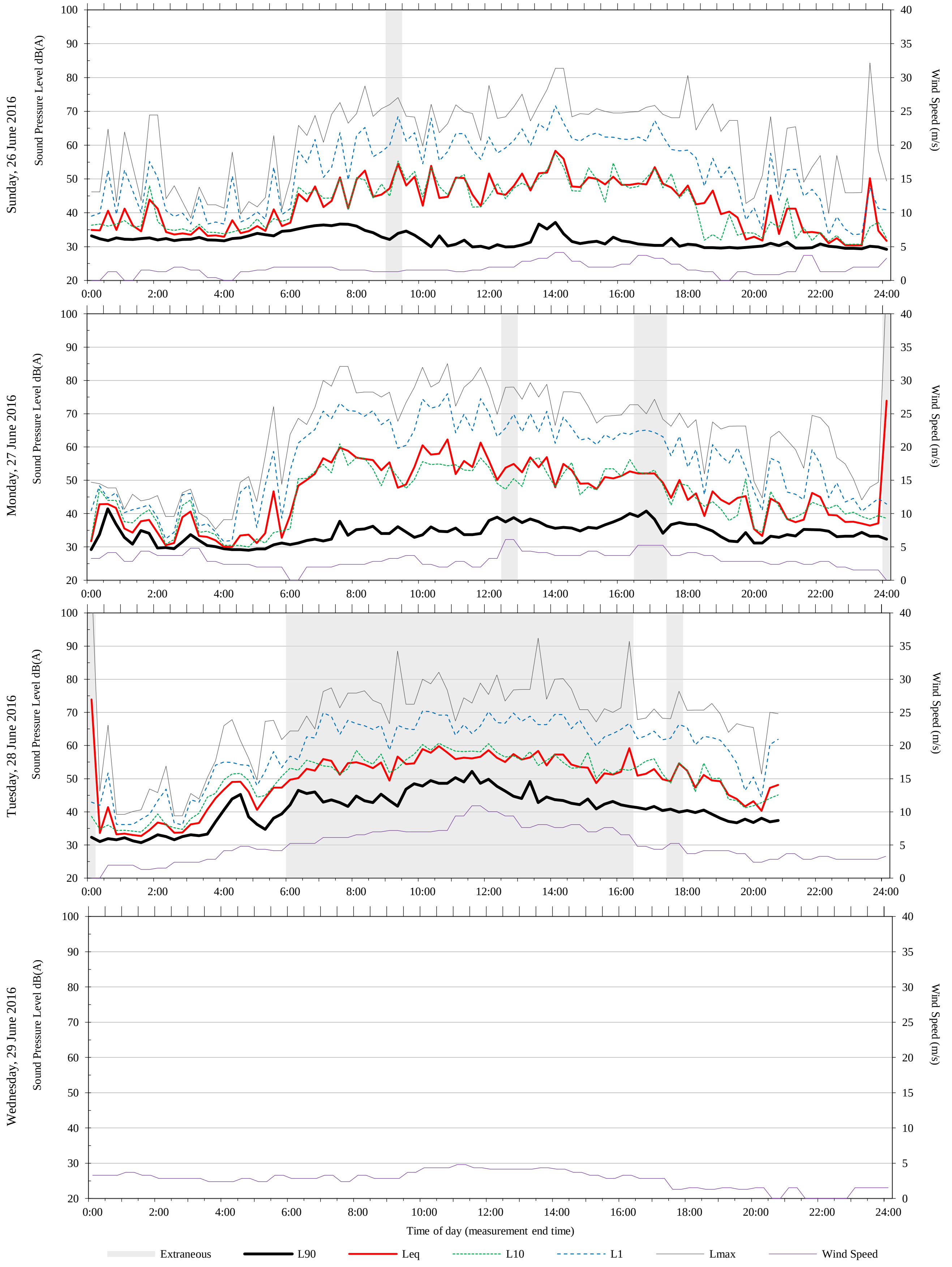

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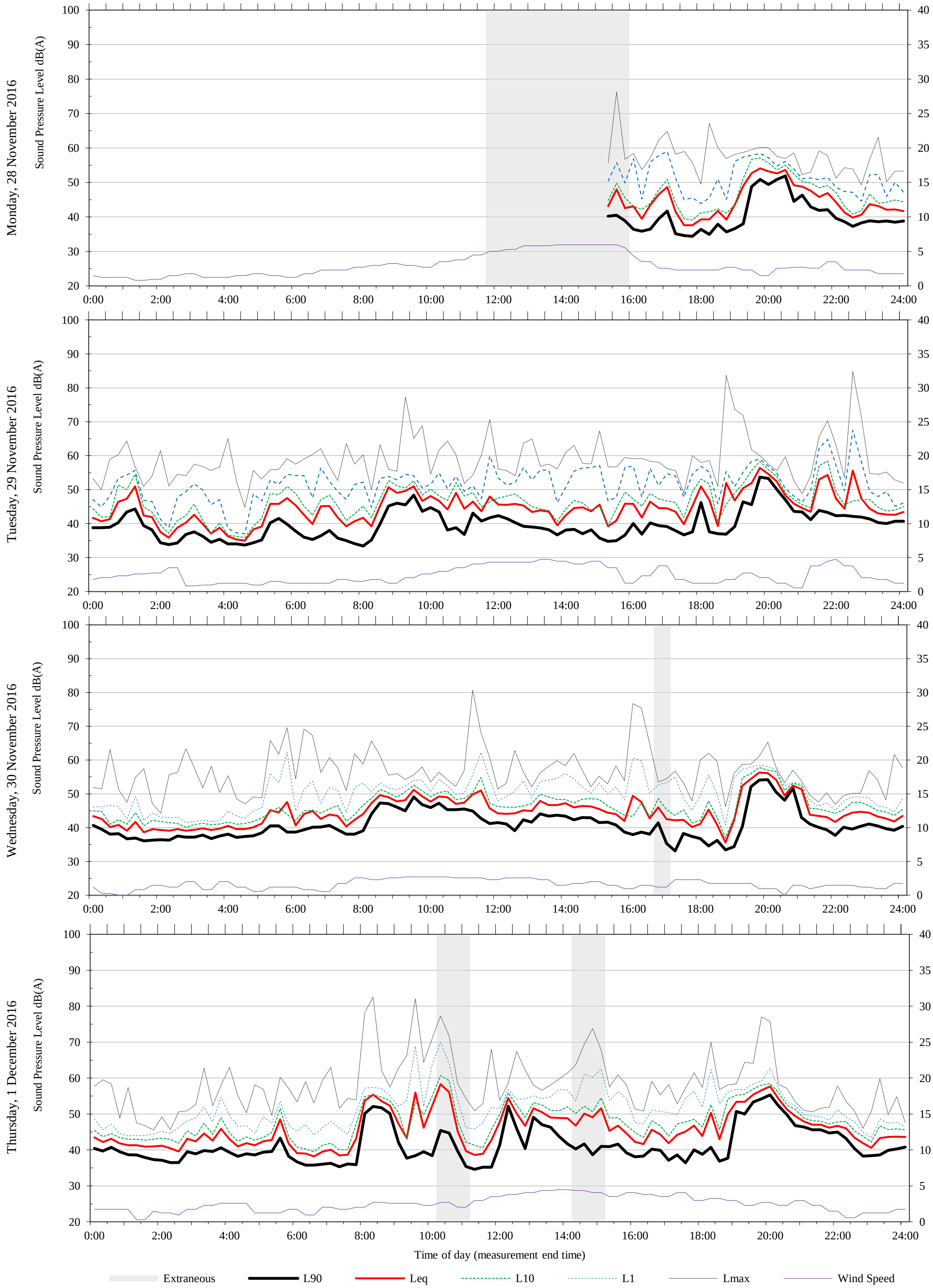

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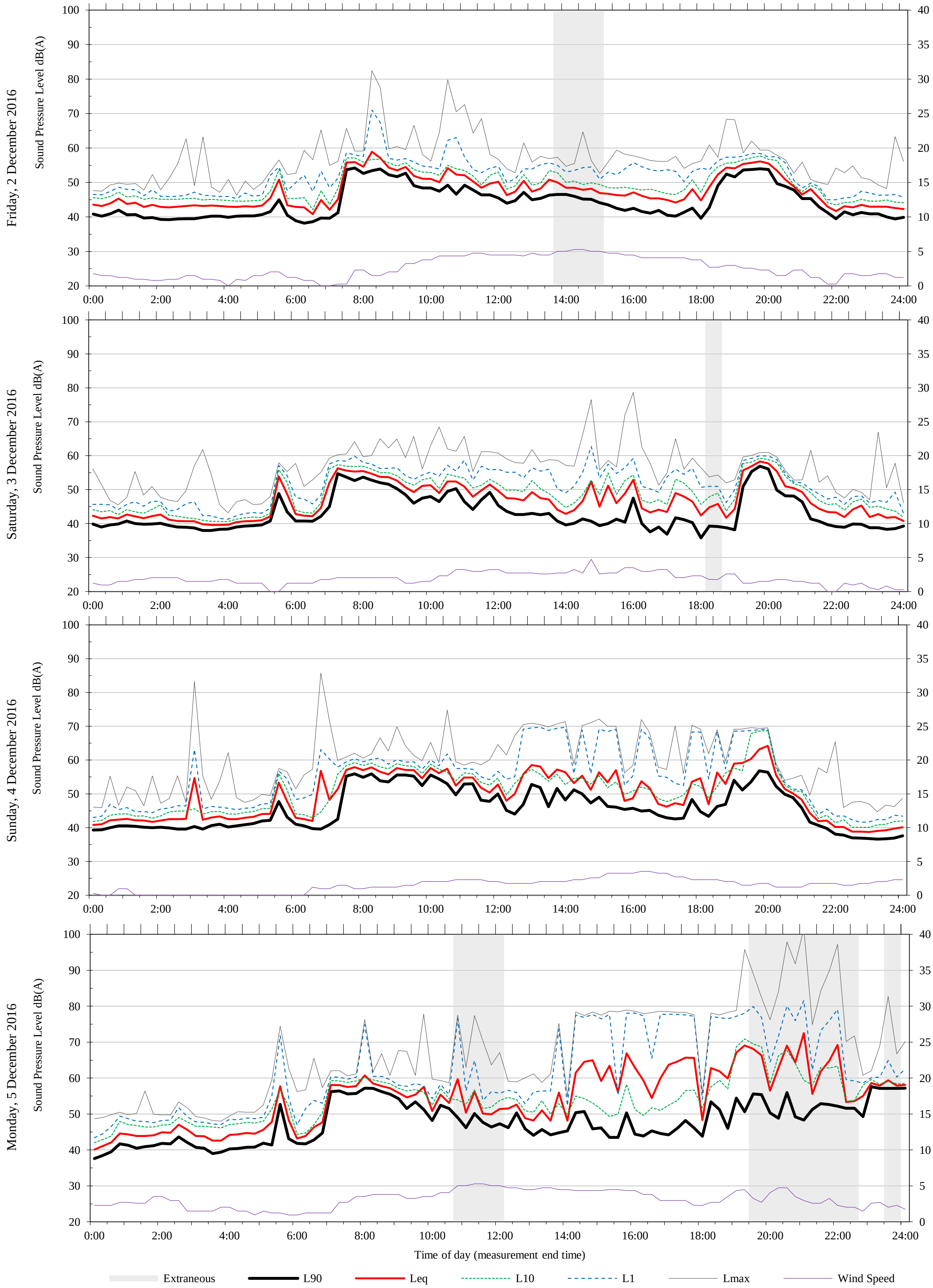

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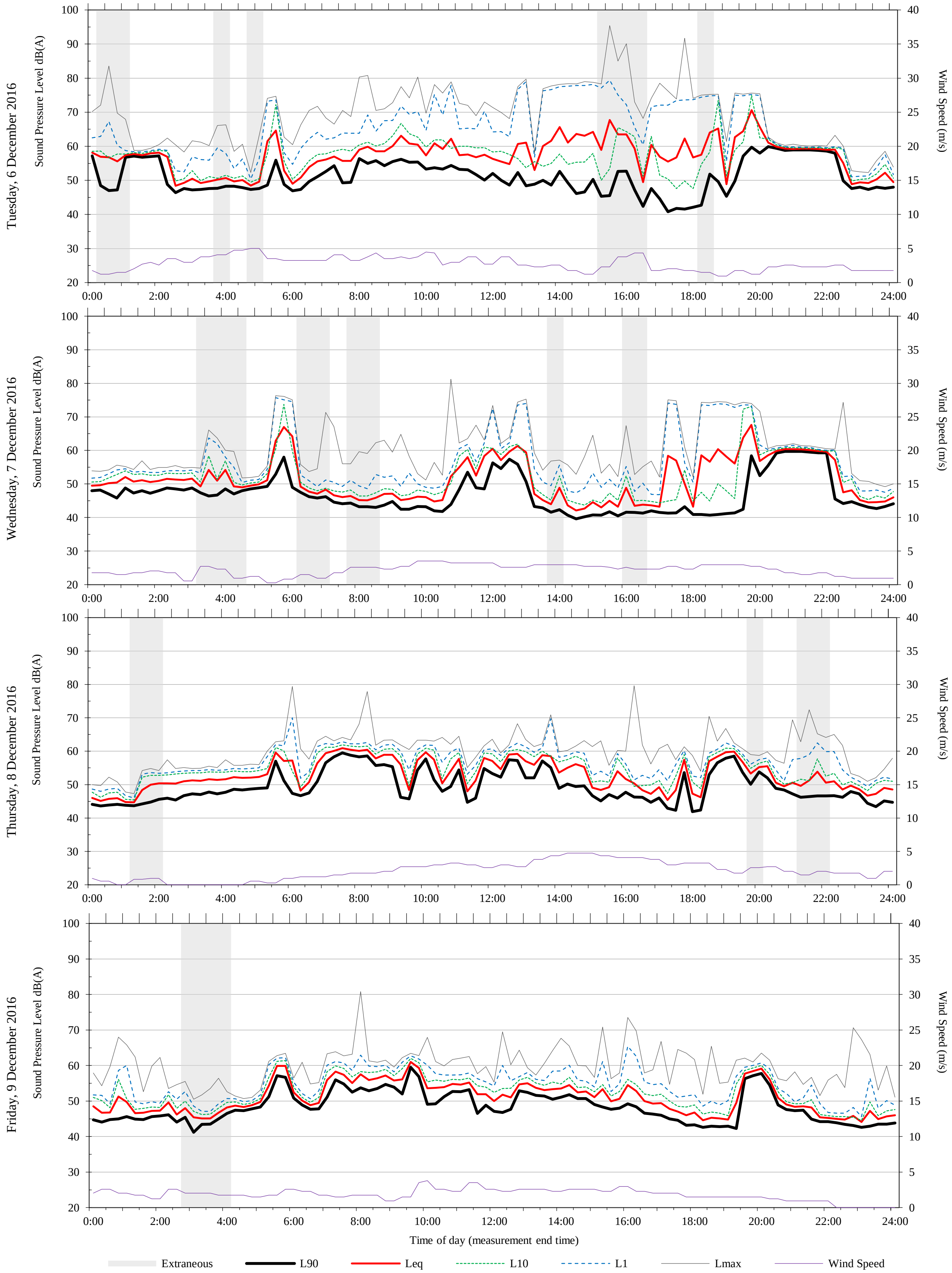

Unattended monitoring: 3 - Baseline (Free Field)

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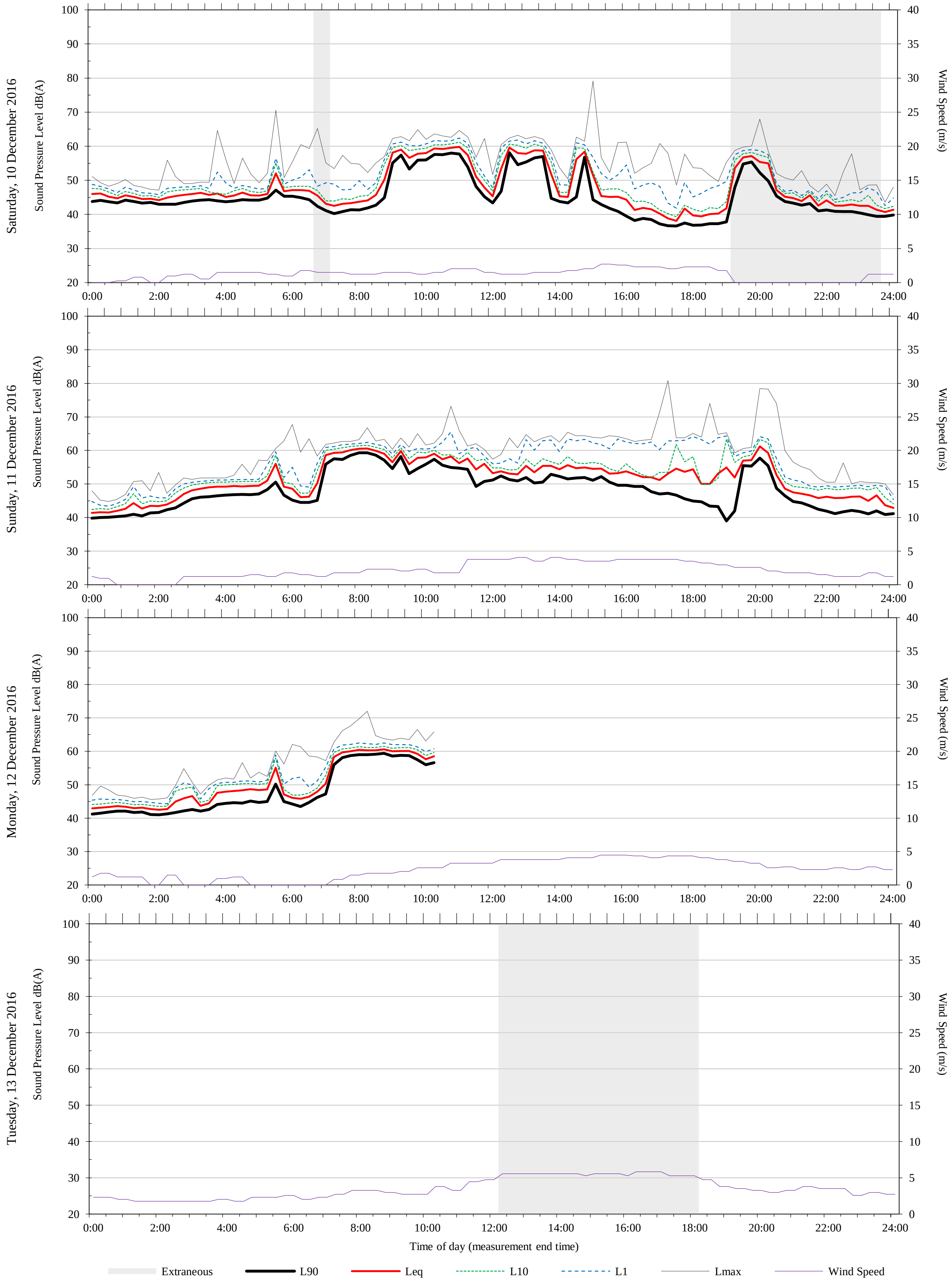

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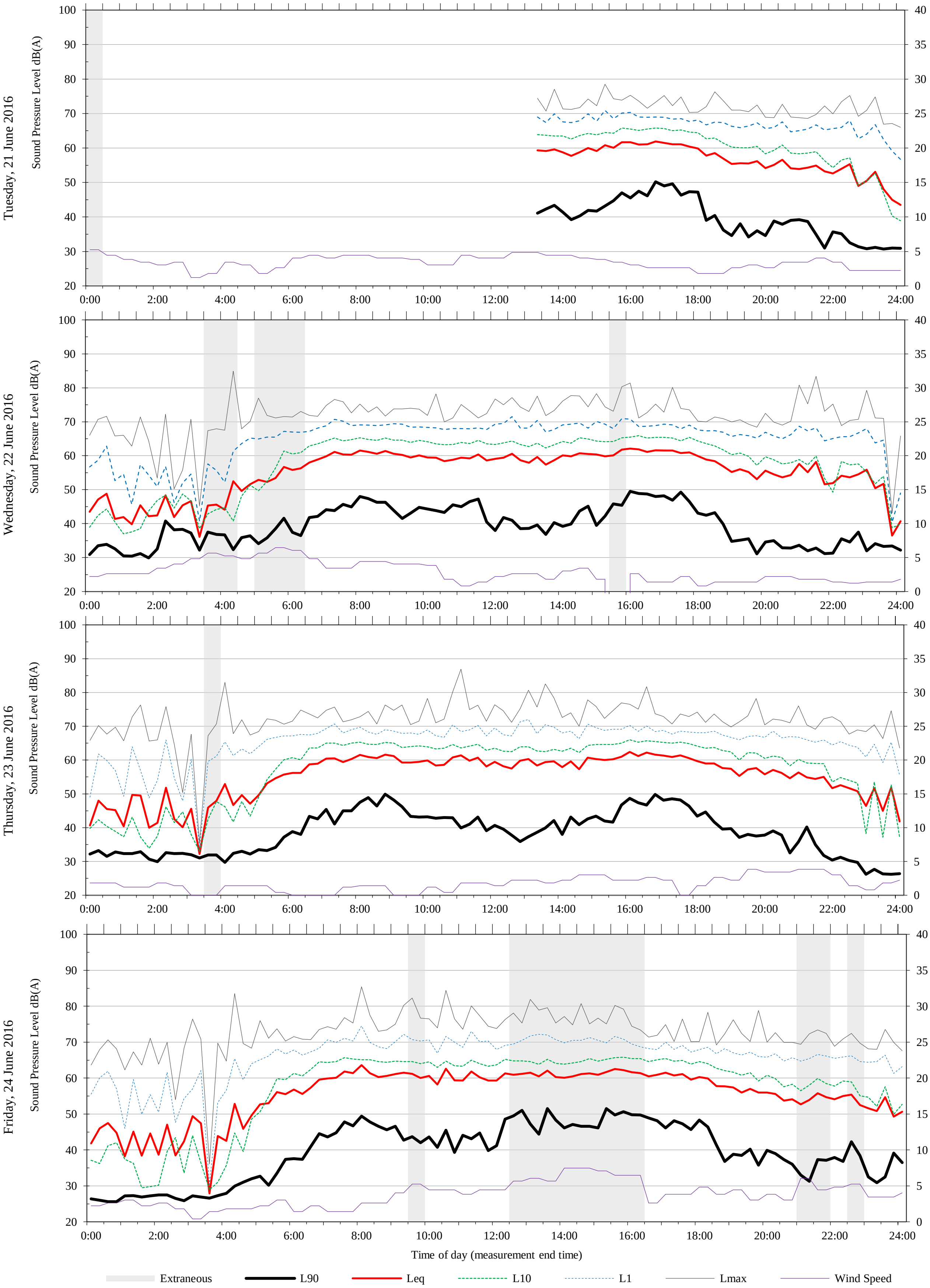

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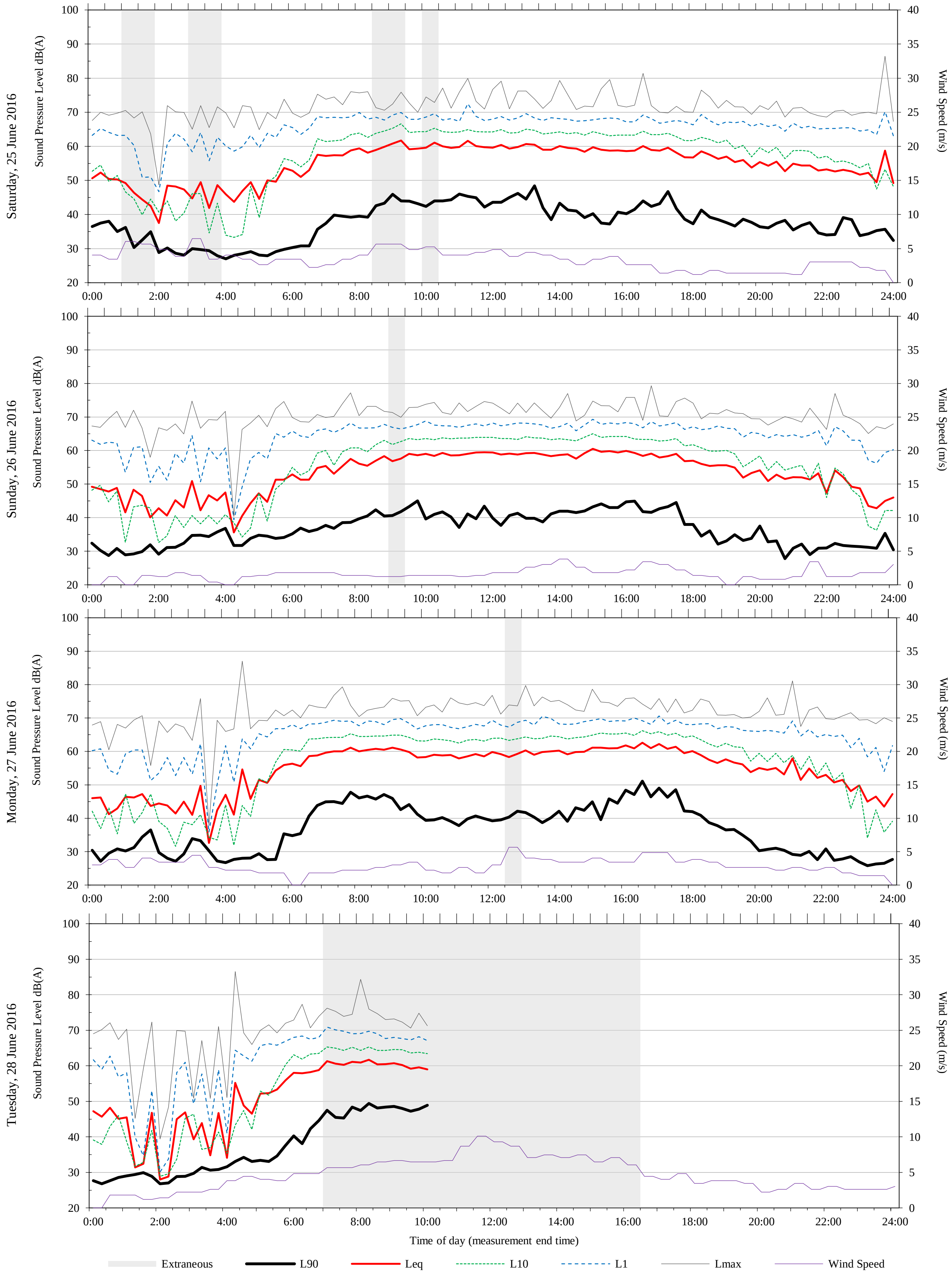

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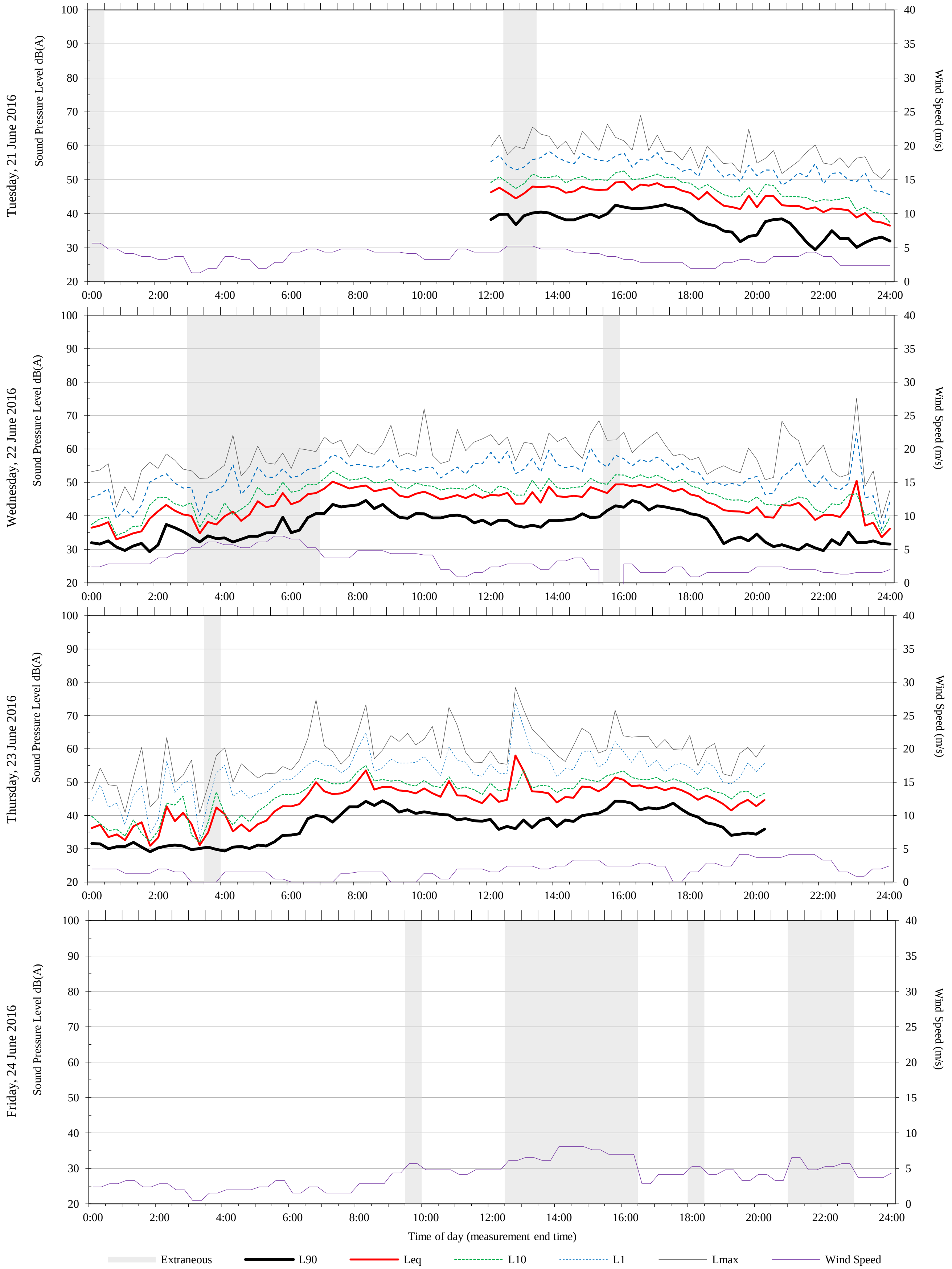

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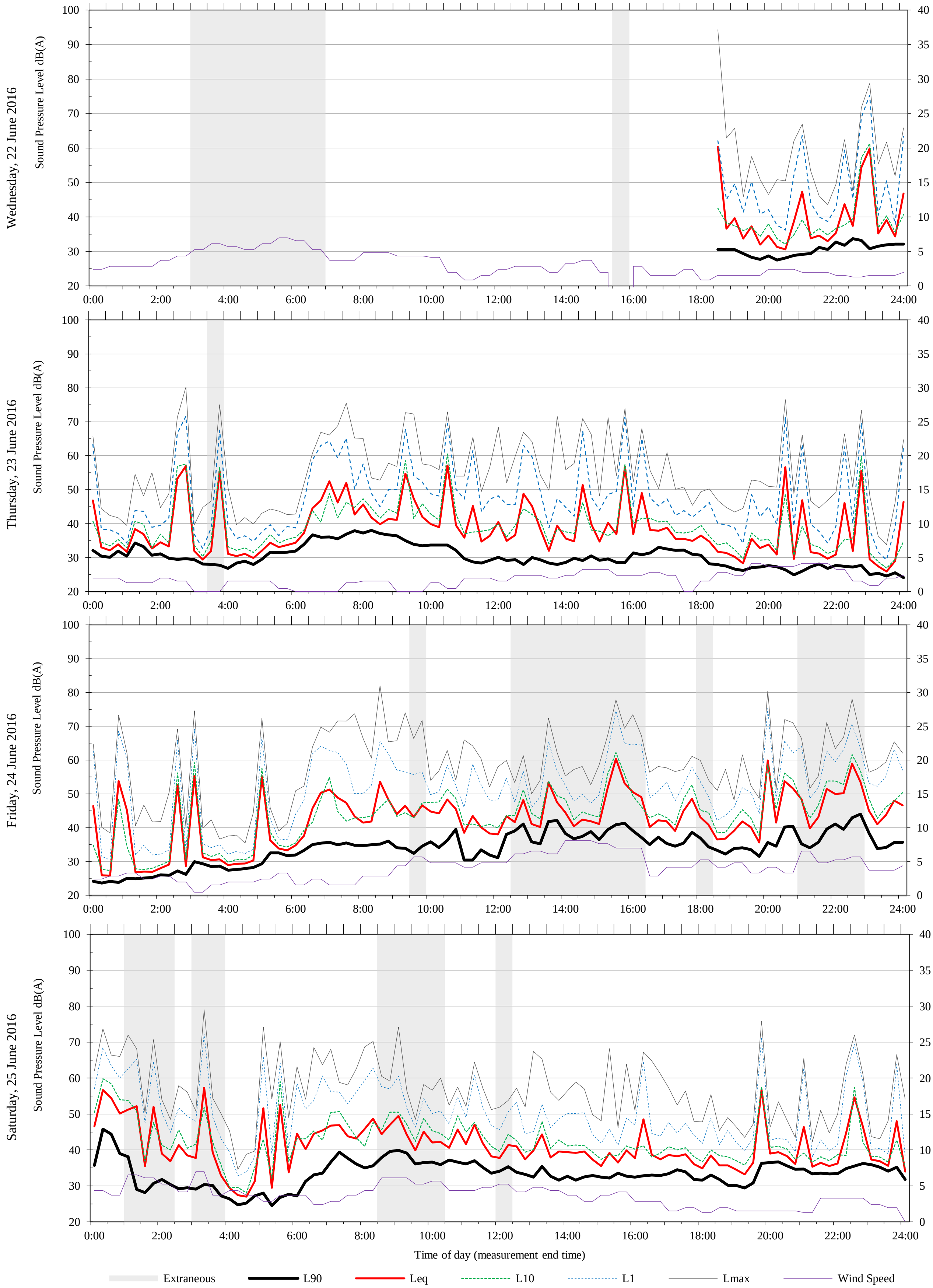

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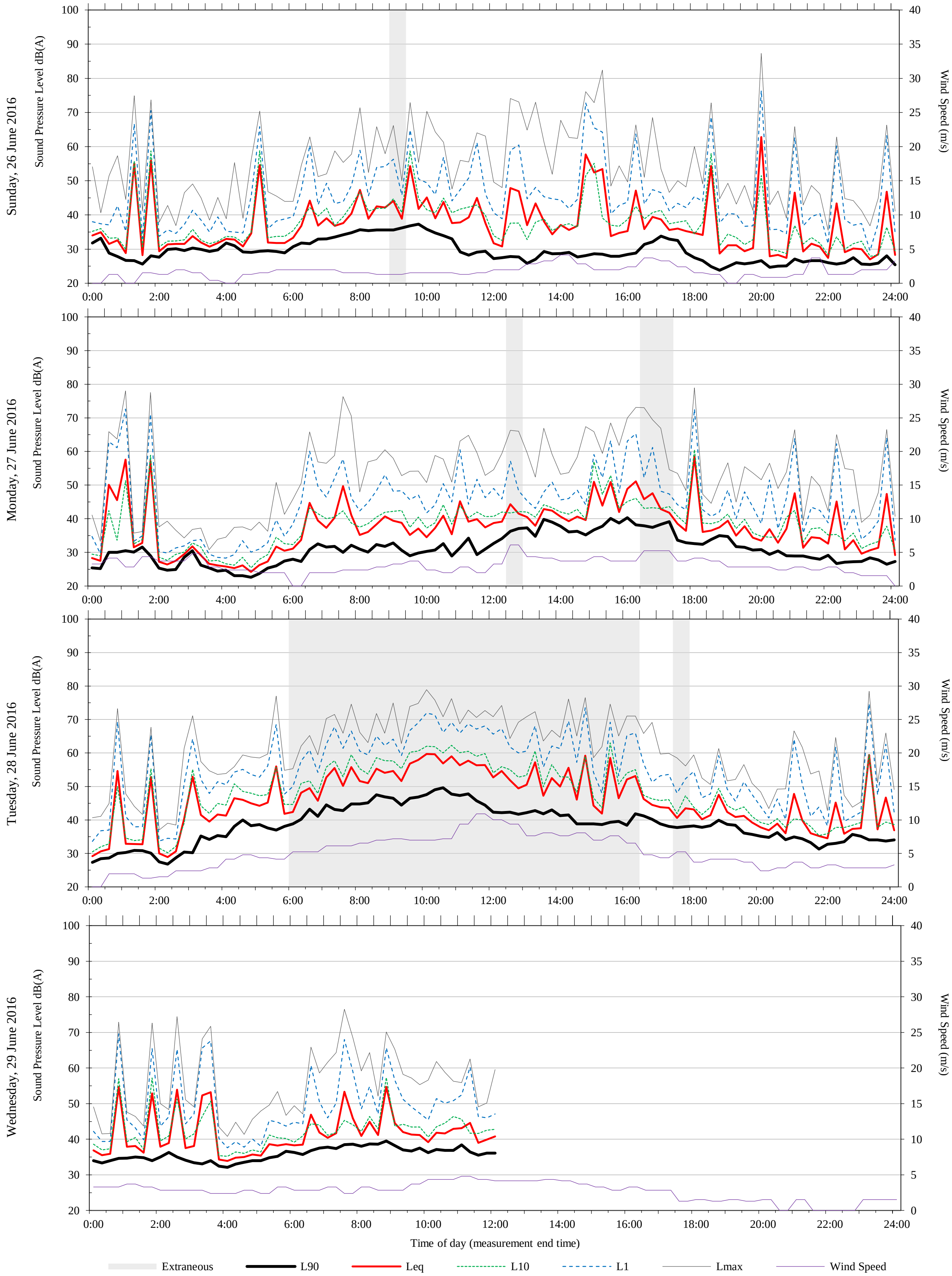

Unattended monitoring: 7 - Baseline (Free Field)

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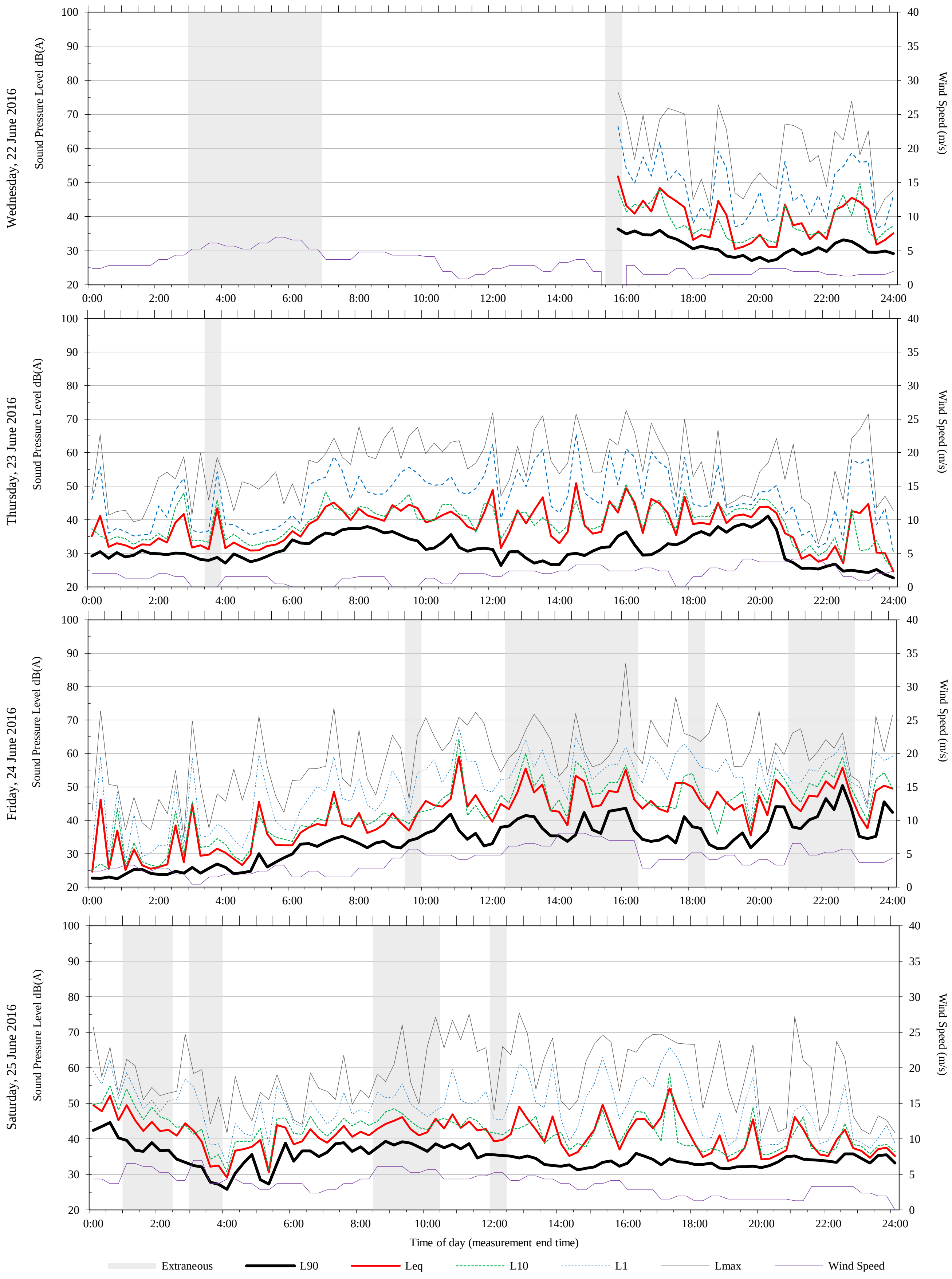

Unattended monitoring: 7 - Baseline (Free Field)

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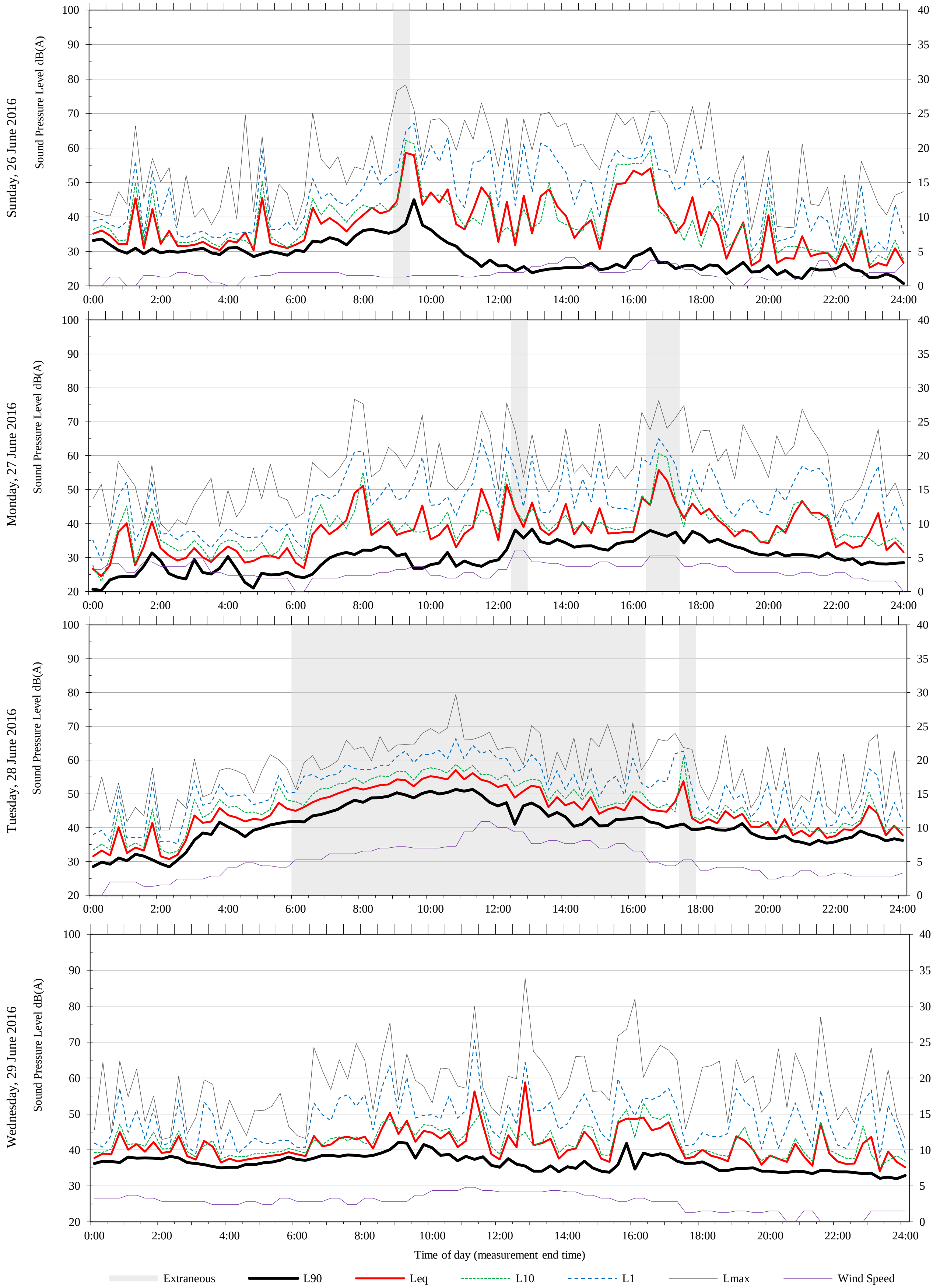

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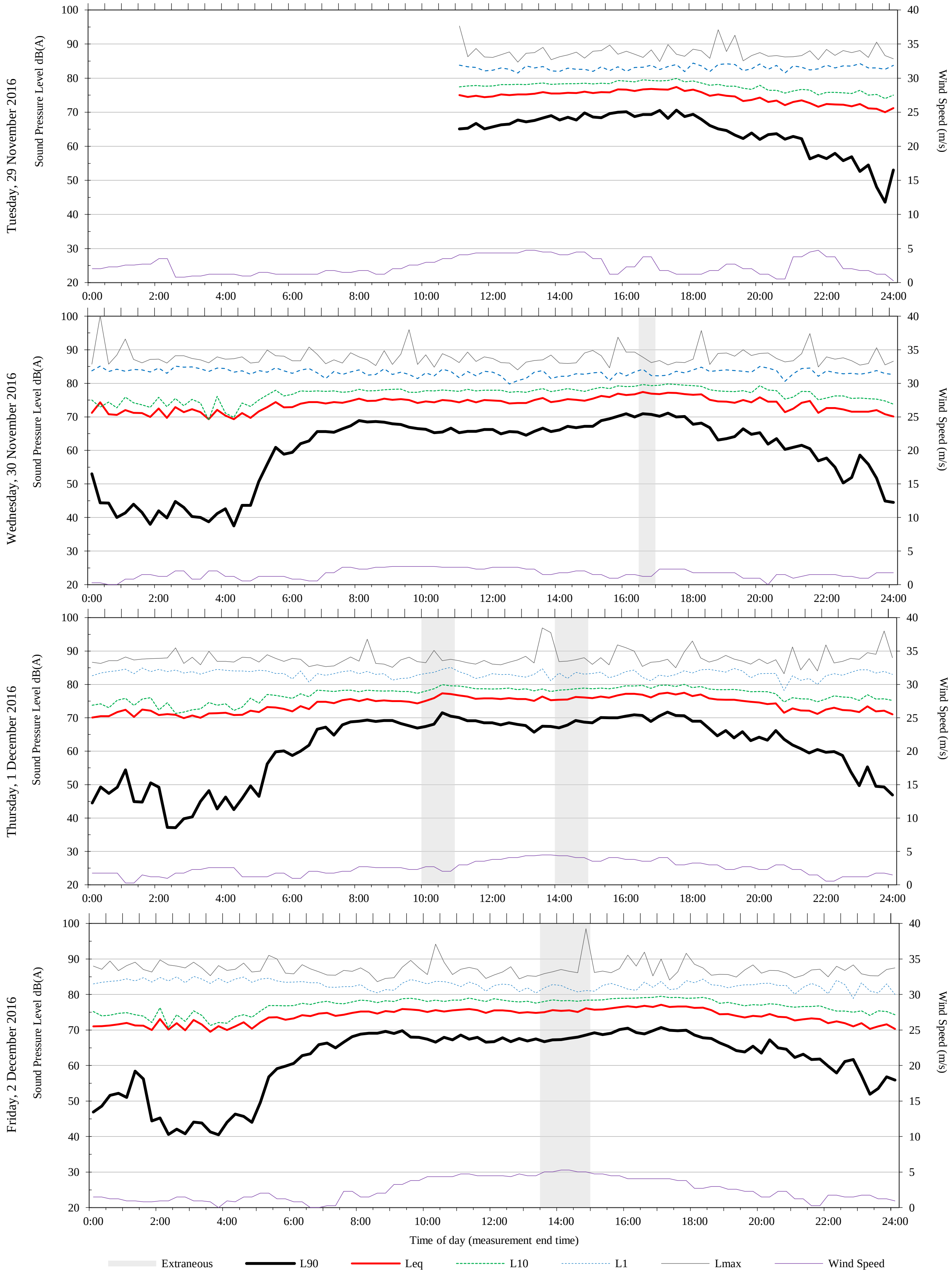

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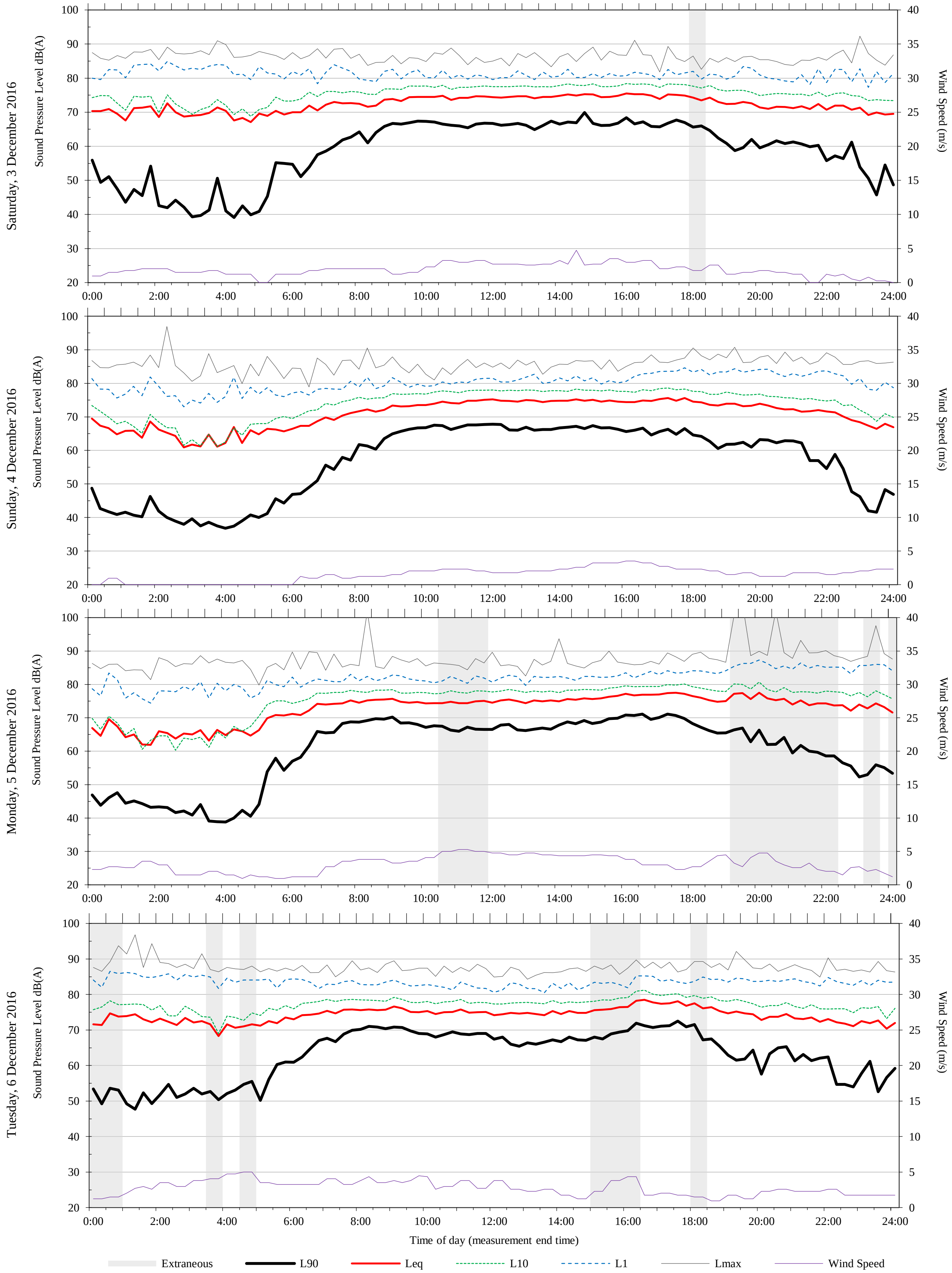

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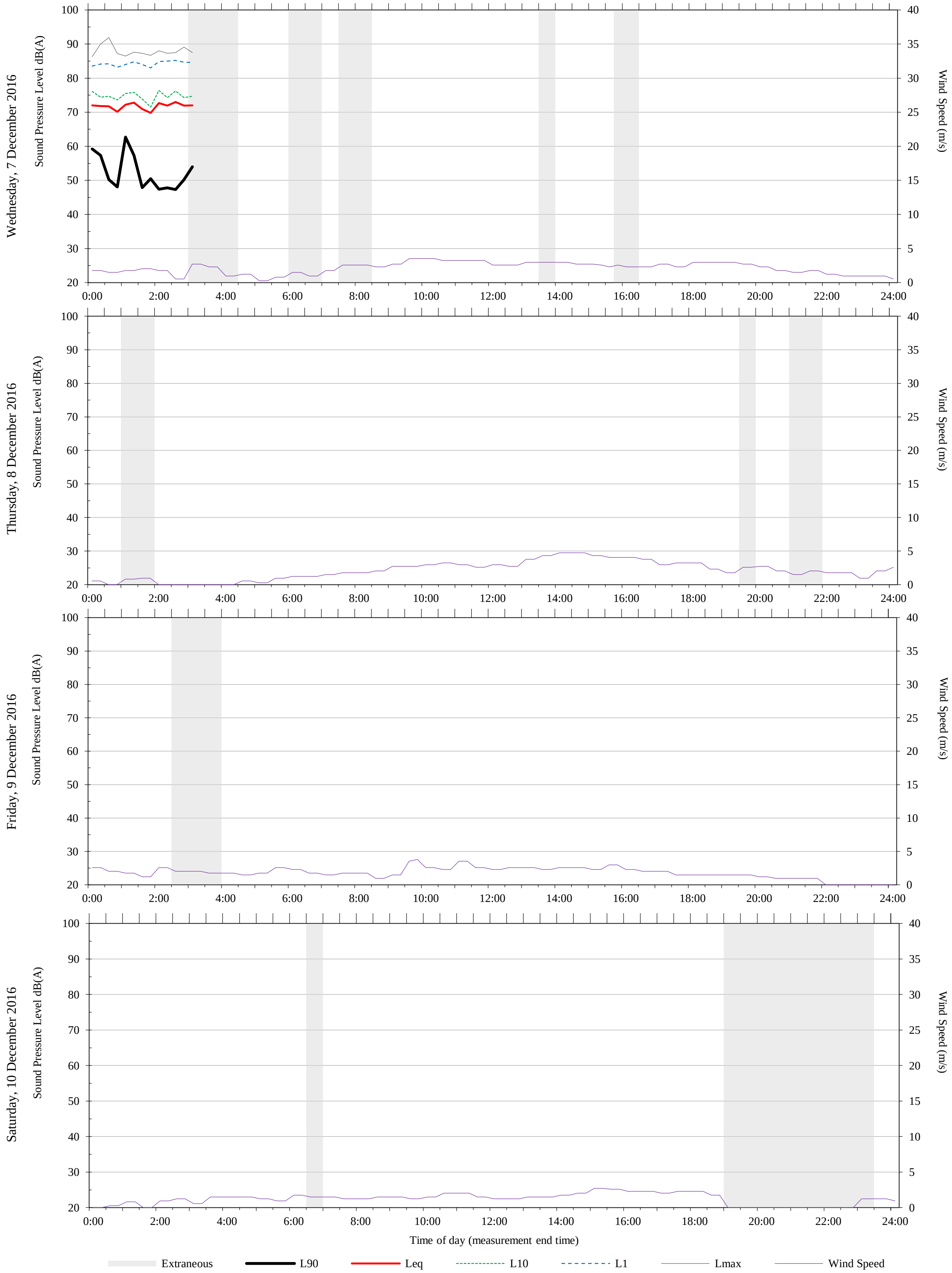

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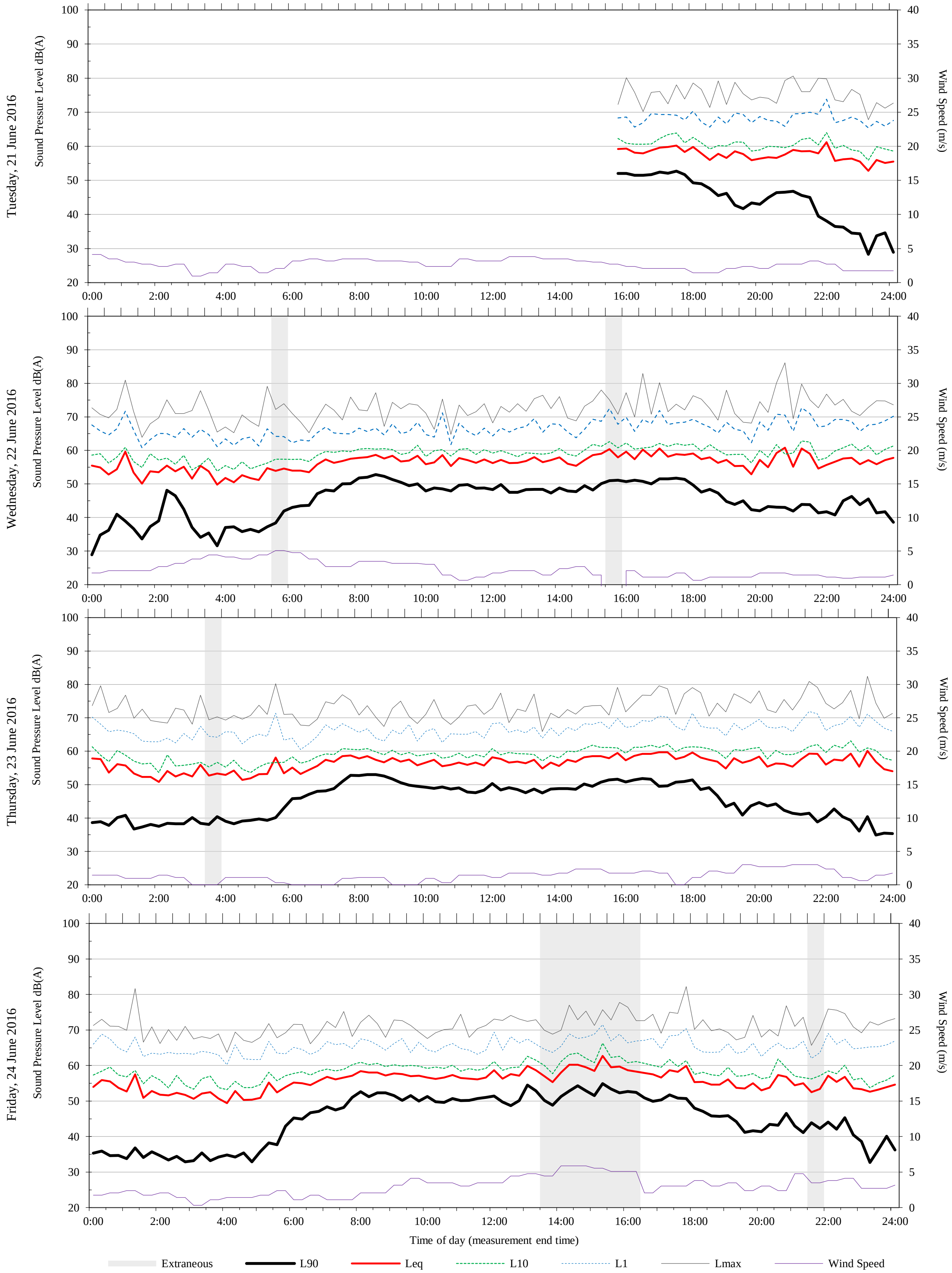

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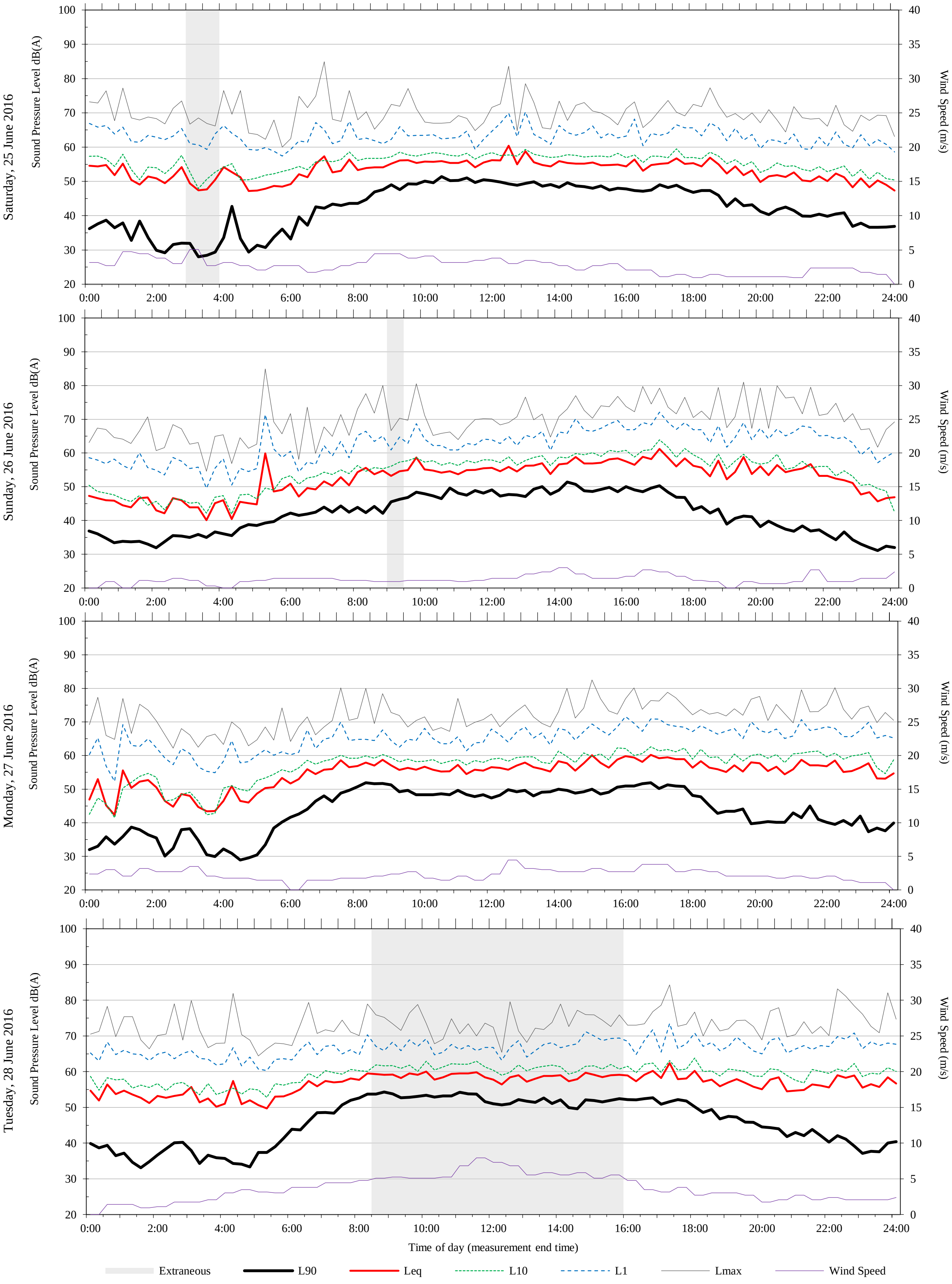

Unattended monitoring: 10 Validation (Free Field)

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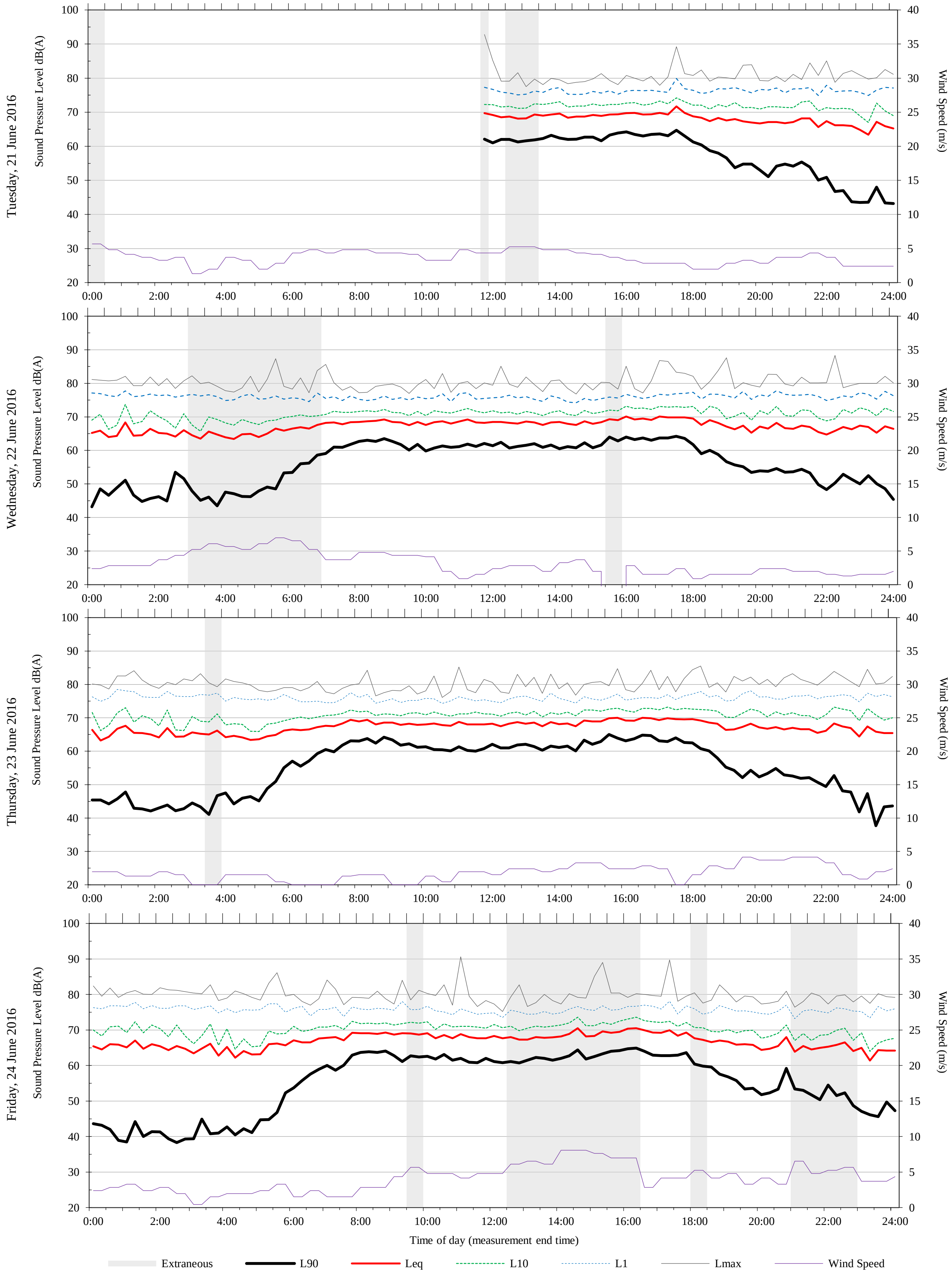

Unattended monitoring: 10 Validation (Free Field)

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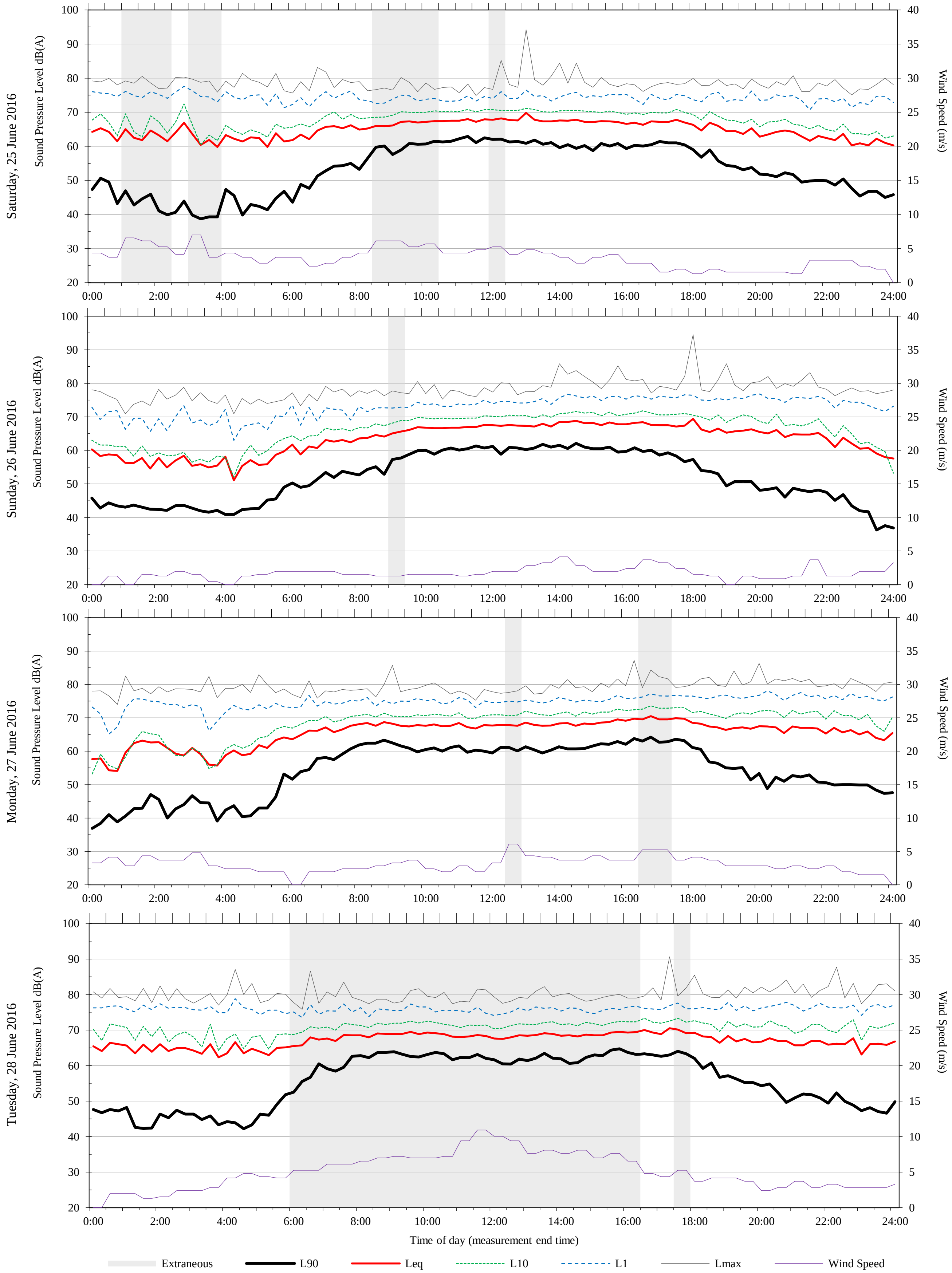

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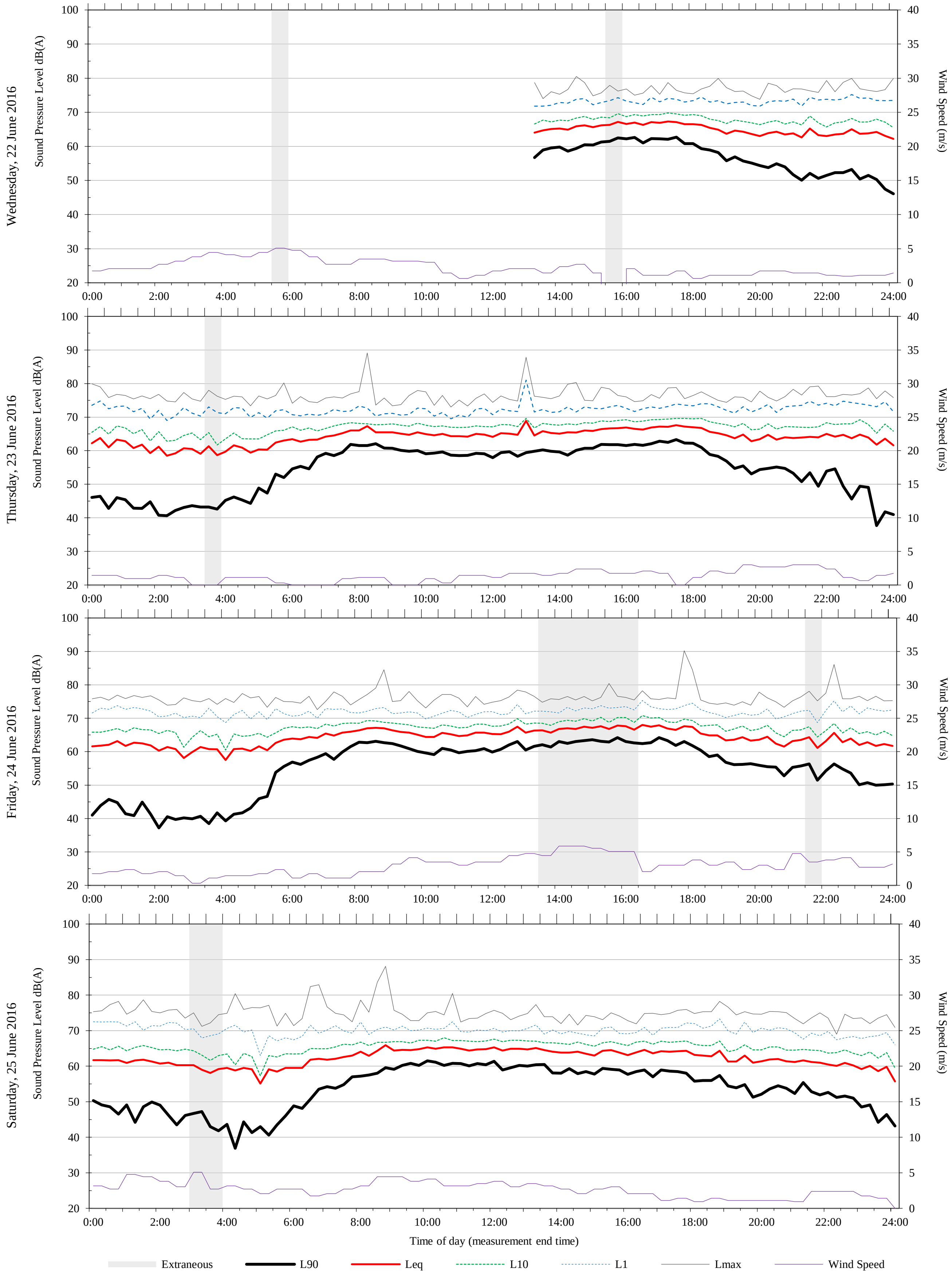

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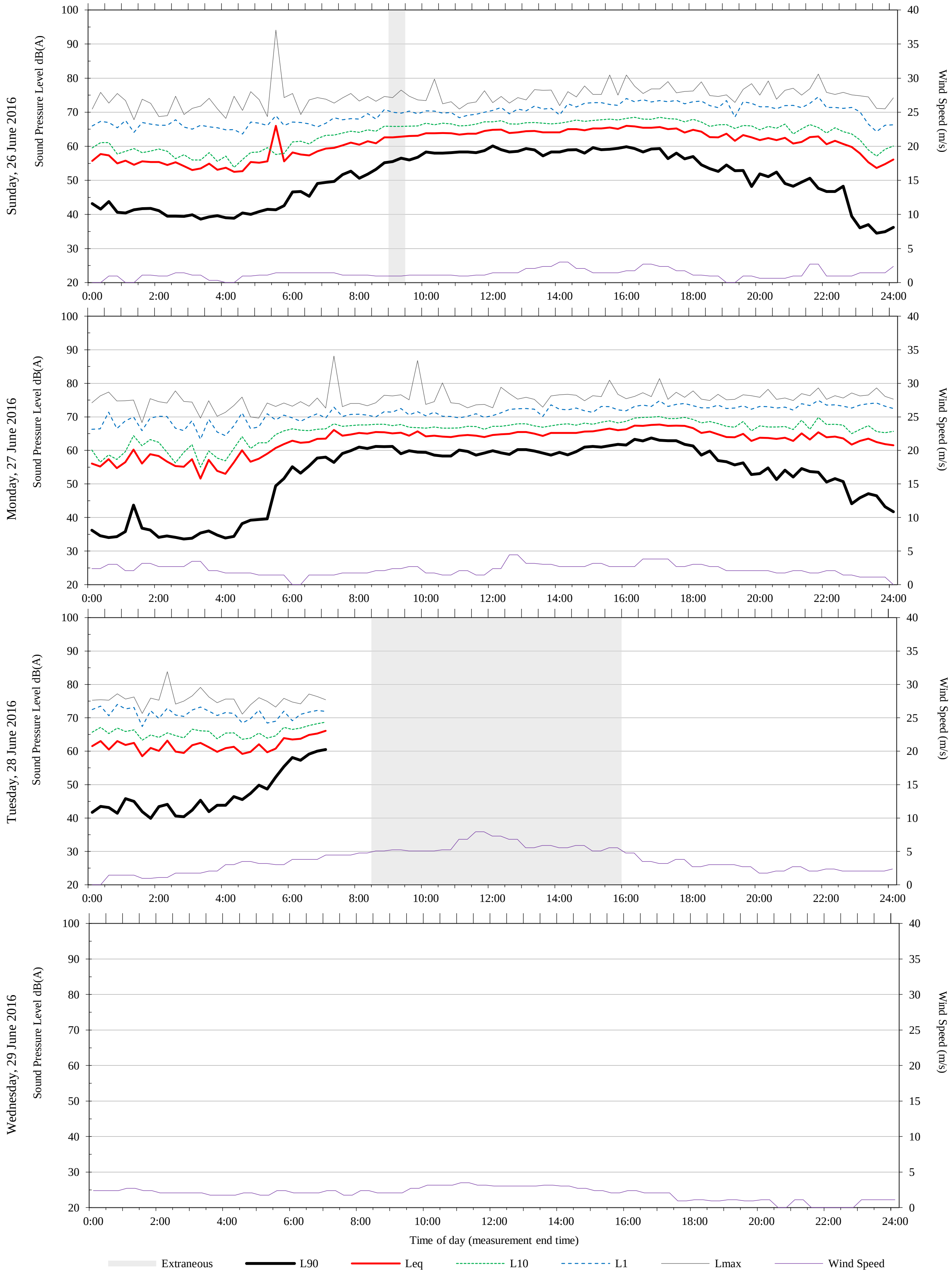

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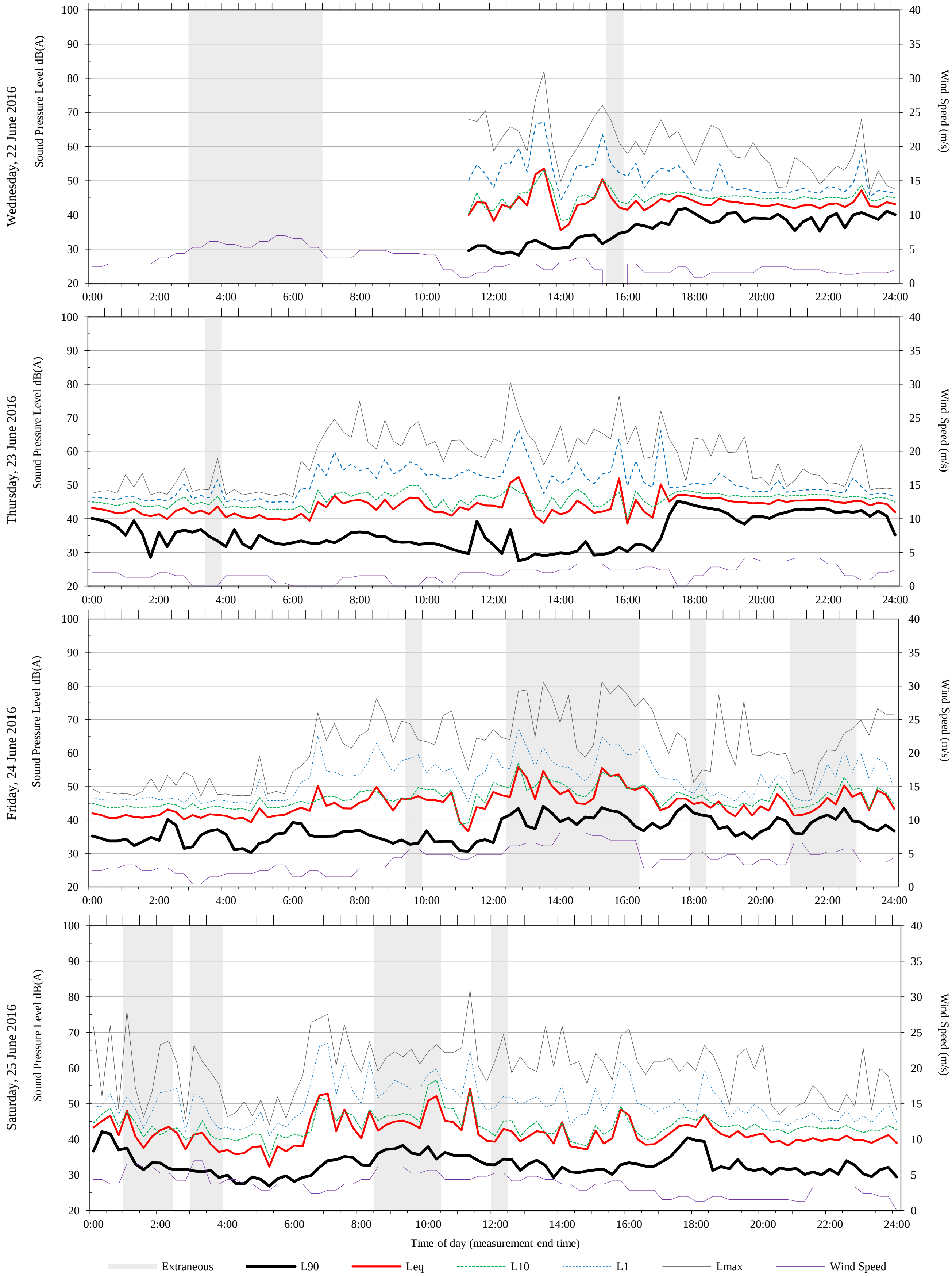

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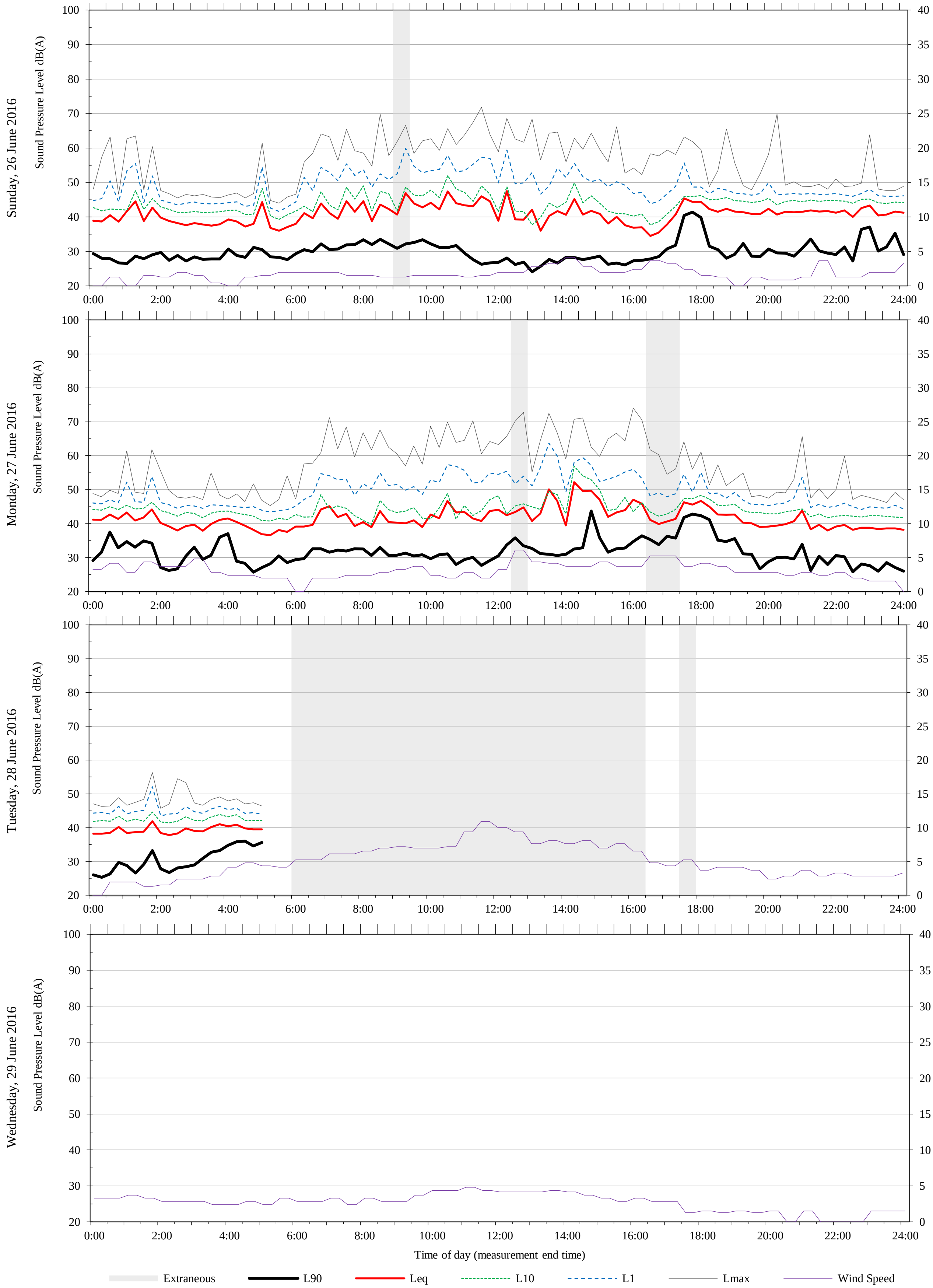

Unattended monitoring: 13 - Baseline (Free Field)

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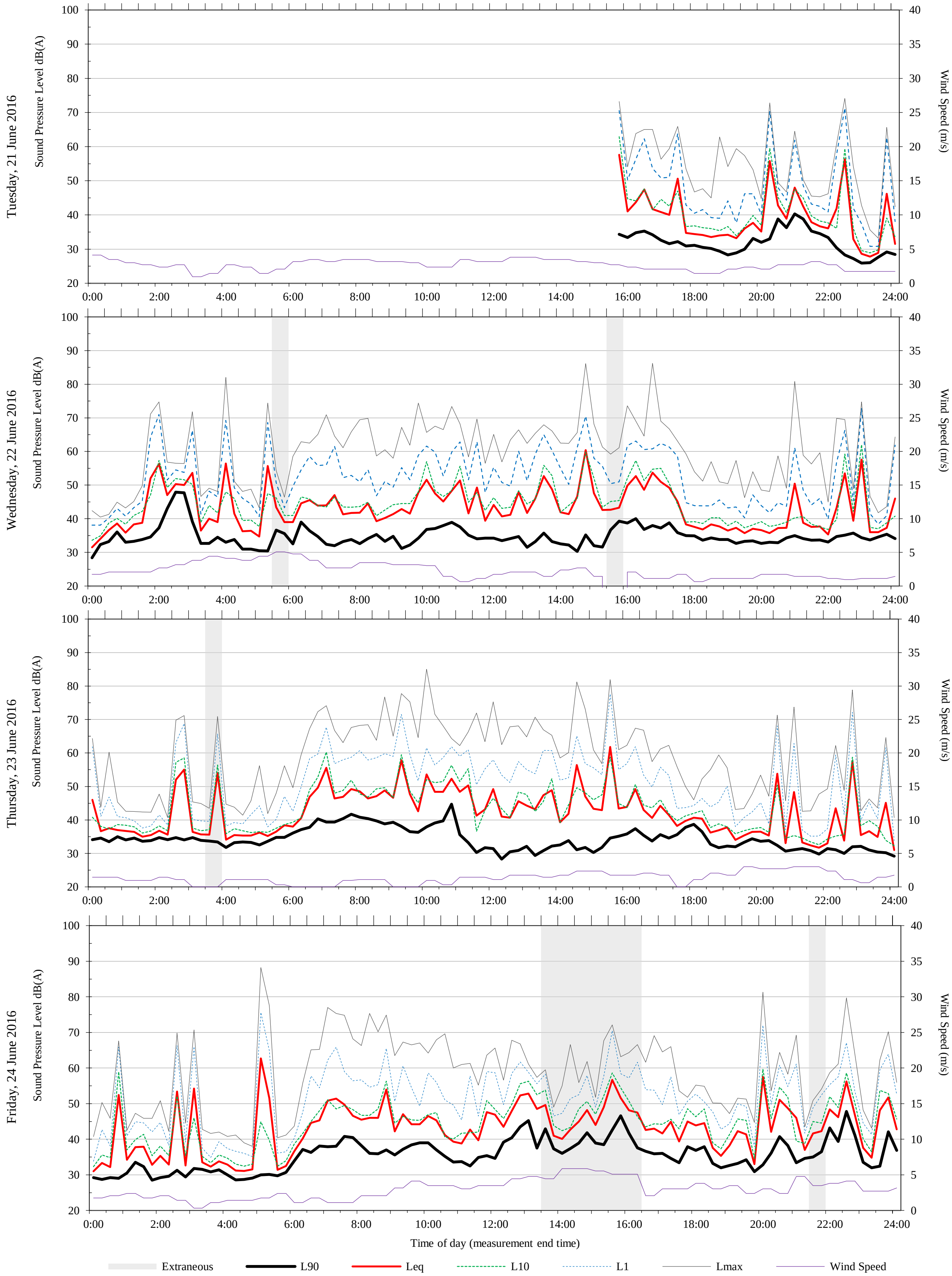

Unattended monitoring: 13 - Baseline (Free Field)

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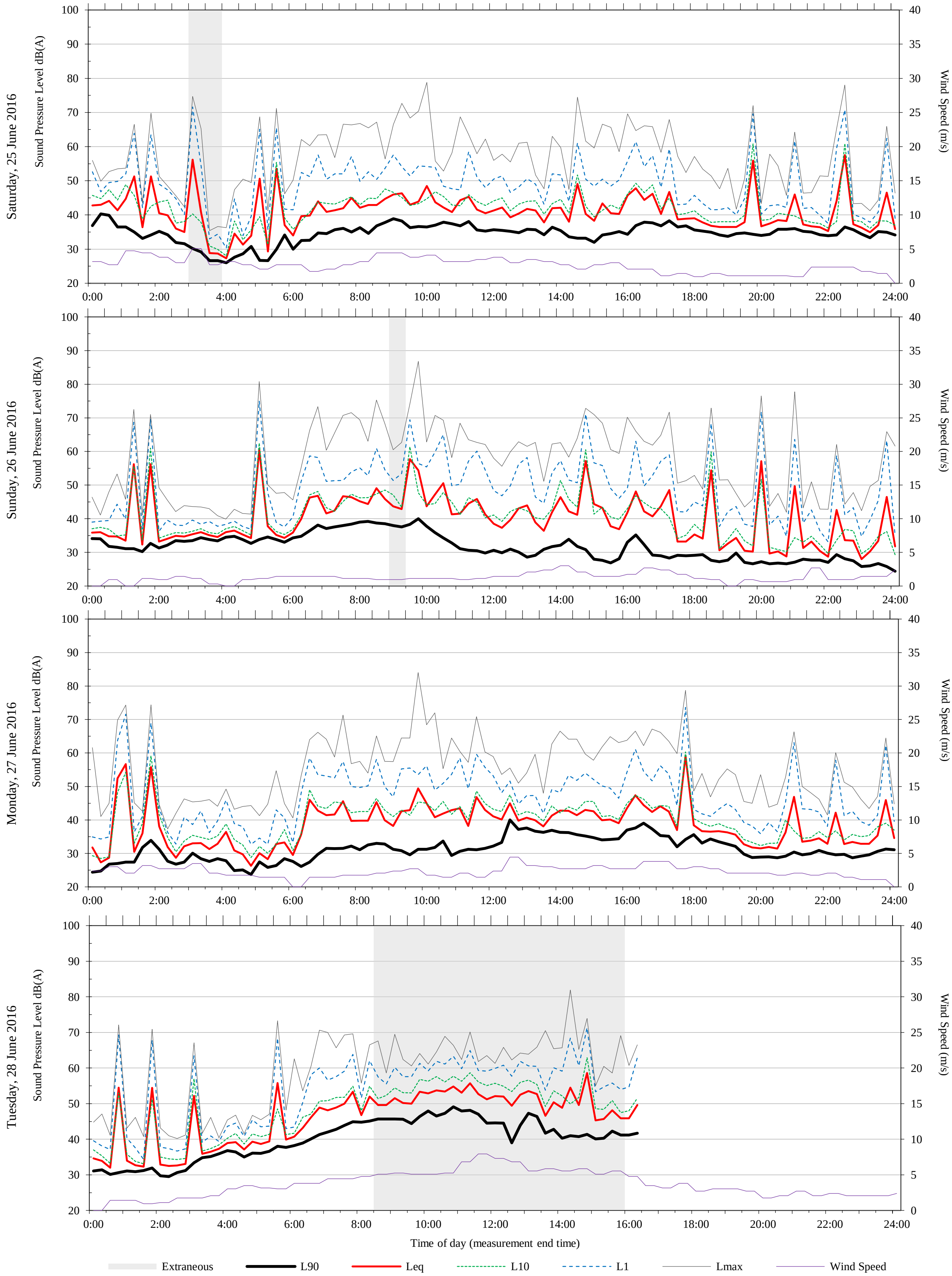

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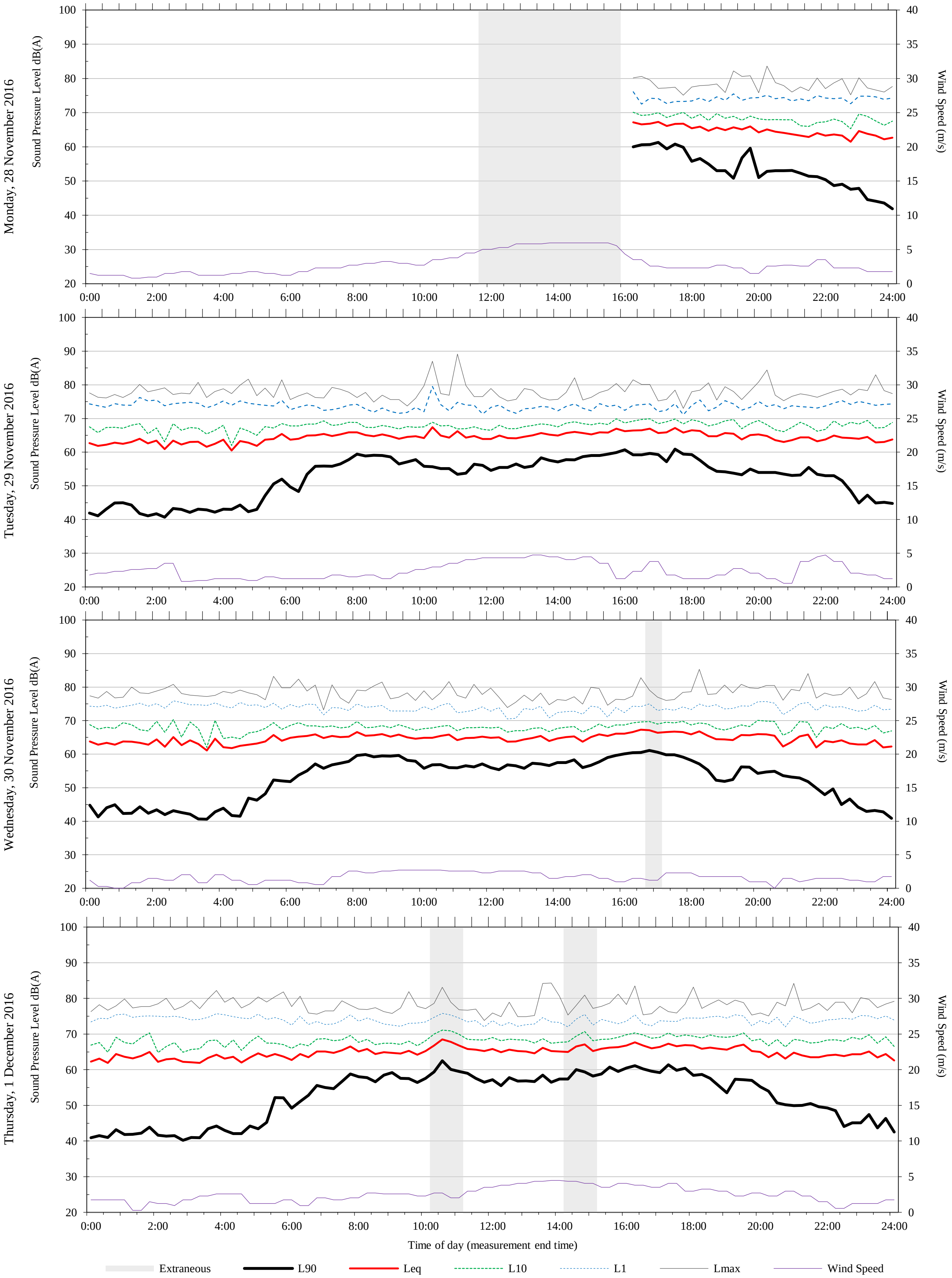

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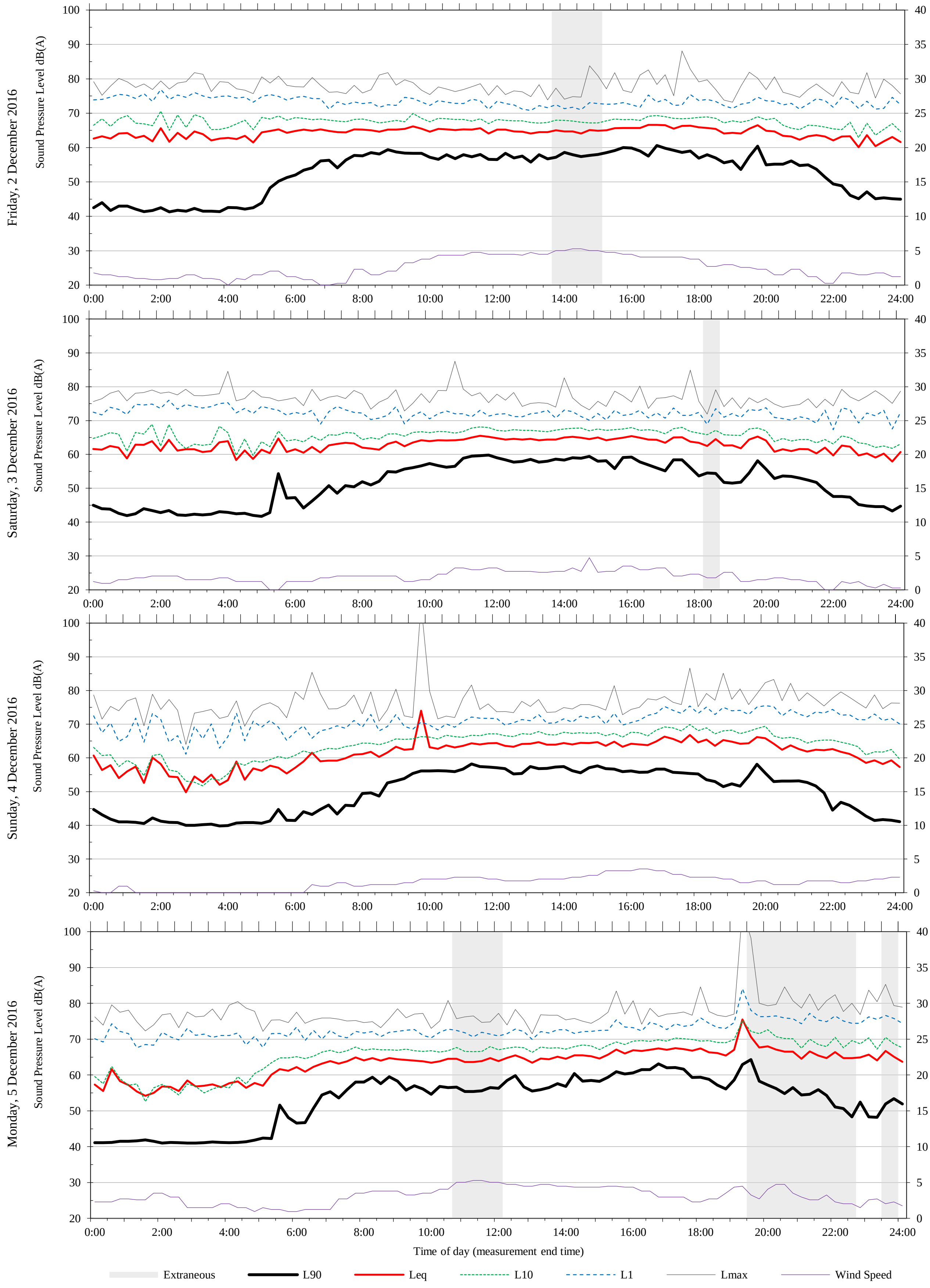

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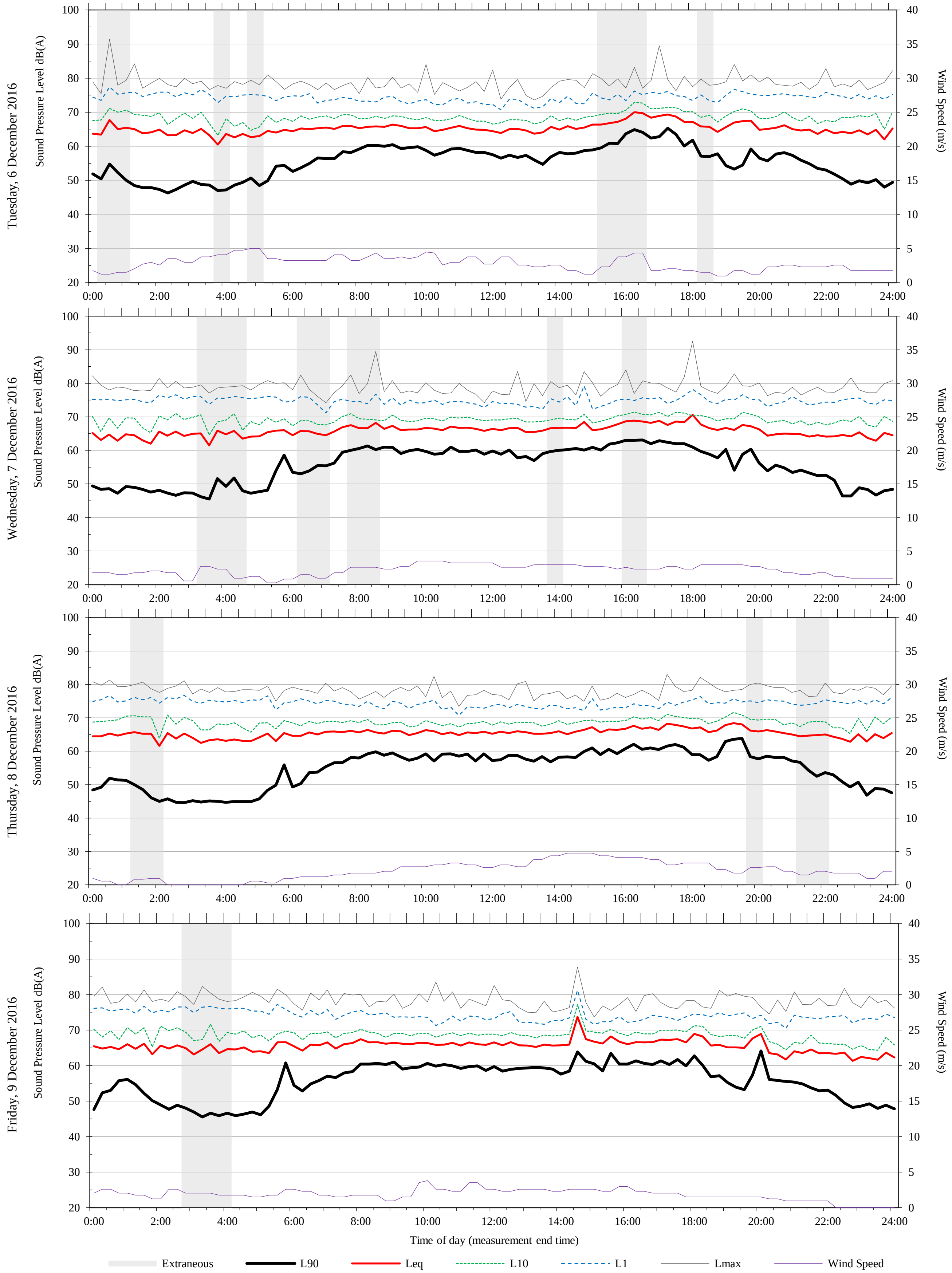

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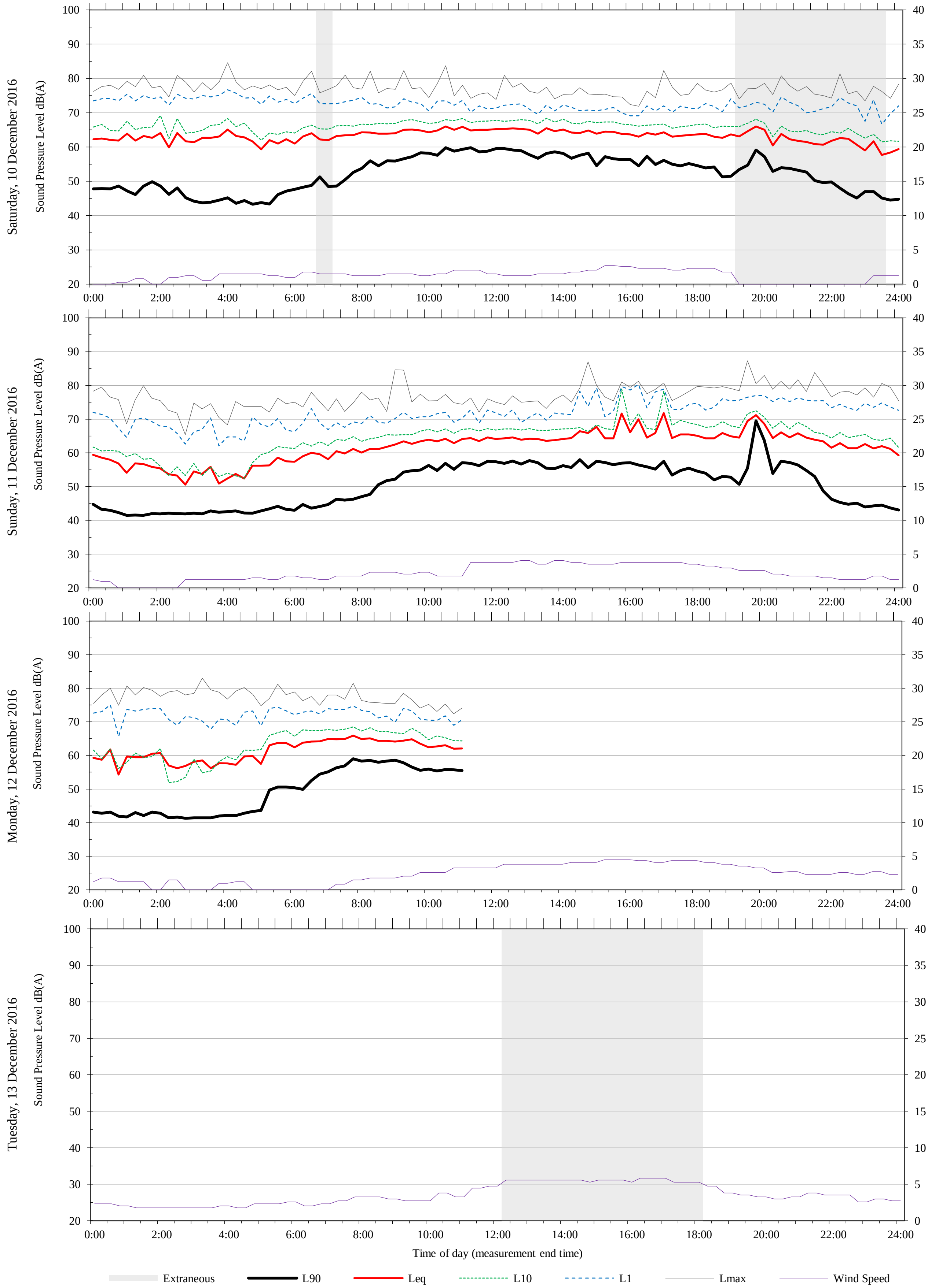
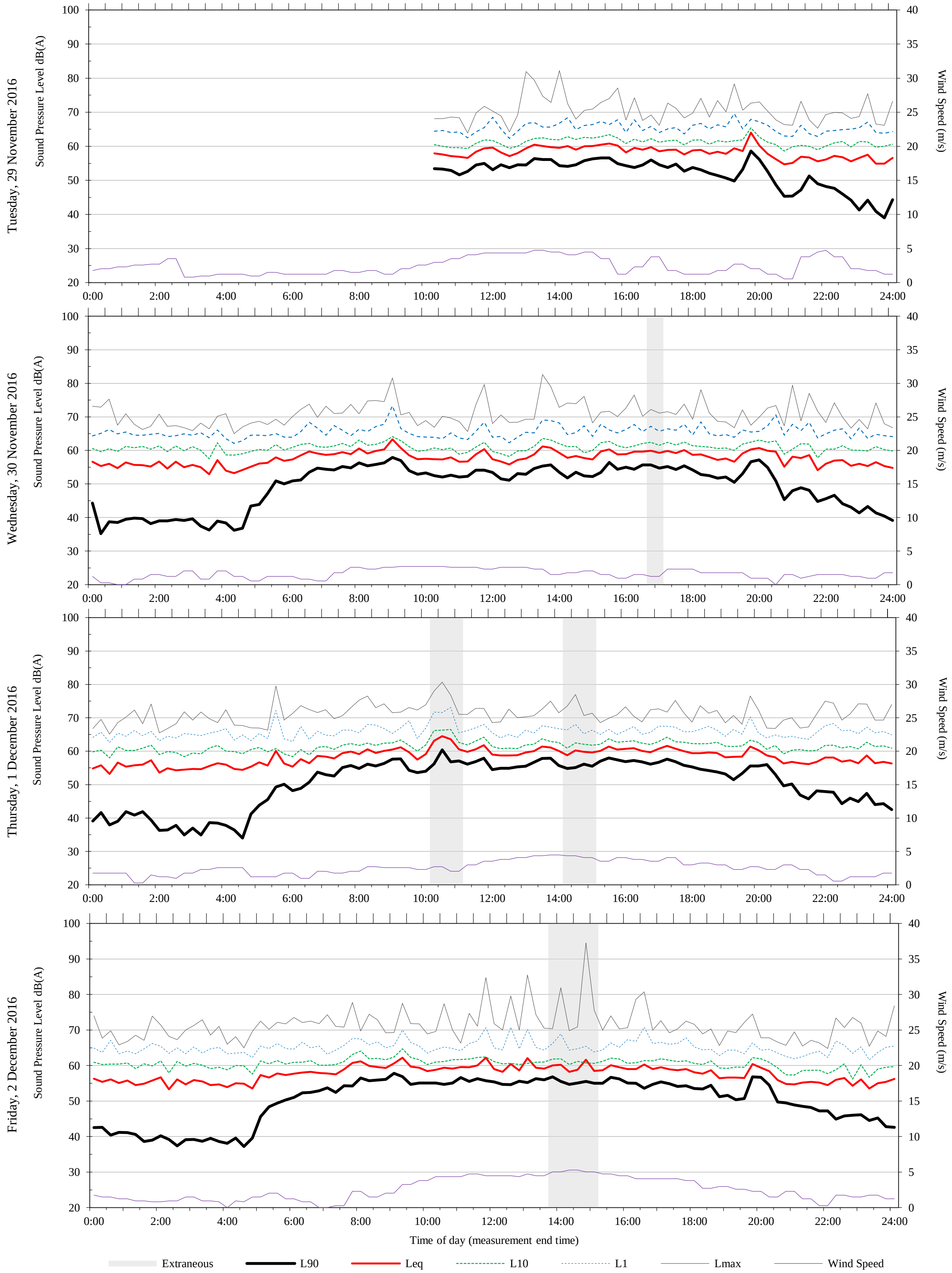


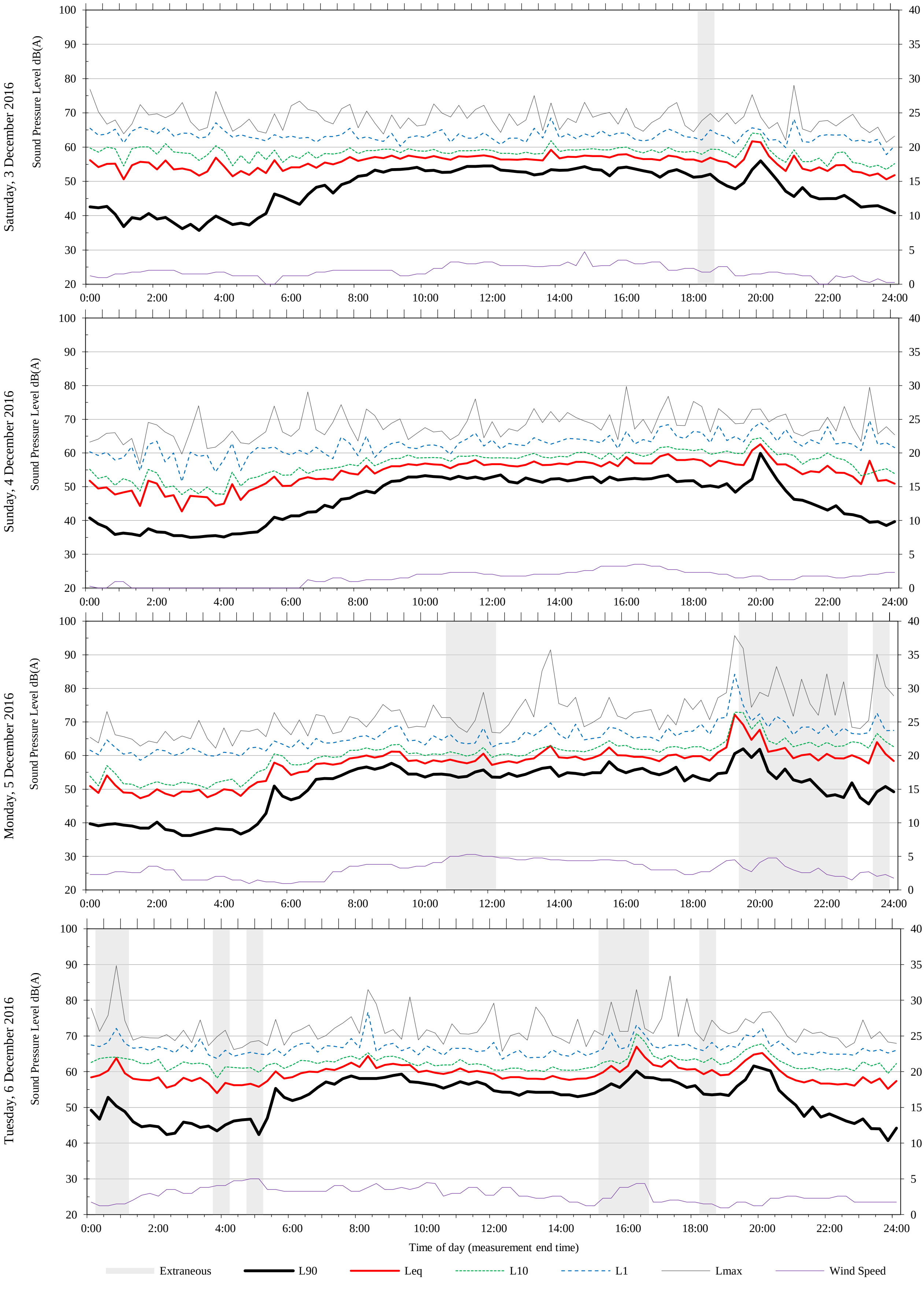
Unattended monitoring: 15 - Validation (Free Field)

ARUP



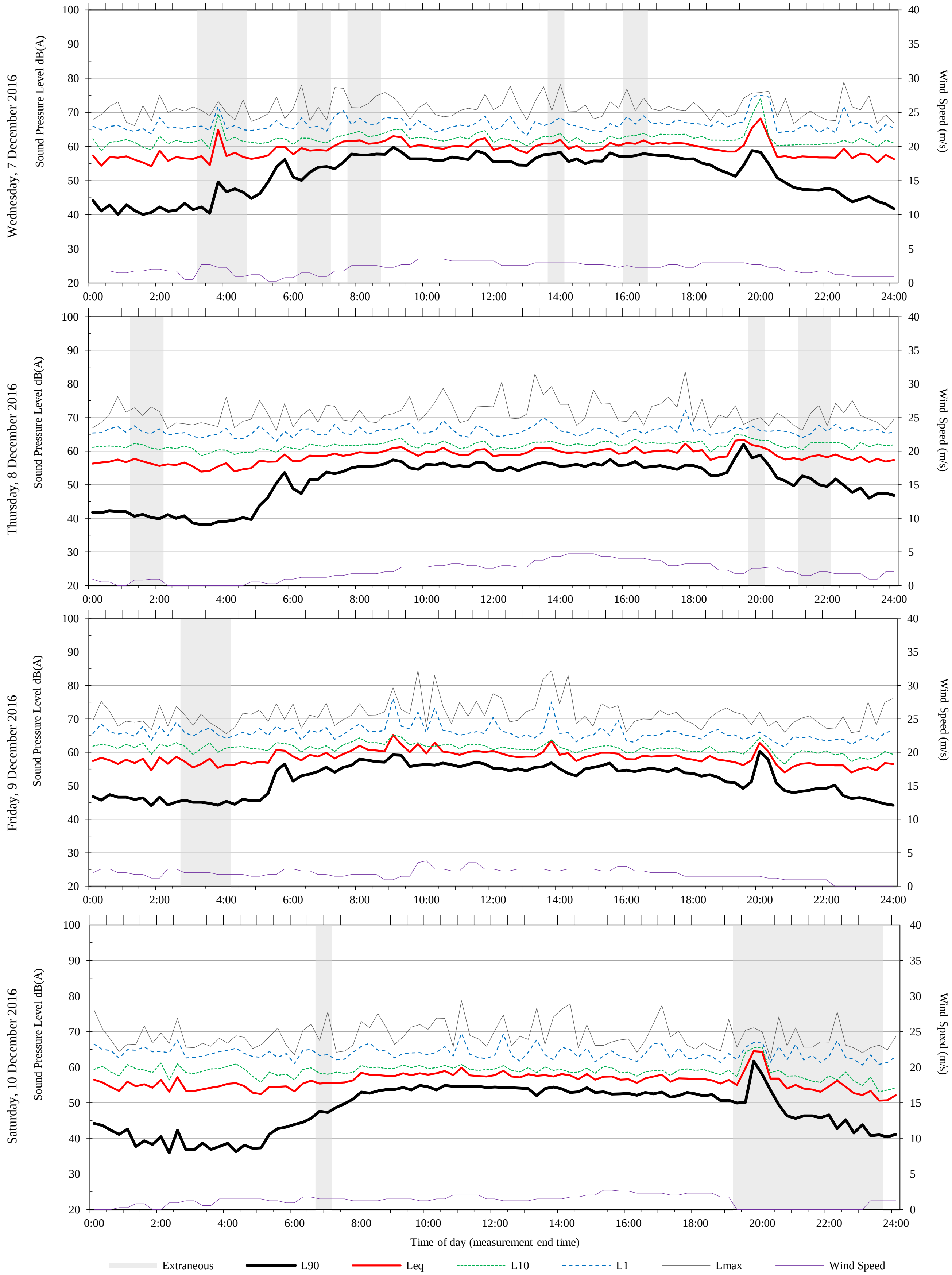
Unattended monitoring: 15 - Validation (Free Field)

ARUP



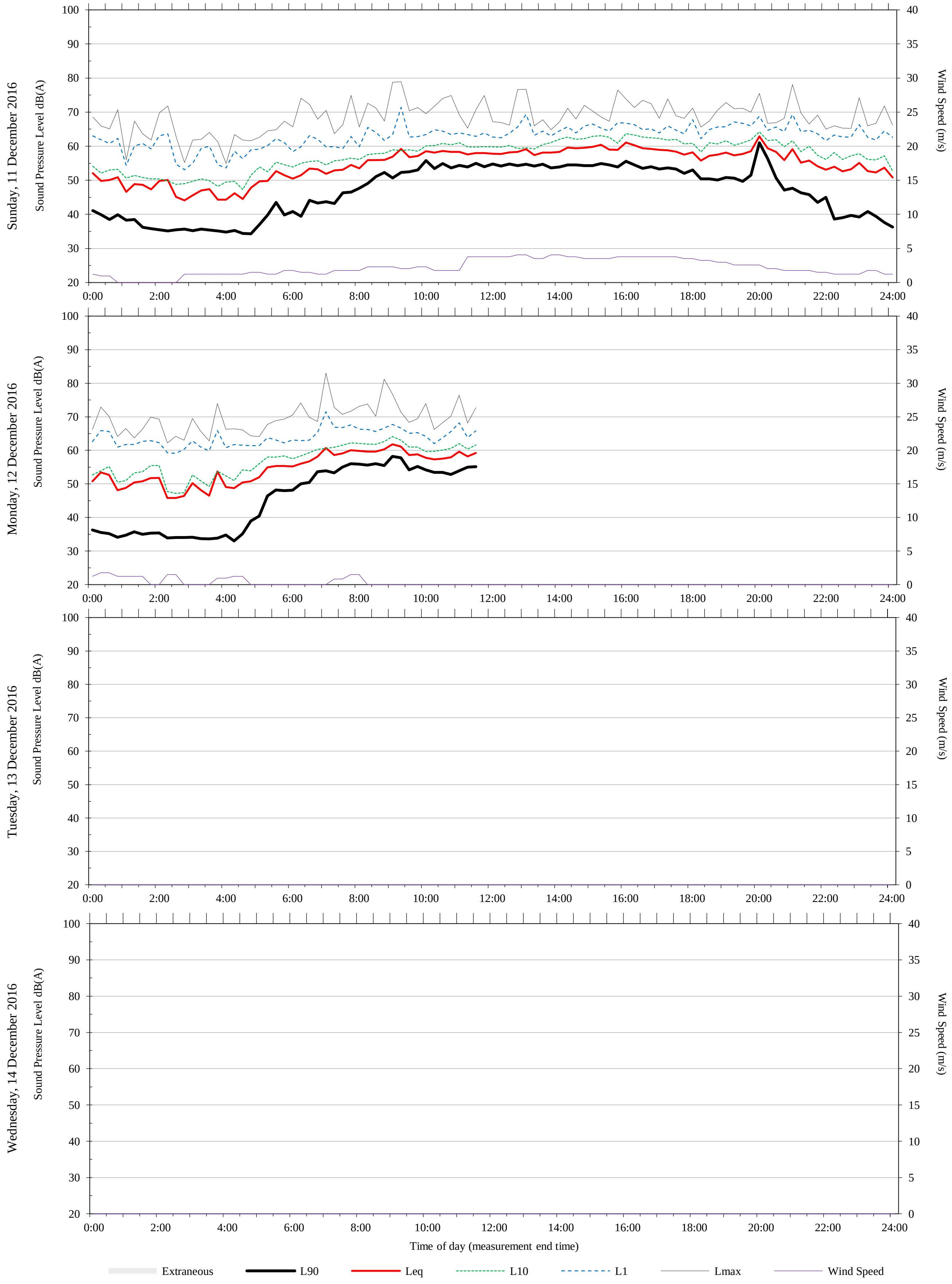
Unattended monitoring: 15 - Validation (Free Field)

ARUP



Unattended monitoring: 15 - Validation (Free Field)

ARUP

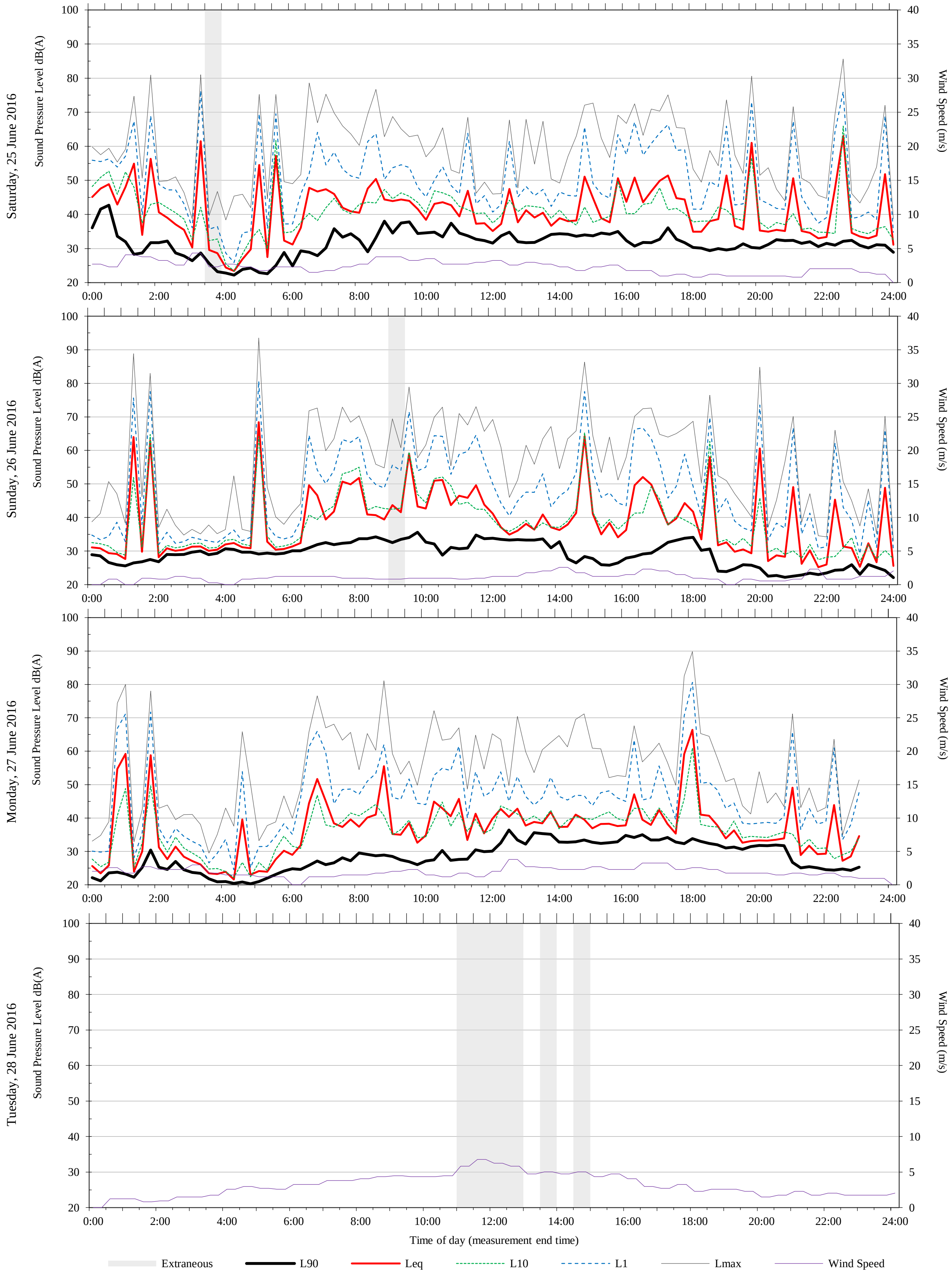


Unattended monitoring: 16 - Baseline (Free Field)

ARUP

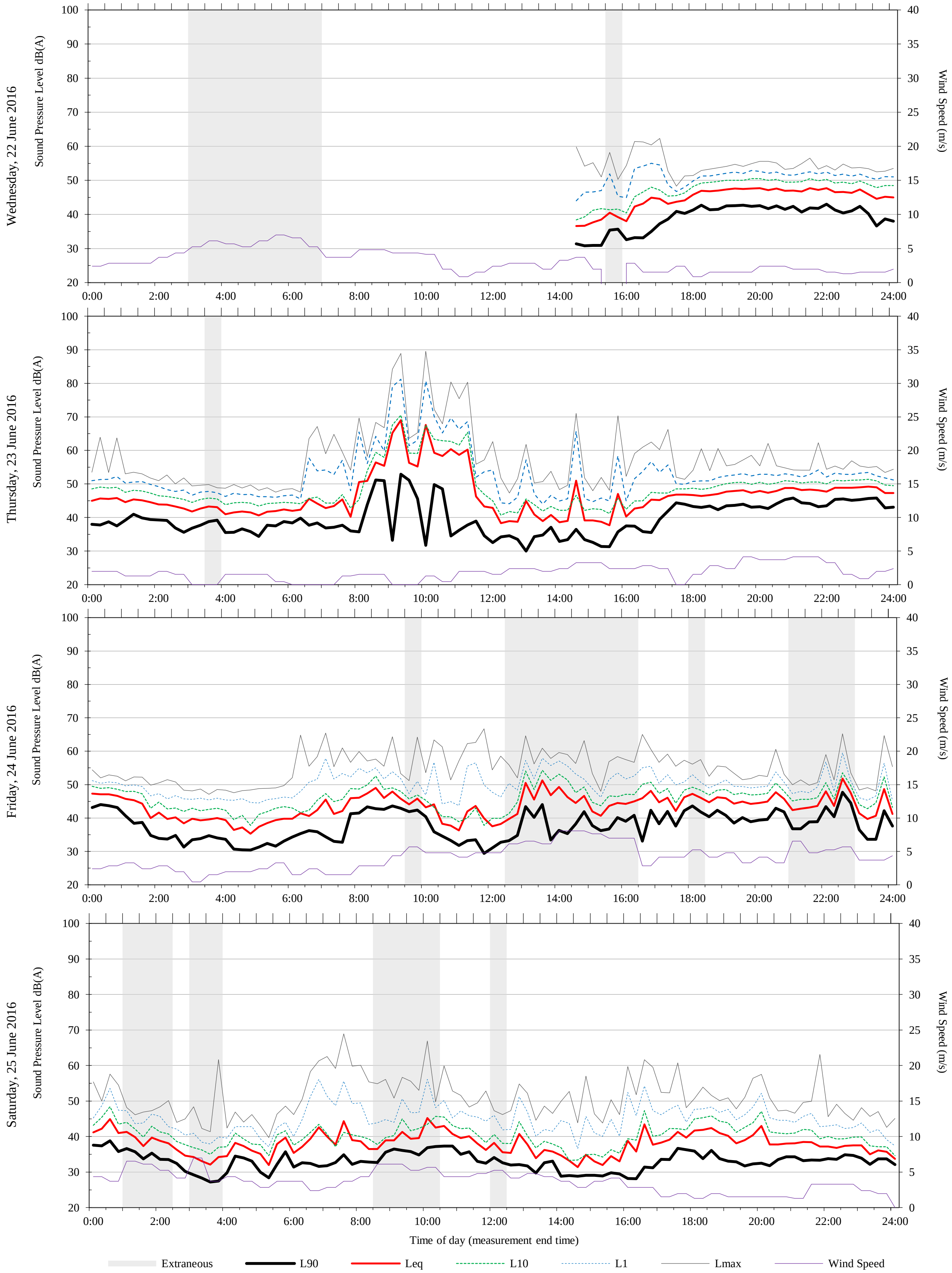
Unattended monitoring: 16 - Baseline (Free Field)

ARUP



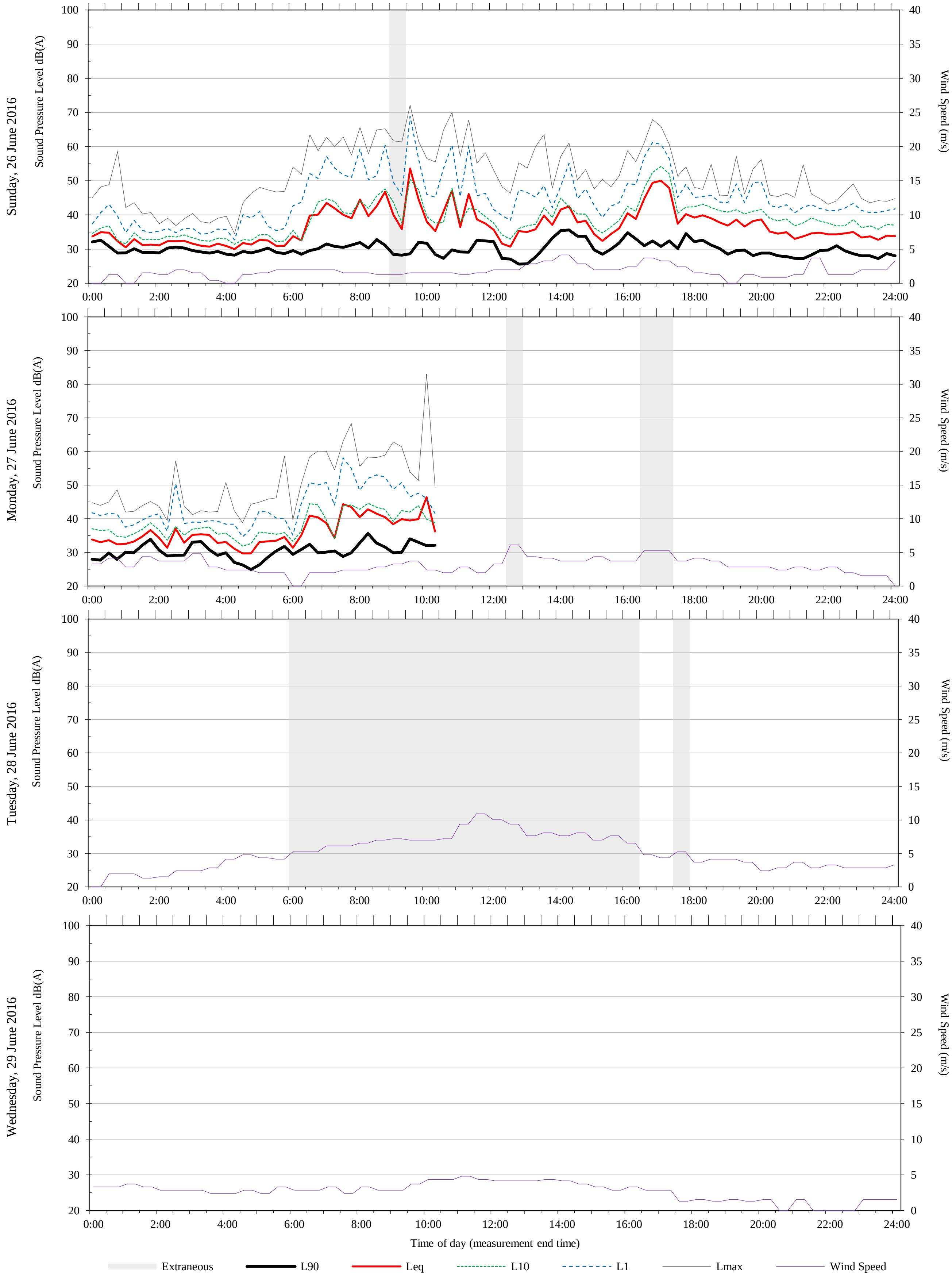
Unattended monitoring: 17 - Baseline (Free Field)

ARUP



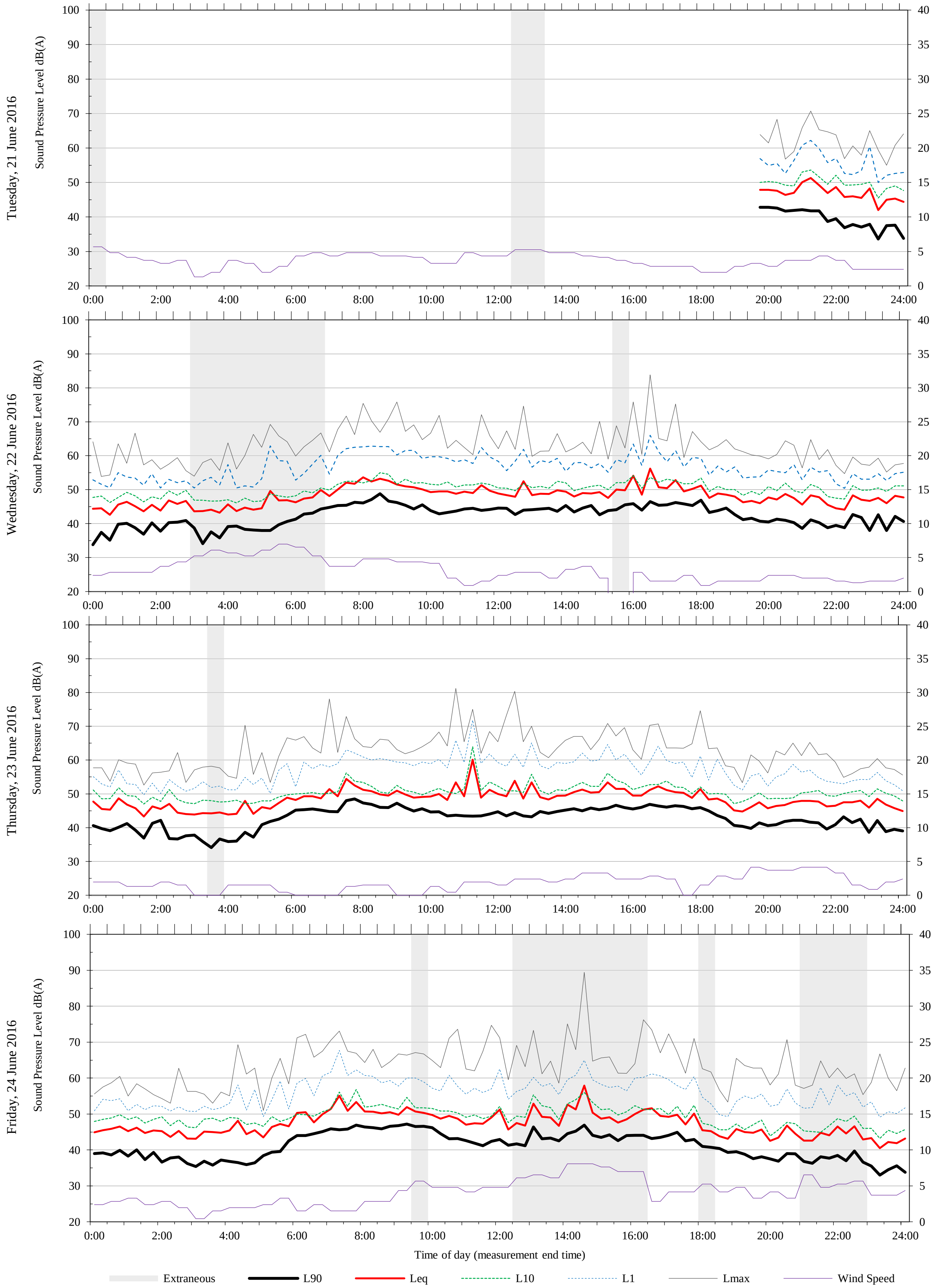
Unattended monitoring: 17 - Baseline (Free Field)

ARUP



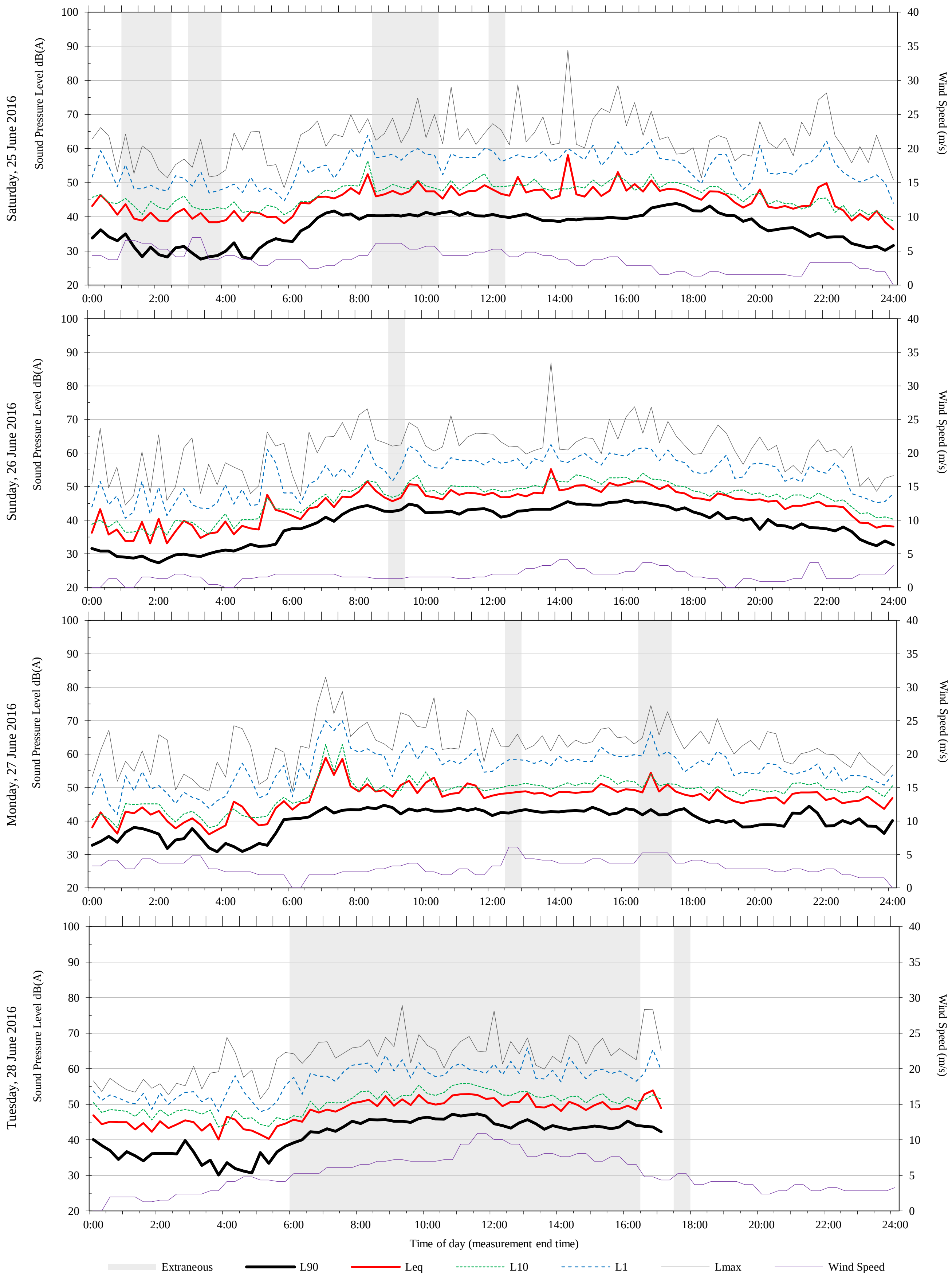
Unattended monitoring: 18 - Baseline (Free Field)

ARUP



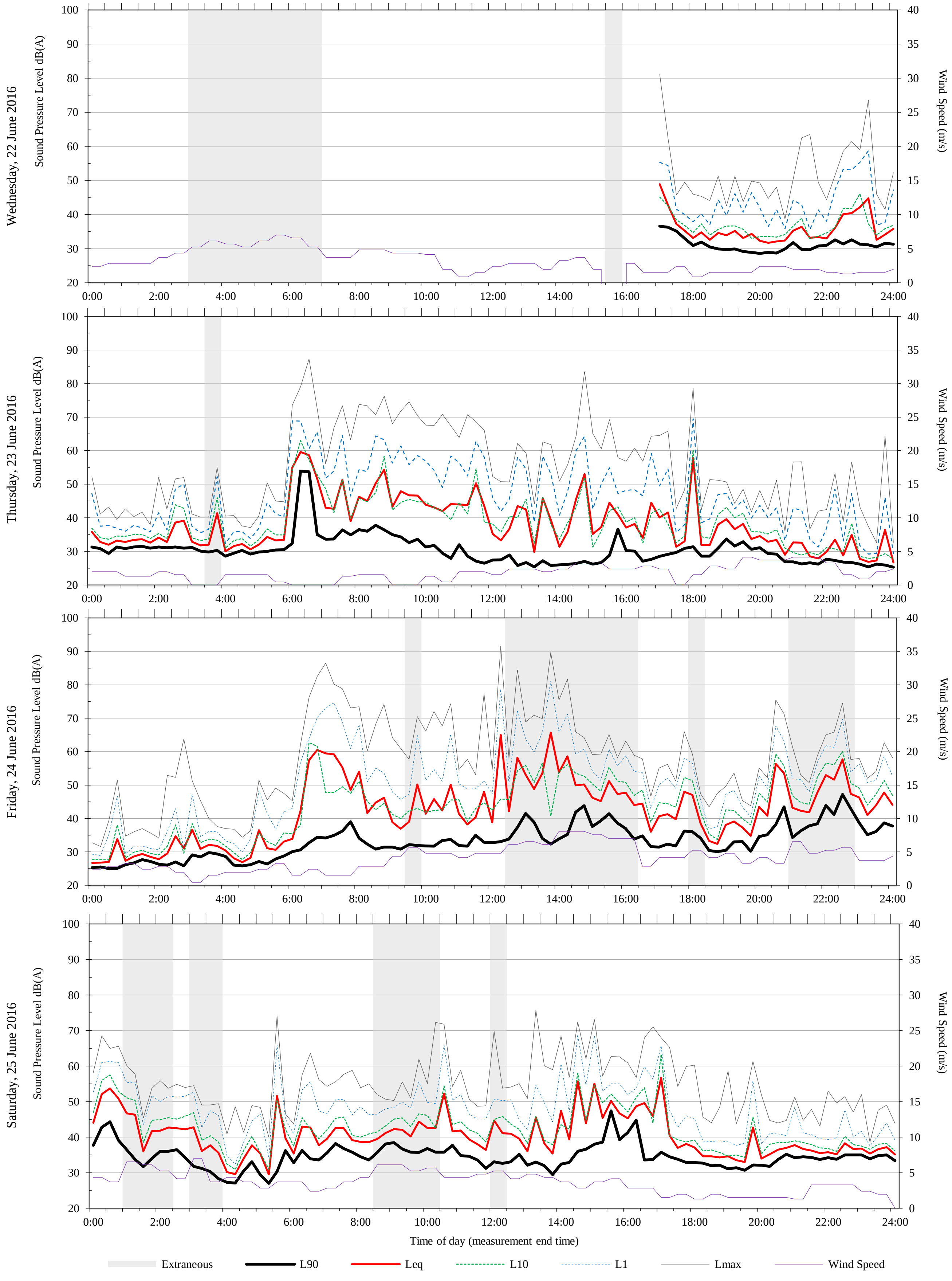
Unattended monitoring: 18 - Baseline (Free Field)

ARUP

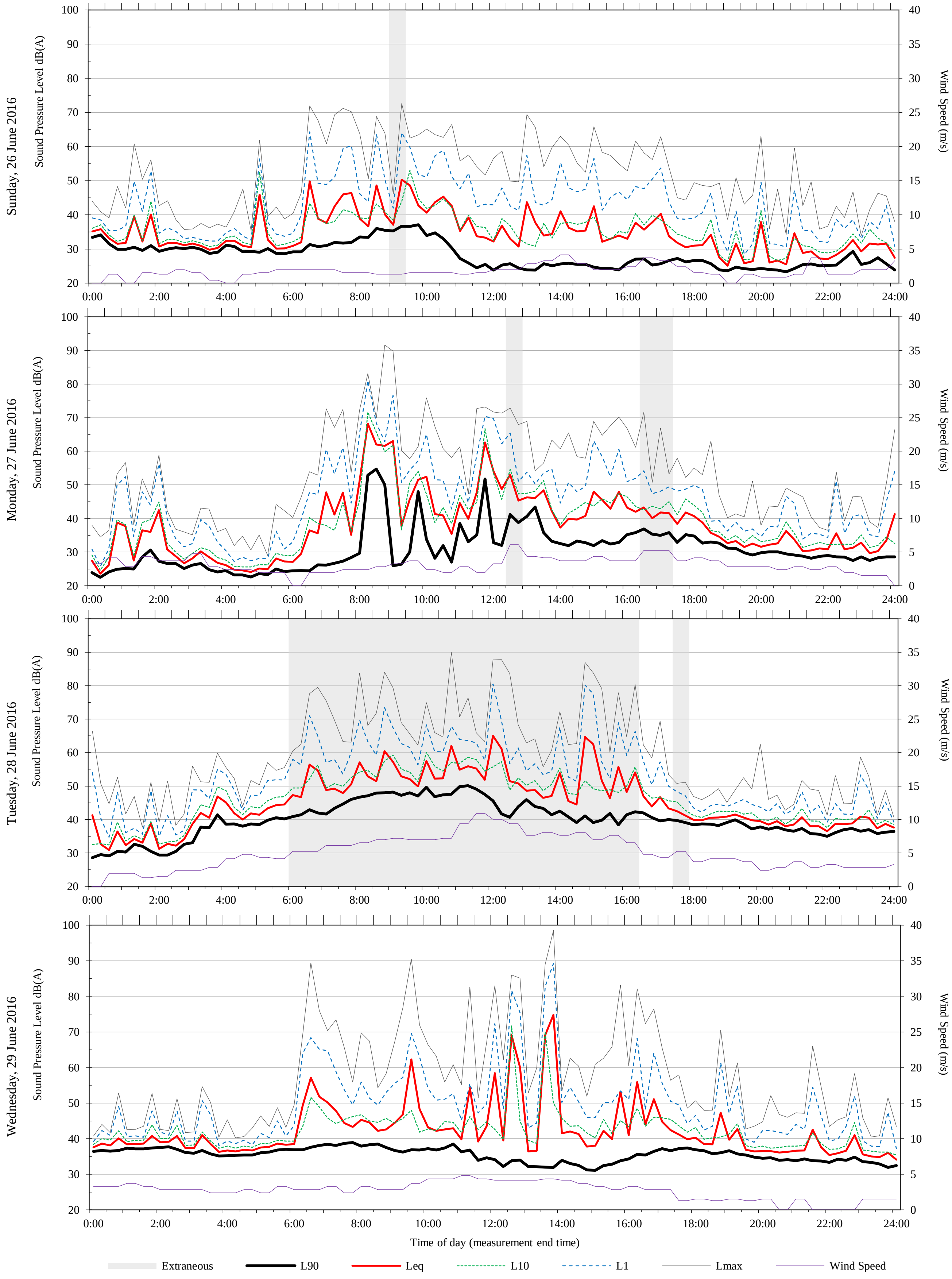


Unattended monitoring: 19 - Baseline (Free Field)

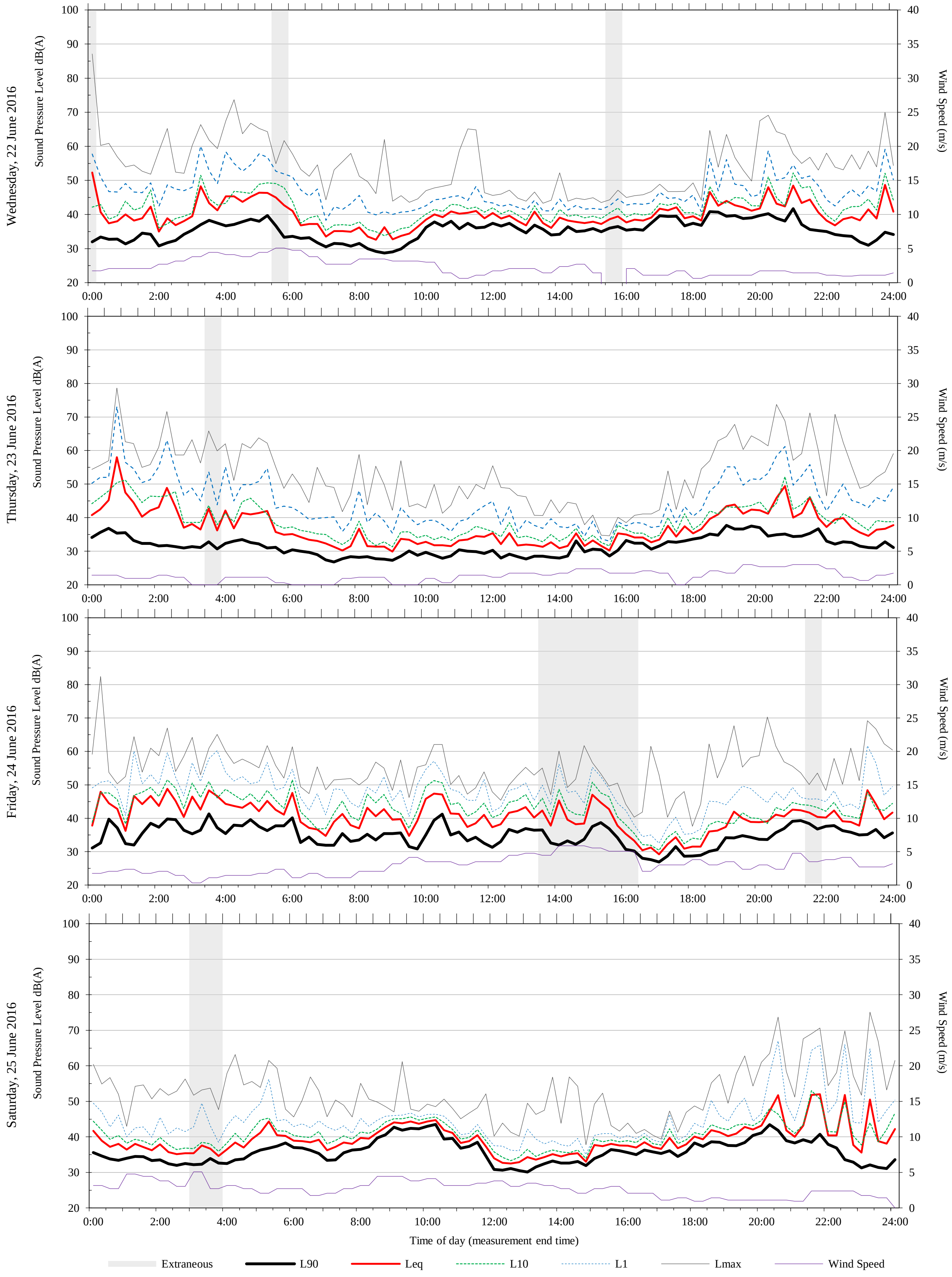
ARUP



Unattended monitoring: 19 - Baseline (Free Field)

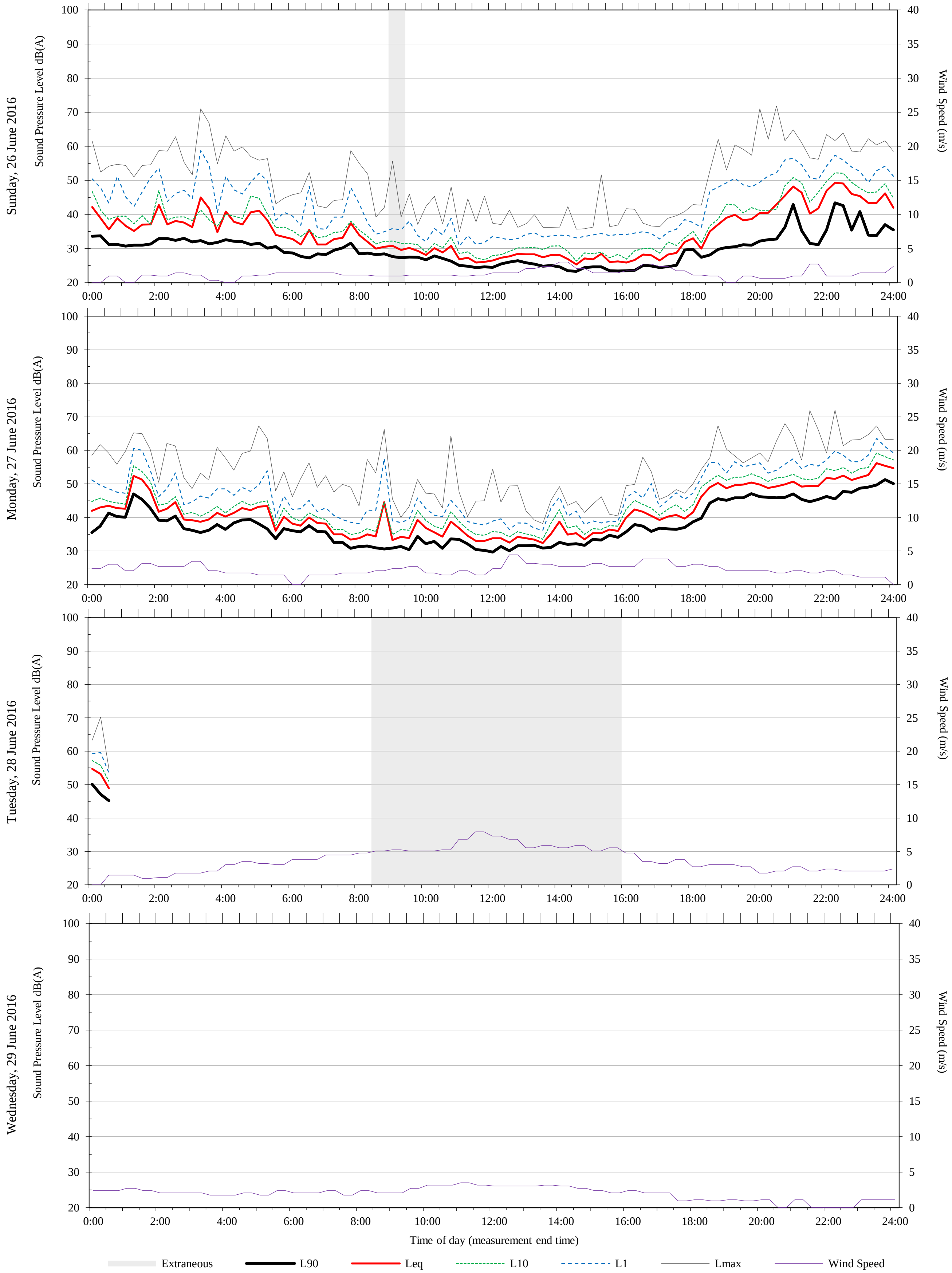


Unattended monitoring: 20 - Baseline (Free Field)



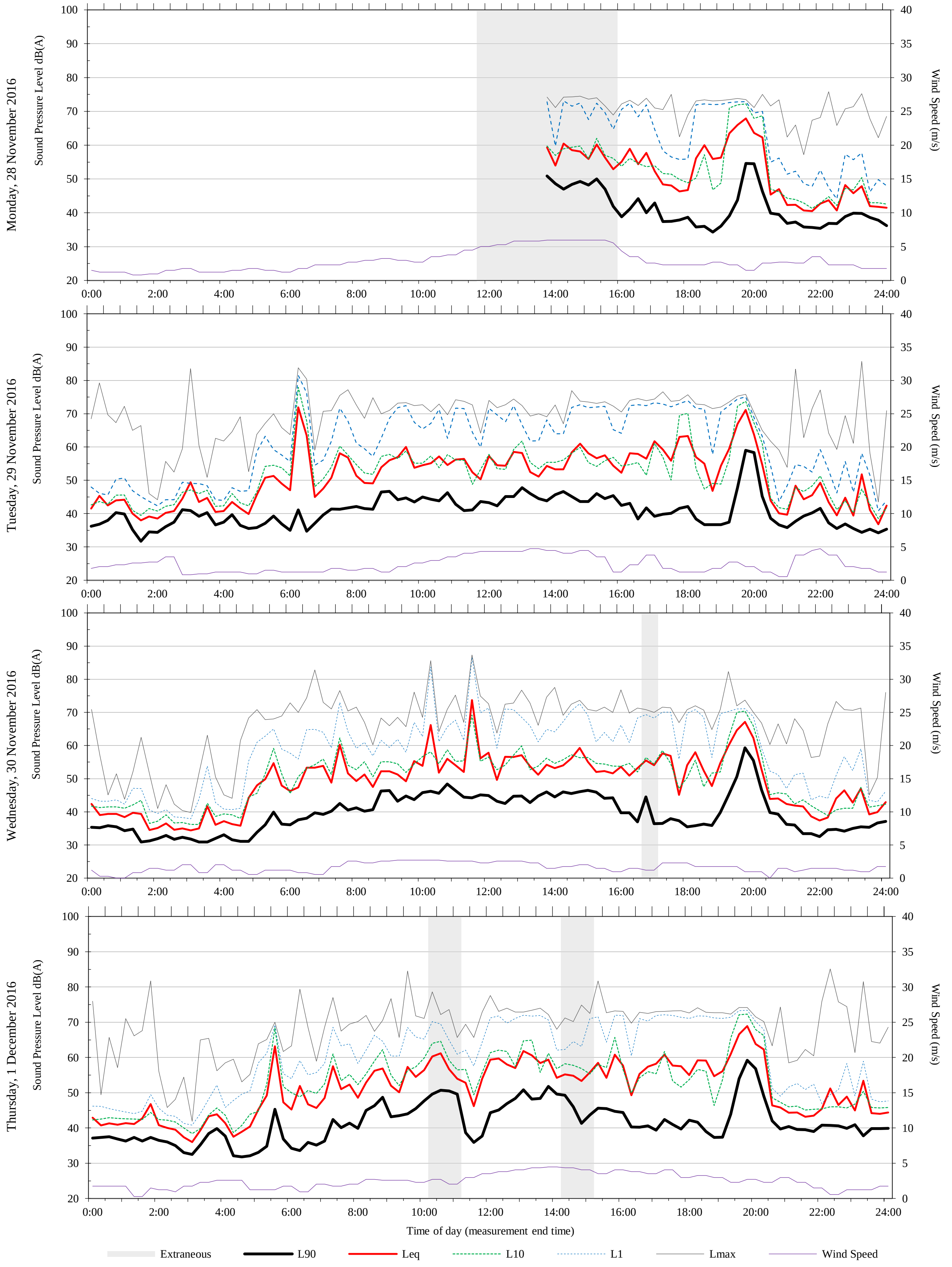
Unattended monitoring: 20 - Baseline (Free Field)

ARUP



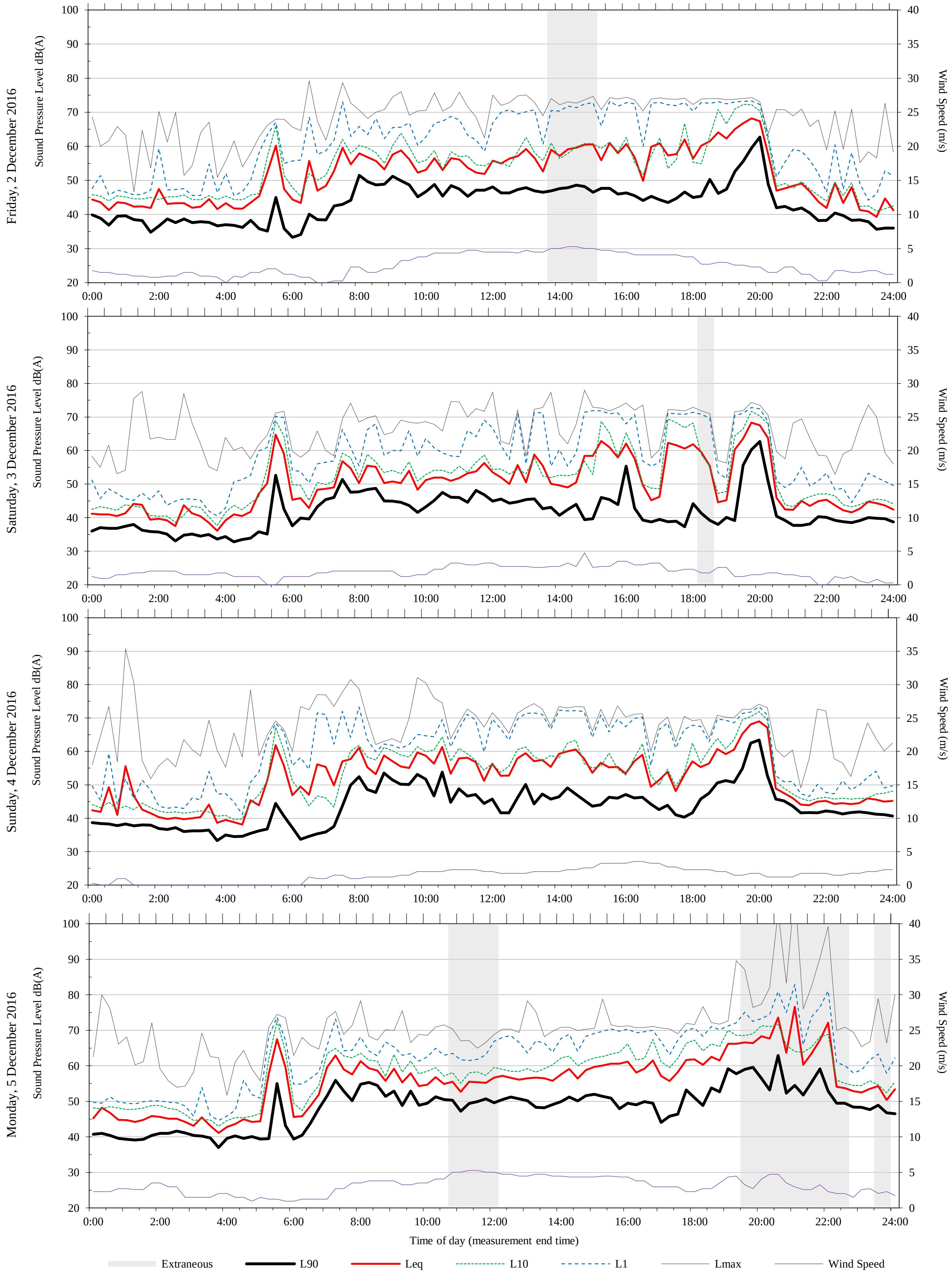
Unattended monitoring: 21 - Baseline (Free Field)

ARUP

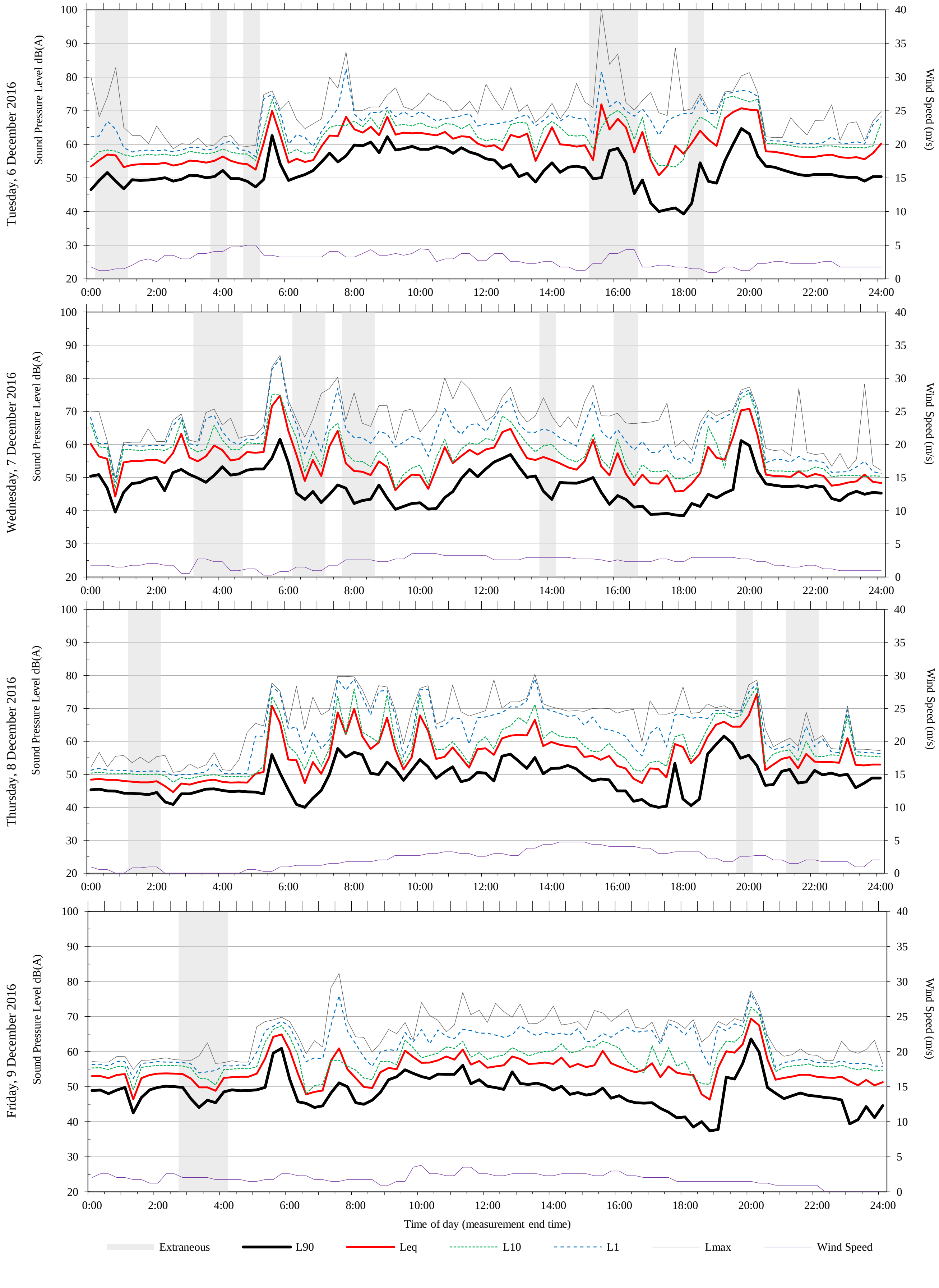


Unattended monitoring: 21 - Baseline (Free Field)

ARUP

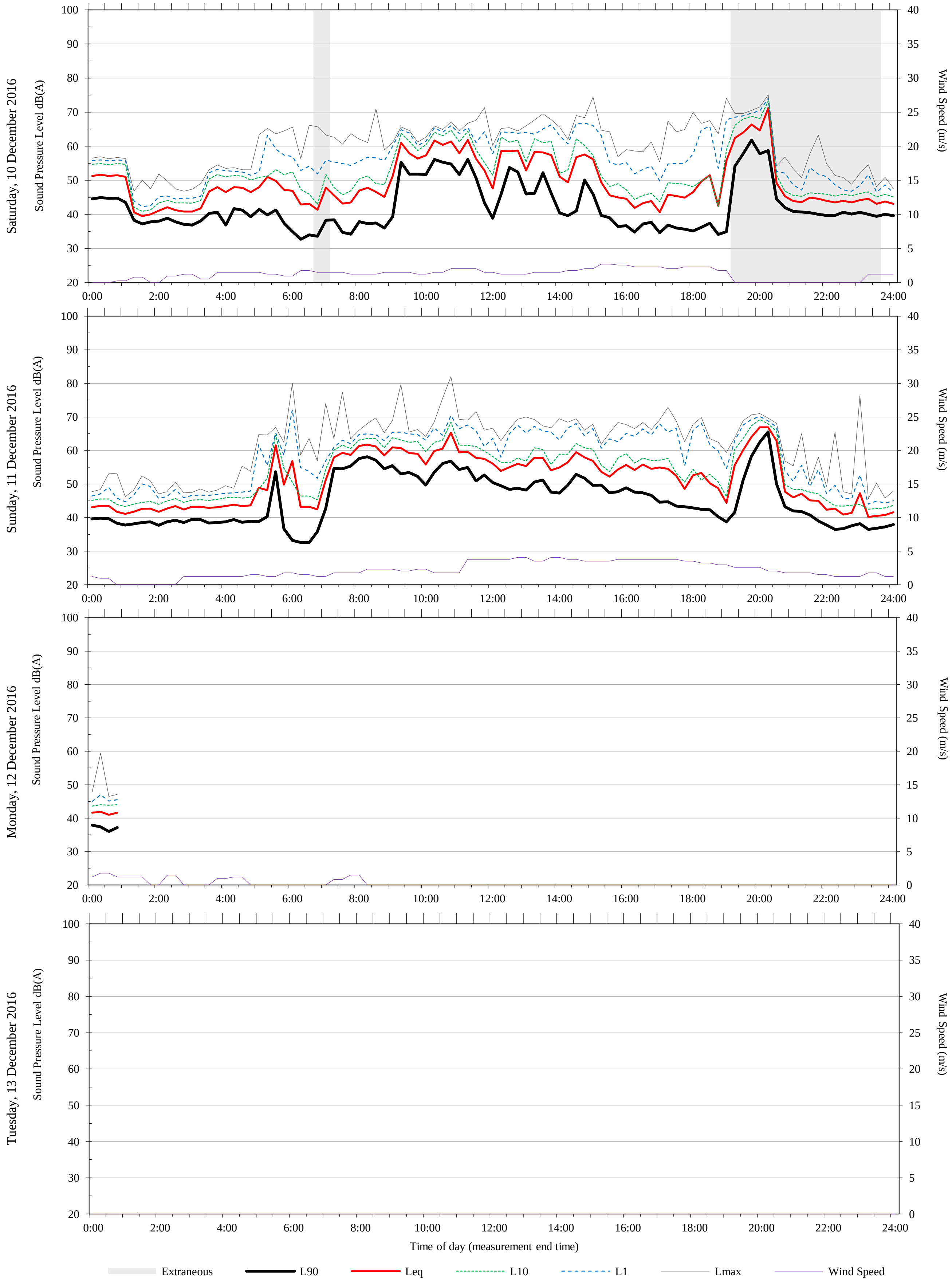


Unattended monitoring: 21 - Baseline (Free Field)



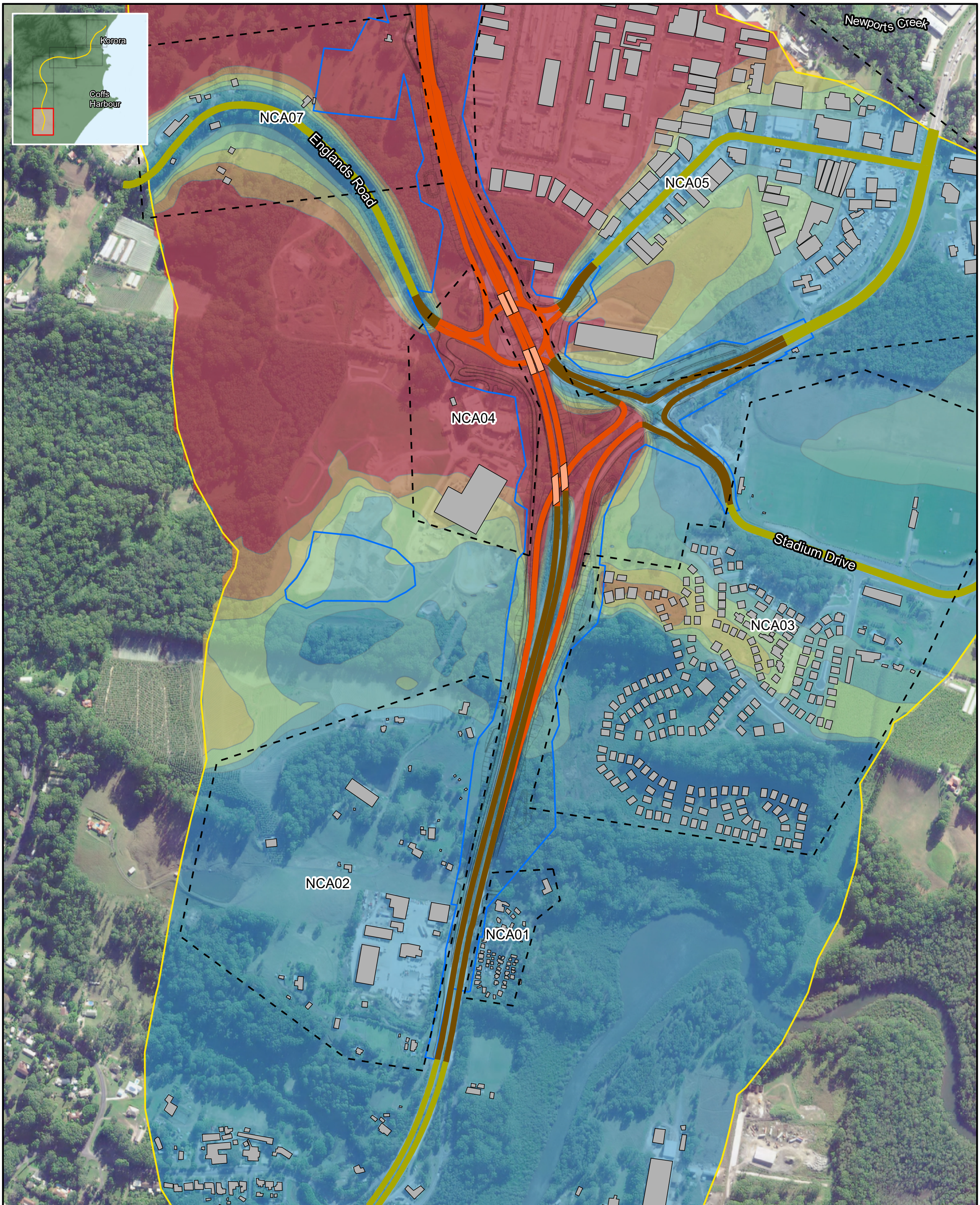
Unattended monitoring: 21 - Baseline (Free Field)

ARUP



Appendix E

Transition Zone Noise Contours



Legend

- Construction footprint
- Bridge
- Tunnel
- NCA
- Study Area
- New roads
- Redeveloped roads
- Existing Roads

2034 Daytime transition zone criteria

- Criteria: 60dBA
- Criteria: 59dBA
- Criteria: 58dBA
- Criteria: 57dBA
- Criteria: 56dBA
- Criteria: 55dBA

Coffs Harbour Bypass
NCG Transition Zones
Road classification and transition zone criteria - 01

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N

Legend

- Construction footprint
- Bridge
- Tunnel
- NCA
- Study Area
- New roads
- Redeveloped roads
- Existing Roads

2034 Daytime transition zone criteria

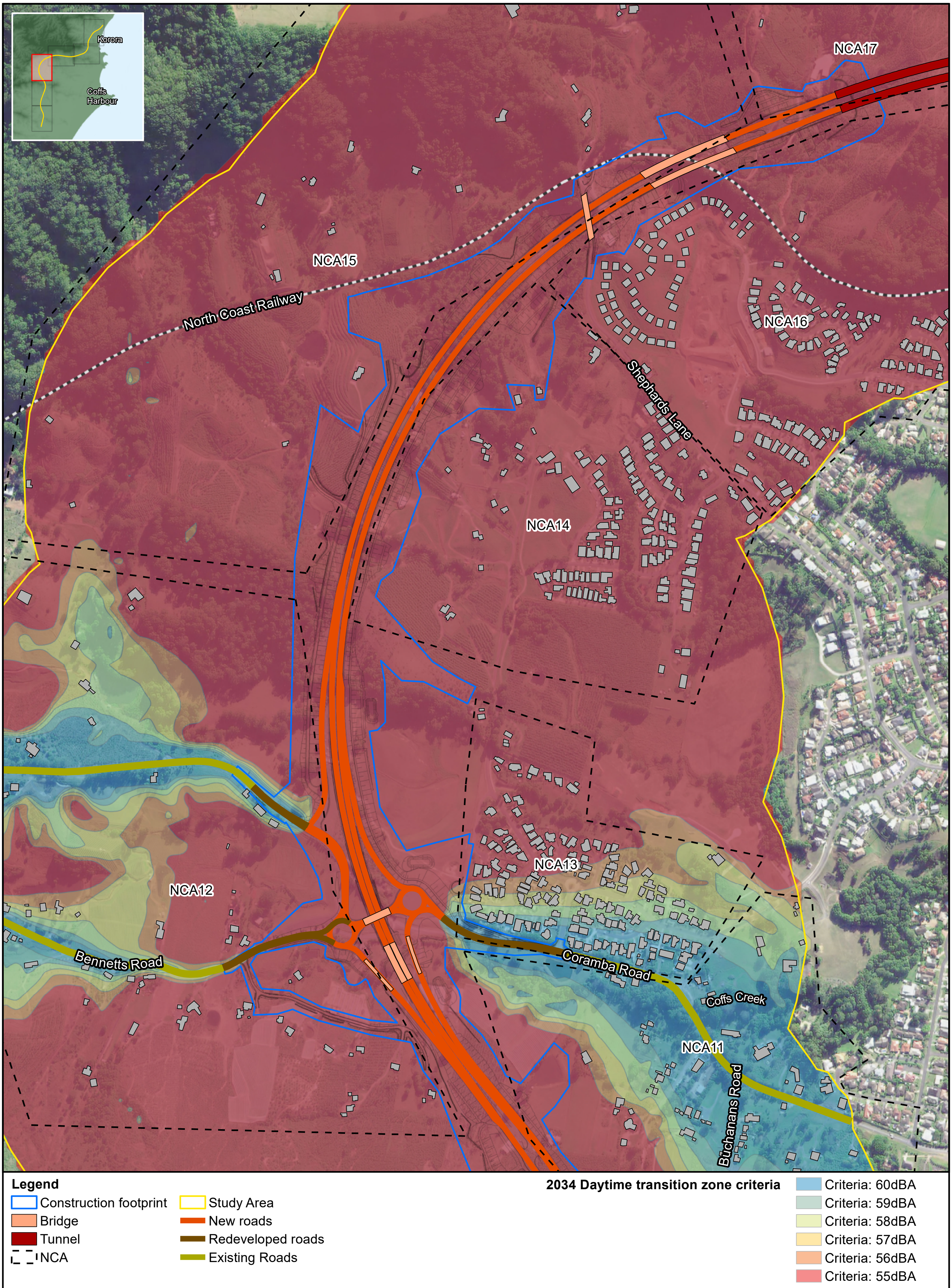
- Criteria: 60dBA
- Criteria: 59dBA
- Criteria: 58dBA
- Criteria: 57dBA
- Criteria: 56dBA
- Criteria: 55dBA

Coffs Harbour Bypass
NCG Transition Zones
Road classification and transition zone criteria - 02

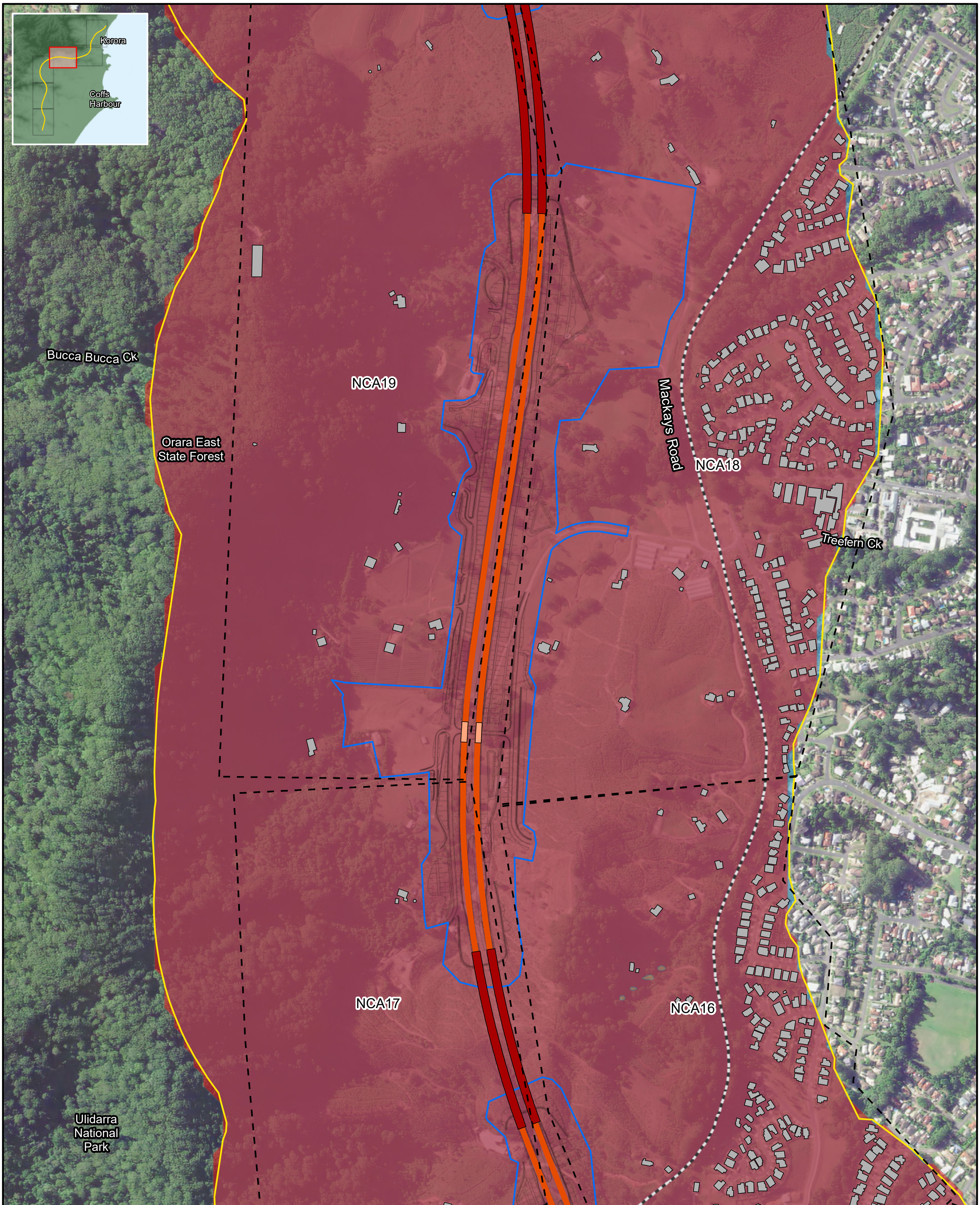
0 0.1 0.2 0.3 km

N

Scale @A4: 1:10,000
GDA 1994 MGA Zone 56



Coffs Harbour Bypass
NCG Transition Zones
Road classification and transition zone criteria - 03

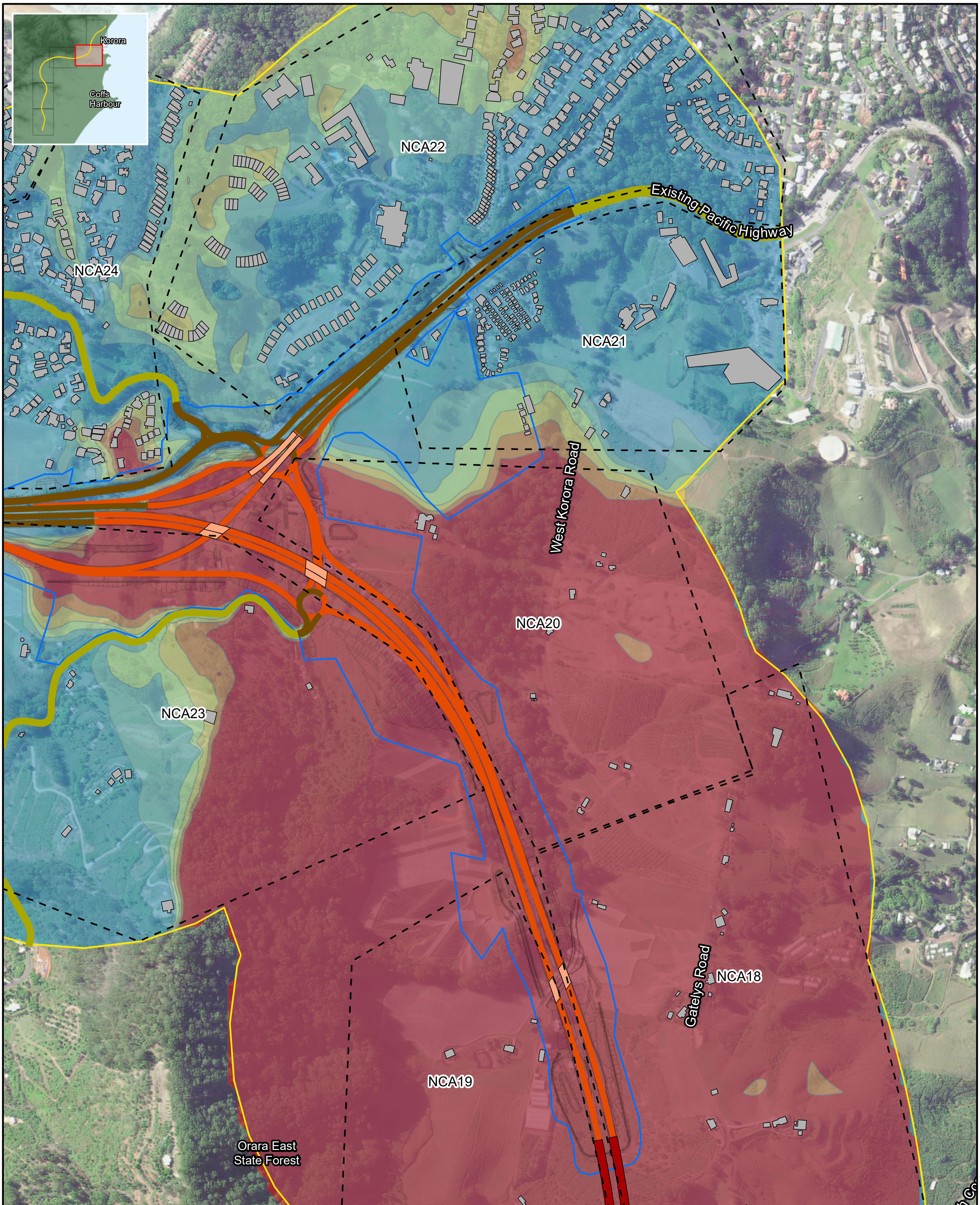


Legend
Construction footprint
Bridge
Tunnel
NCA
Study Area
New roads
Redeveloped roads
Existing Roads

2034 Daytime transition zone criteria
Criteria: 60dBA
Criteria: 59dBA
Criteria: 58dBA
Criteria: 57dBA
Criteria: 56dBA
Criteria: 55dBA

Coffs Harbour Bypass
NCG Transition Zones
Road classification and transition zone criteria - 04

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56



Legend

- Construction footprint
- Bridge
- Tunnel
- NCA
- Study Area
- New roads
- Redeveloped roads
- Existing Roads

2034 Daytime transition zone criteria

- Criteria: 60dBA
- Criteria: 59dBA
- Criteria: 58dBA
- Criteria: 57dBA
- Criteria: 56dBA
- Criteria: 55dBA

0 0.1 0.2 0.3 km

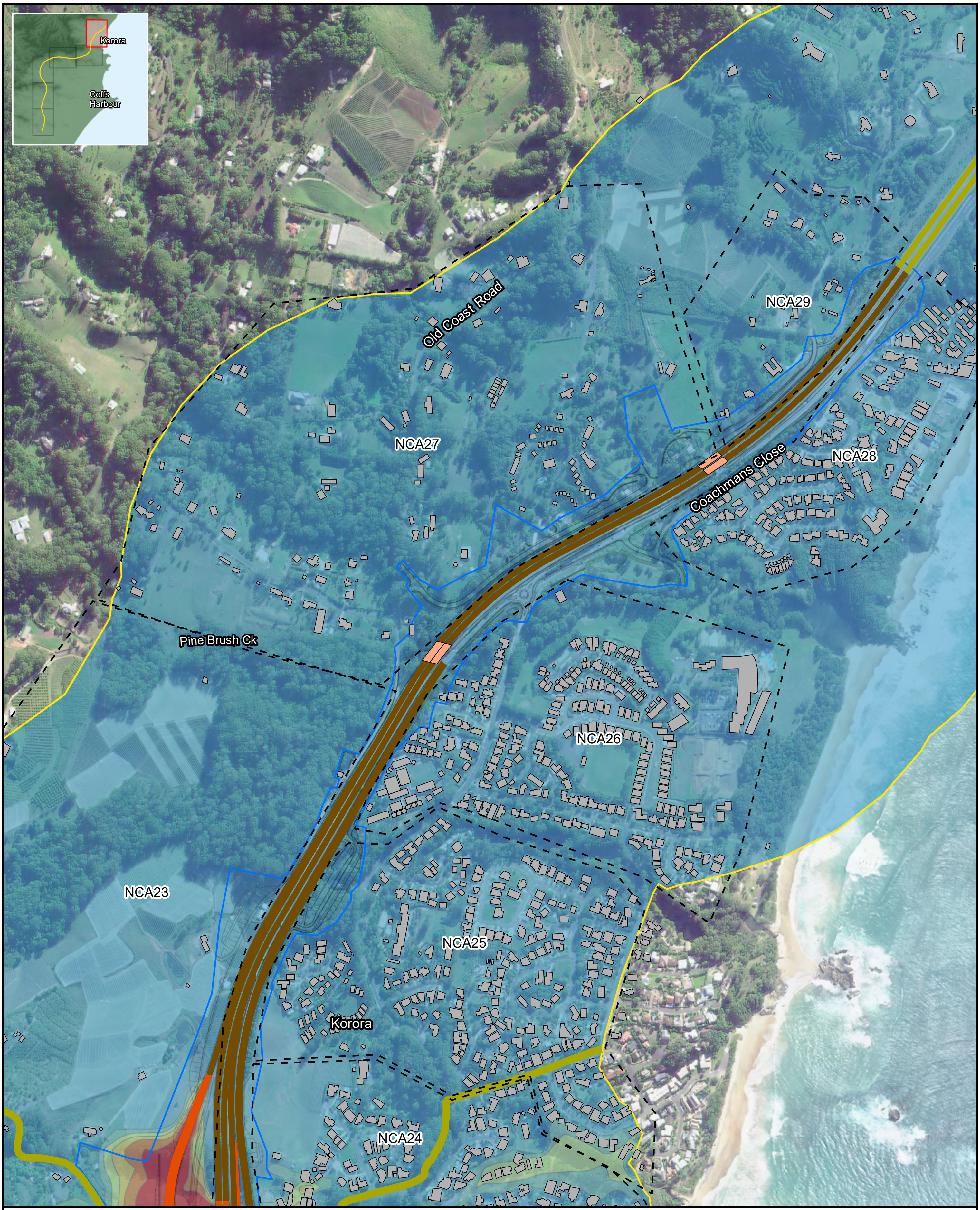
Scale @A4: 1:10,000

GDA 1994 MGA Zone 56

Coffs Harbour Bypass

NCG Transition Zones

Road classification and transition zone criteria - 05



Legend

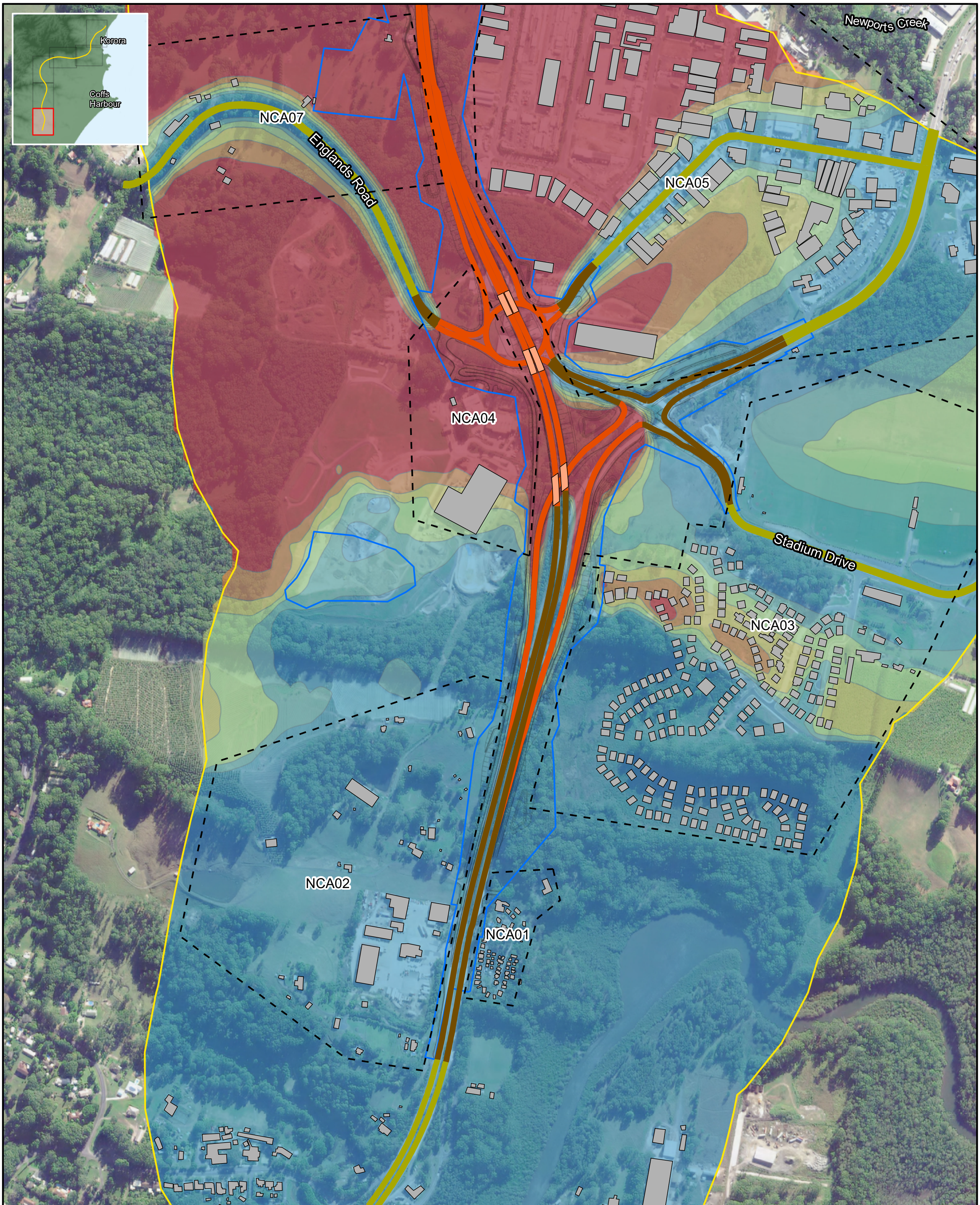
- Construction footprint
- Bridge
- Tunnel
- NCA
- Study Area
- New roads
- Redeveloped roads
- Existing Roads

2034 Daytime transition zone criteria

- Criteria: 60dBA
- Criteria: 59dBA
- Criteria: 58dBA
- Criteria: 57dBA
- Criteria: 56dBA
- Criteria: 55dBA

Coffs Harbour Bypass
NCG Transition Zones
Road classification and transition zone criteria - 06

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N



Legend

- Construction footprint
- Bridge
- Tunnel
- NCA
- Study Area
- New roads
- Redeveloped roads
- Existing Roads

2034 Night-time transition zone criteria

- Criteria: 55dBA
- Criteria: 54dBA
- Criteria: 53dBA
- Criteria: 52dBA
- Criteria: 51dBA
- Criteria: 50dBA

Coffs Harbour Bypass
NCG Transition Zones
Road classification and transition zone criteria - 01

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N

Legend

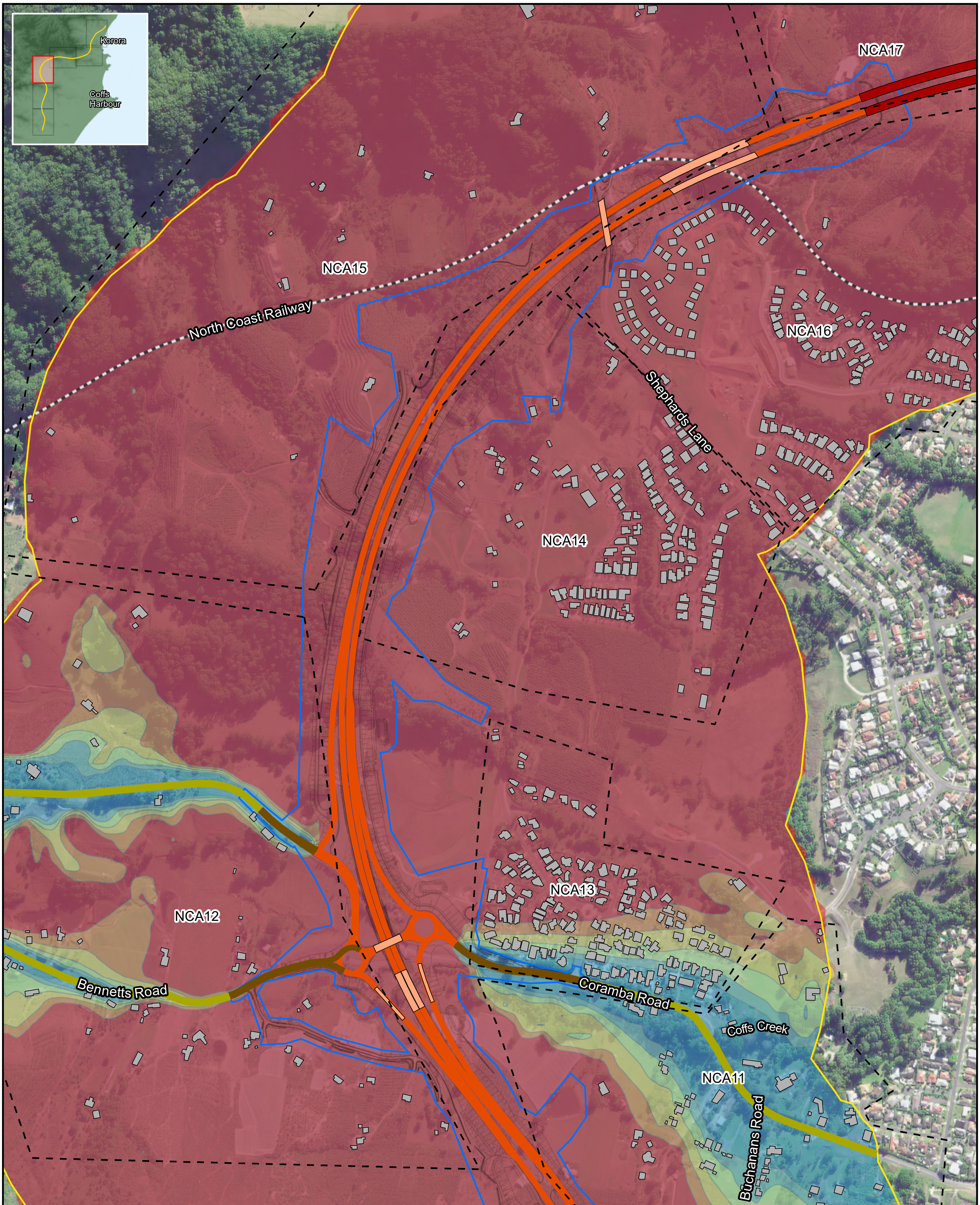
Construction footprint
Bridge
Tunnel
NCA
Study Area
New roads
Redeveloped roads
Existing Roads

2034 Night-time transition zone criteria

Criteria: 55dBA
Criteria: 54dBA
Criteria: 53dBA
Criteria: 52dBA
Criteria: 51dBA
Criteria: 50dBA

Coffs Harbour Bypass
NCG Transition Zones
Road classification and transition zone criteria - 02

0 0.1 0.2 0.3 km
N
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56



Legend

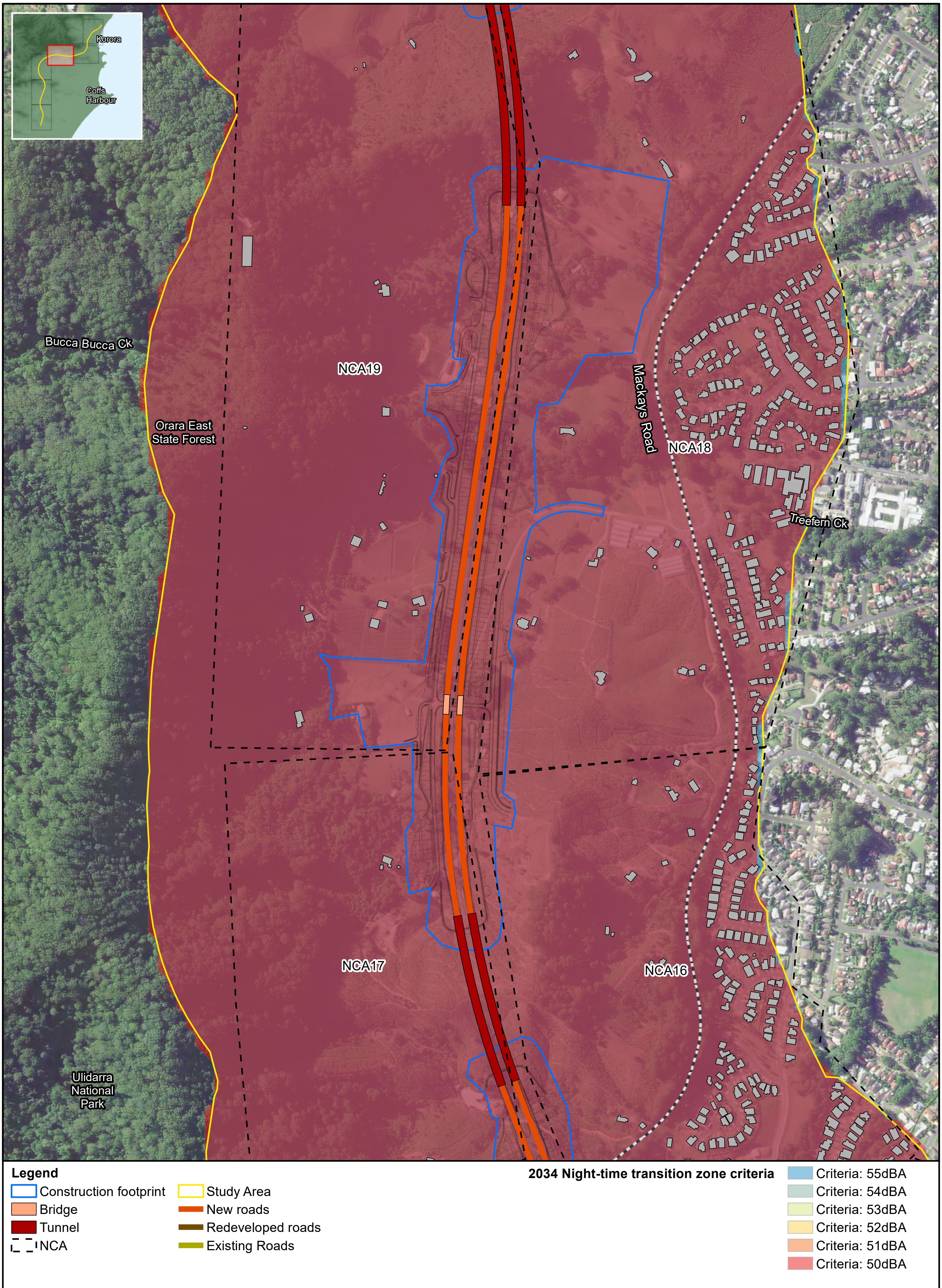
- Construction footprint
- Bridge
- Tunnel
- NCA
- Study Area
- New roads
- Redeveloped roads
- Existing Roads

2034 Night-time transition zone criteria

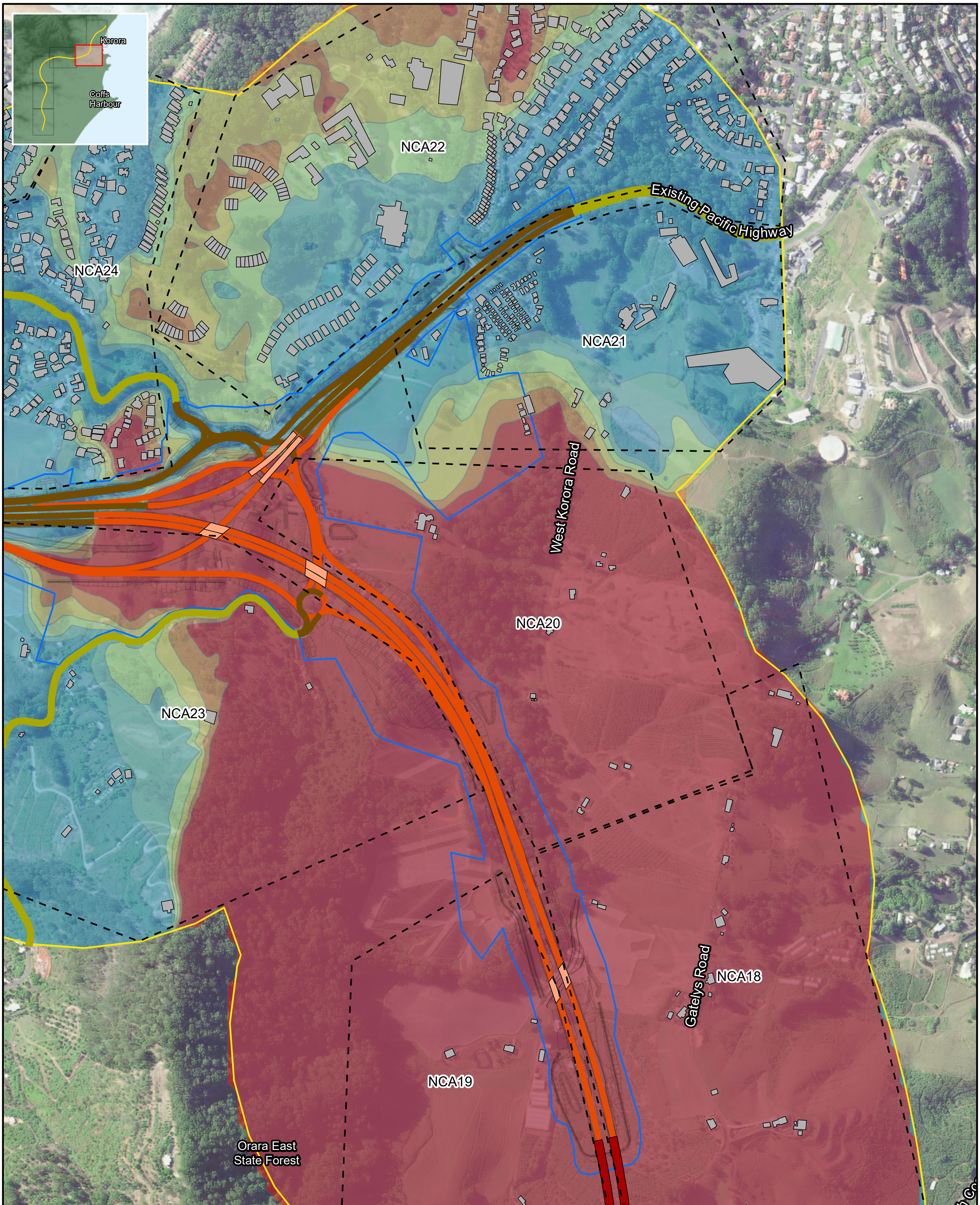
- Criteria: 55dBA
- Criteria: 54dBA
- Criteria: 53dBA
- Criteria: 52dBA
- Criteria: 51dBA
- Criteria: 50dBA

Coffs Harbour Bypass
NCG Transition Zones
Road classification and transition zone criteria - 03

0 0.1 0.2 0.3 km
N
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56



Coffs Harbour Bypass
NCG Transition Zones
Road classification and transition zone criteria - 04



Legend

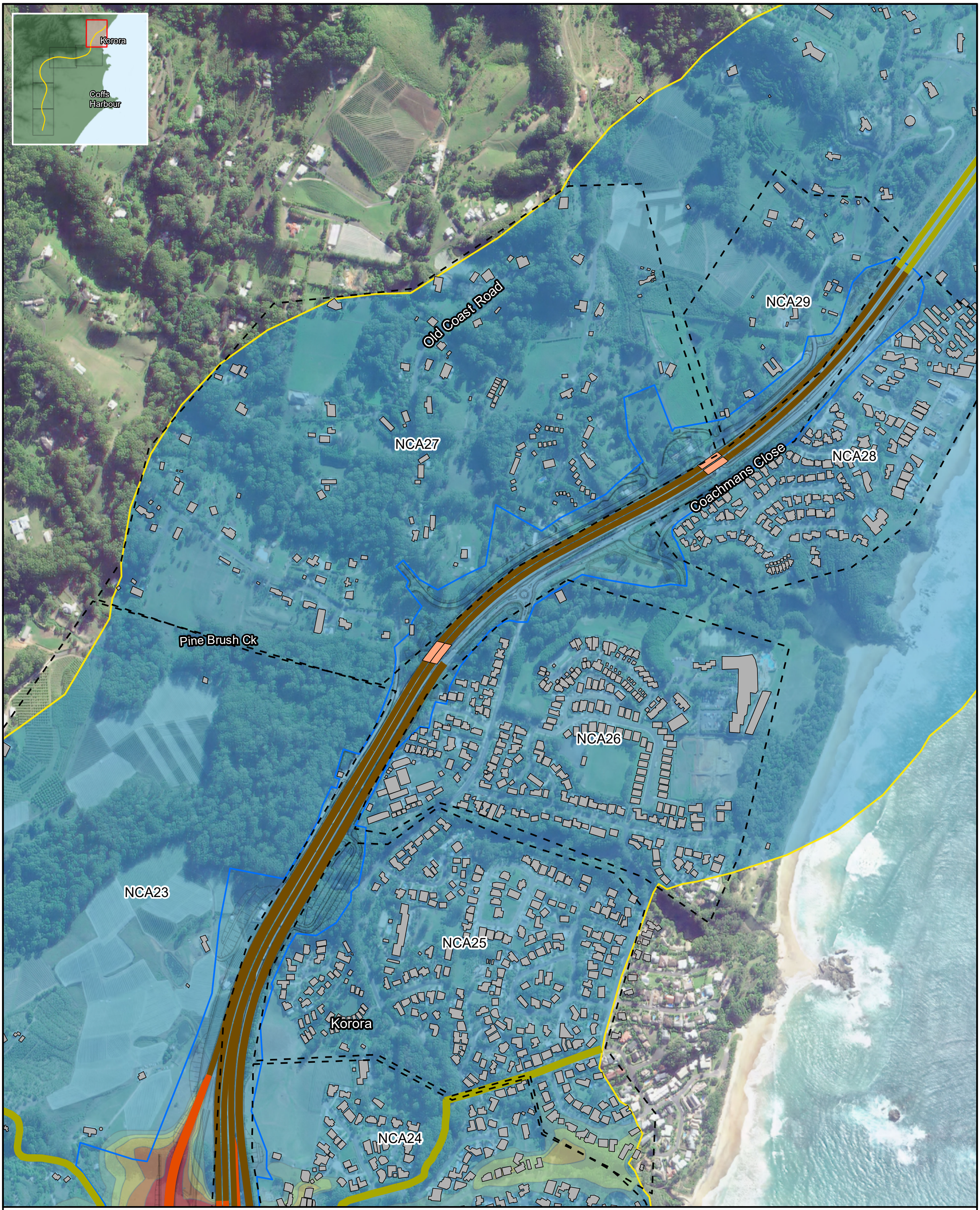
- Construction footprint
- Bridge
- Tunnel
- NCA
- Study Area
- New roads
- Redeveloped roads
- Existing Roads

2034 Night-time transition zone criteria

- Criteria: 55dBA
- Criteria: 54dBA
- Criteria: 53dBA
- Criteria: 52dBA
- Criteria: 51dBA
- Criteria: 50dBA

Coffs Harbour Bypass
NCG Transition Zones
Road classification and transition zone criteria - 05

0 0.1 0.2 0.3 km
N
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56



Legend

- Construction footprint
- Bridge
- Tunnel
- NCA
- Study Area
- New roads
- Redeveloped roads
- Existing Roads

2034 Night-time transition zone criteria

- Criteria: 55dBA
- Criteria: 54dBA
- Criteria: 53dBA
- Criteria: 52dBA
- Criteria: 51dBA
- Criteria: 50dBA

Coffs Harbour Bypass
NCG Transition Zones
Road classification and transition zone criteria - 06

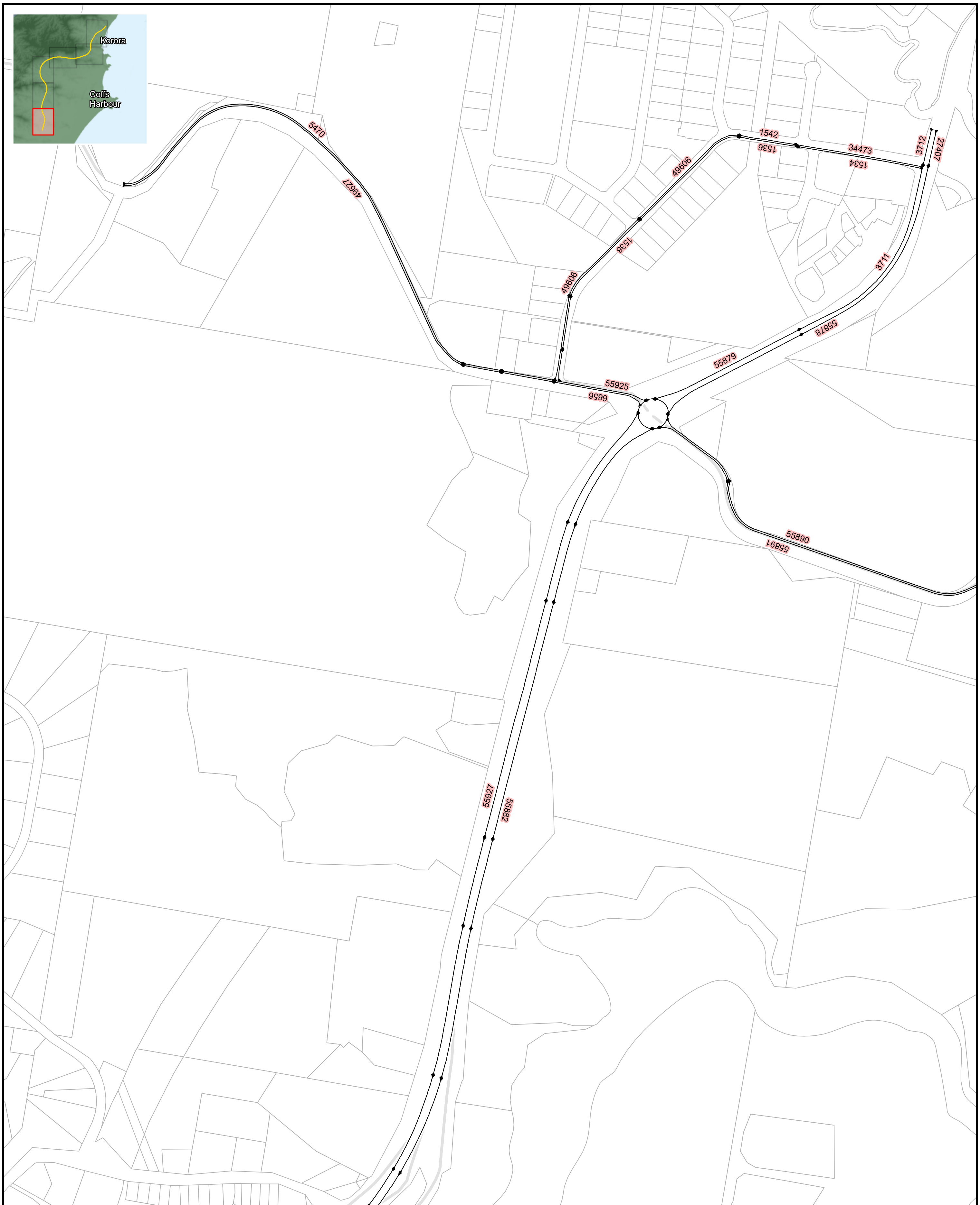
0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N

Appendix F

Traffic Modelling Parameters

F1 Road string IDs

F1.1 No Build Scenario



Legend

North Coast Railway

River (Major)

Park / State forest

Coffs Harbour Bypass

Appendix F

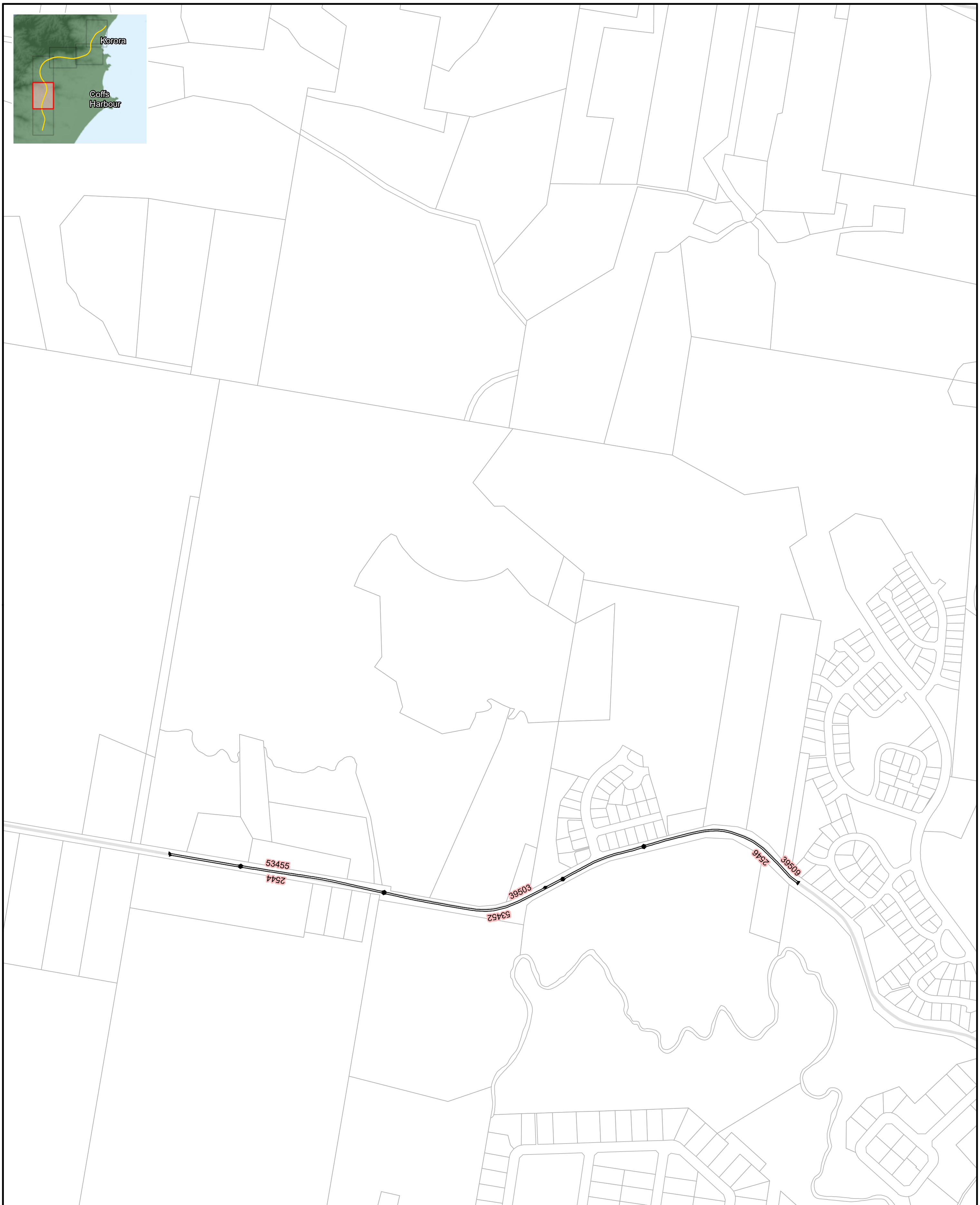
No-build scenario road string IDs - 01

0 0.1 0.2 0.3 km

N

Scale @A4: 1:10,000

GDA 1994 MGA Zone 56



Legend

North Coast Railway

River (Major)

Park / State forest

Coffs Harbour Bypass

Appendix F

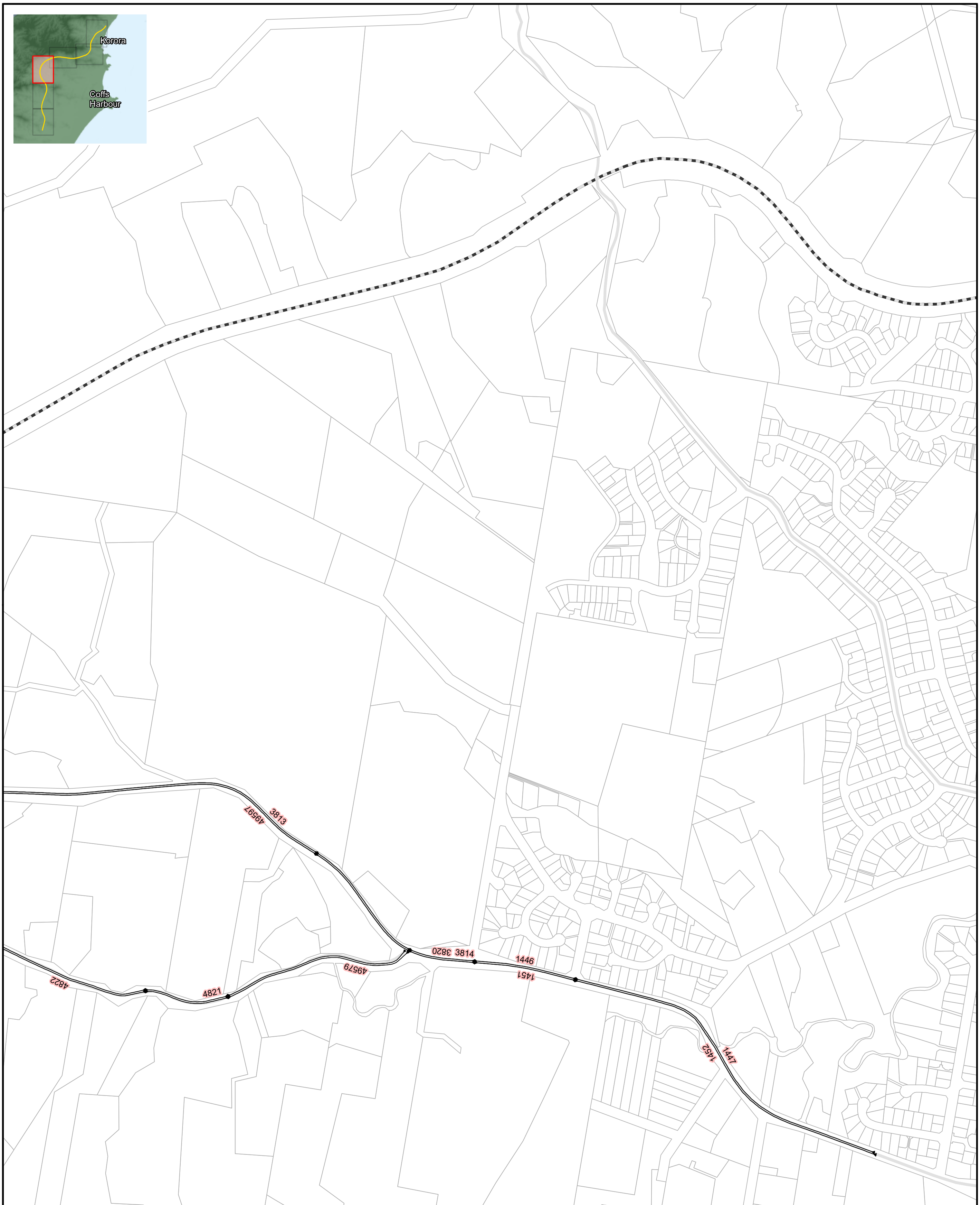
No-build scenario road string IDs - 02

0 0.1 0.2 0.3 km

Scale @A4: 1:10,000

GDA 1994 MGA Zone 56

N



Legend

North Coast Railway

River (Major)

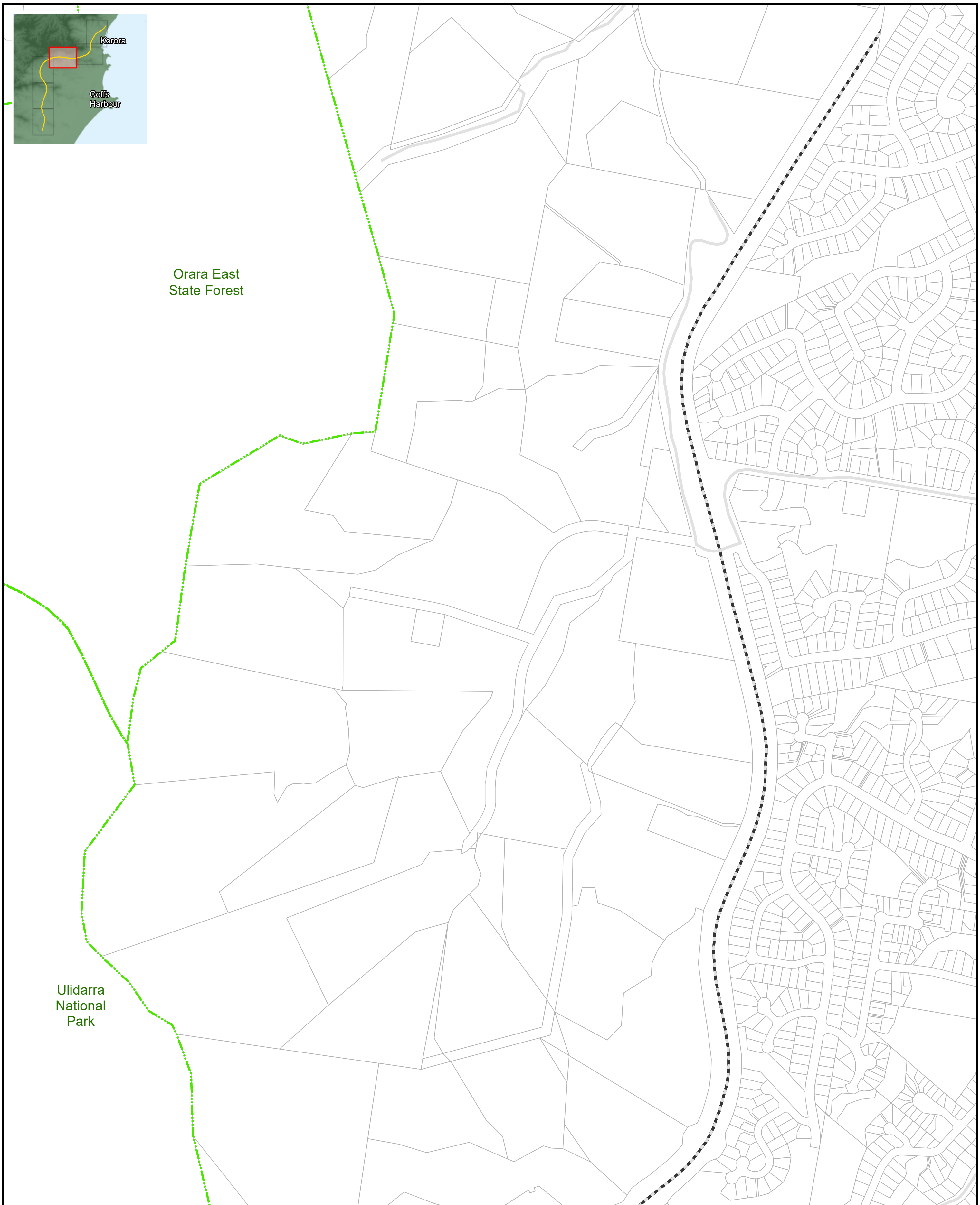
Park / State forest

Coffs Harbour Bypass
Appendix F
No-build scenario road string IDs - 03

0 0.1 0.2 0.3 km

Scale @A4: 1:10,000
GDA 1994 MGA Zone 56

N



Legend

North Coast Railway

River (Major)

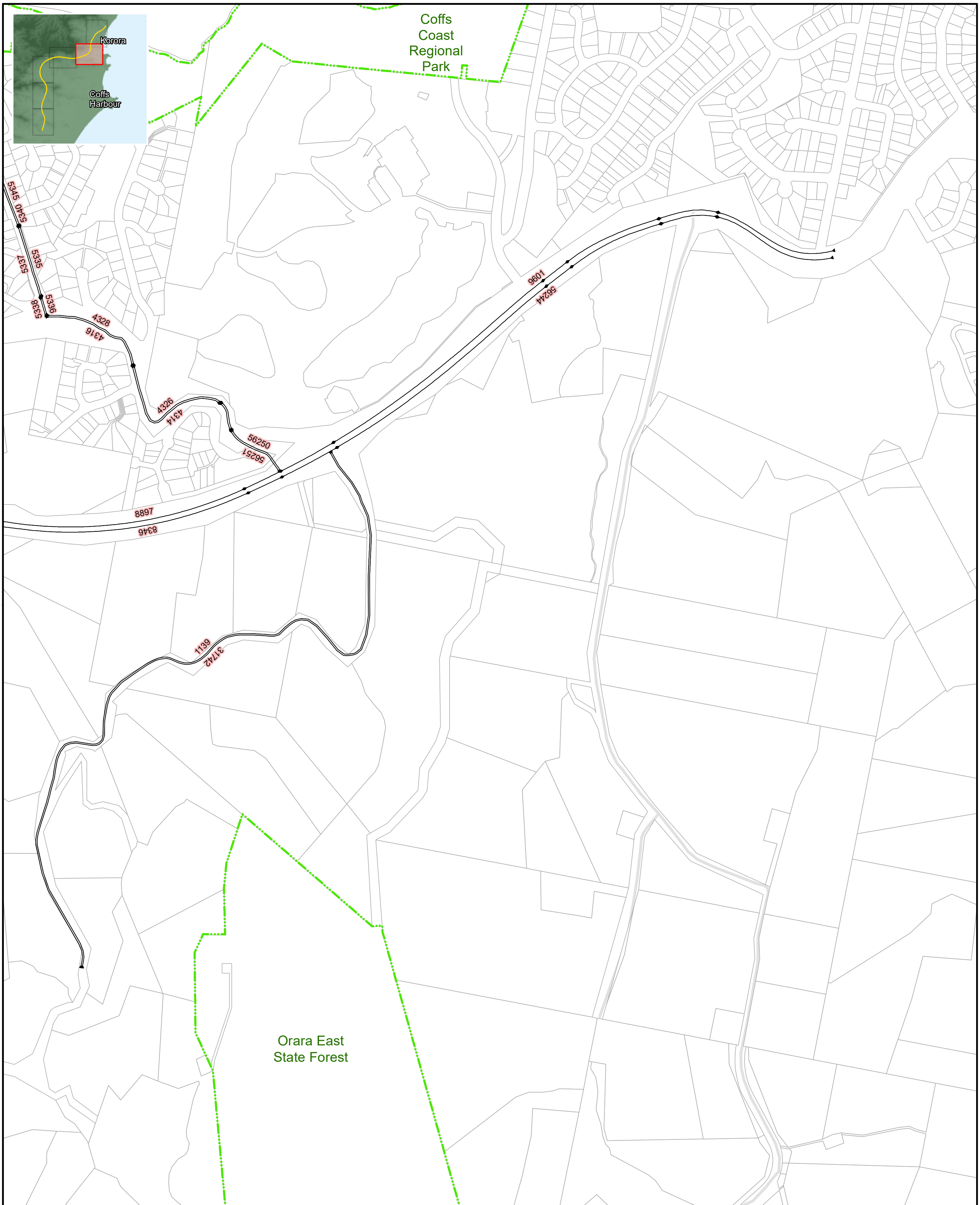
Park / State forest

Coffs Harbour Bypass
Appendix F
No-build scenario road string IDs - 04

0 0.1 0.2 0.3 km

N

Scale @A4: 1:10,000
GDA 1994 MGA Zone 56



Legend

North Coast Railway

River (Major)

Park / State forest

Coffs Harbour Bypass

Appendix F

No-build scenario road string IDs - 05

0 0.1 0.2 0.3 km

N

Scale @A4: 1:10,000

GDA 1994 MGA Zone 56

Legend

North Coast Railway

River (Major)

Park / State forest

Coffs Harbour Bypass
Appendix F
No-build scenario road string IDs - 06

0 0.1 0.2 0.3 km

Scale @A4: 1:10,000
GDA 1994 MGA Zone 56

N

F1.2 Build Scenario

Legend

North Coast Railway

River (Major)

Park / State forest

Coffs Harbour Bypass

Appendix F

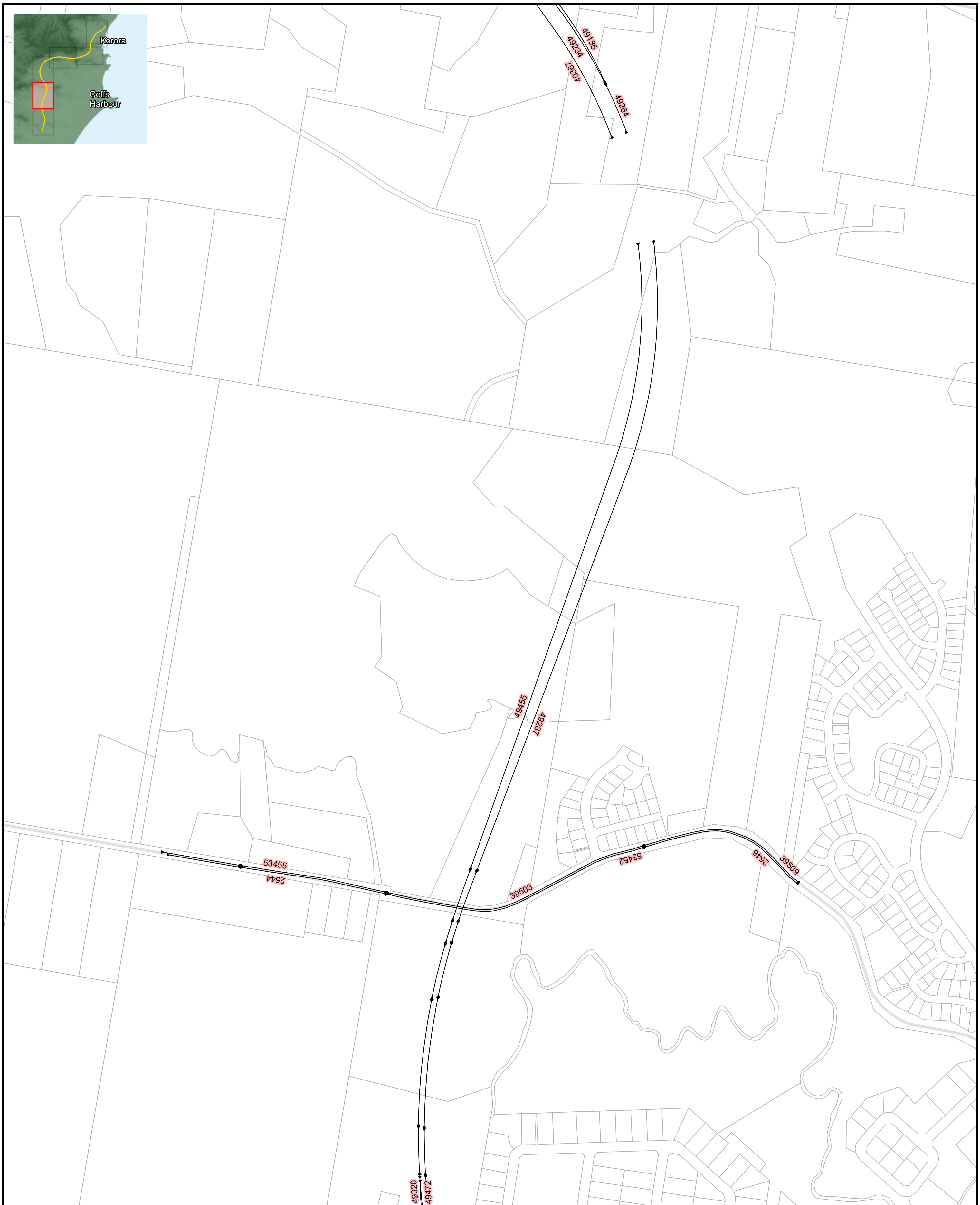
Build scenario road string IDs - 01

0 0.1 0.2 0.3 km

Scale @A4: 1:10,000

GDA 1994 MGA Zone 56

N

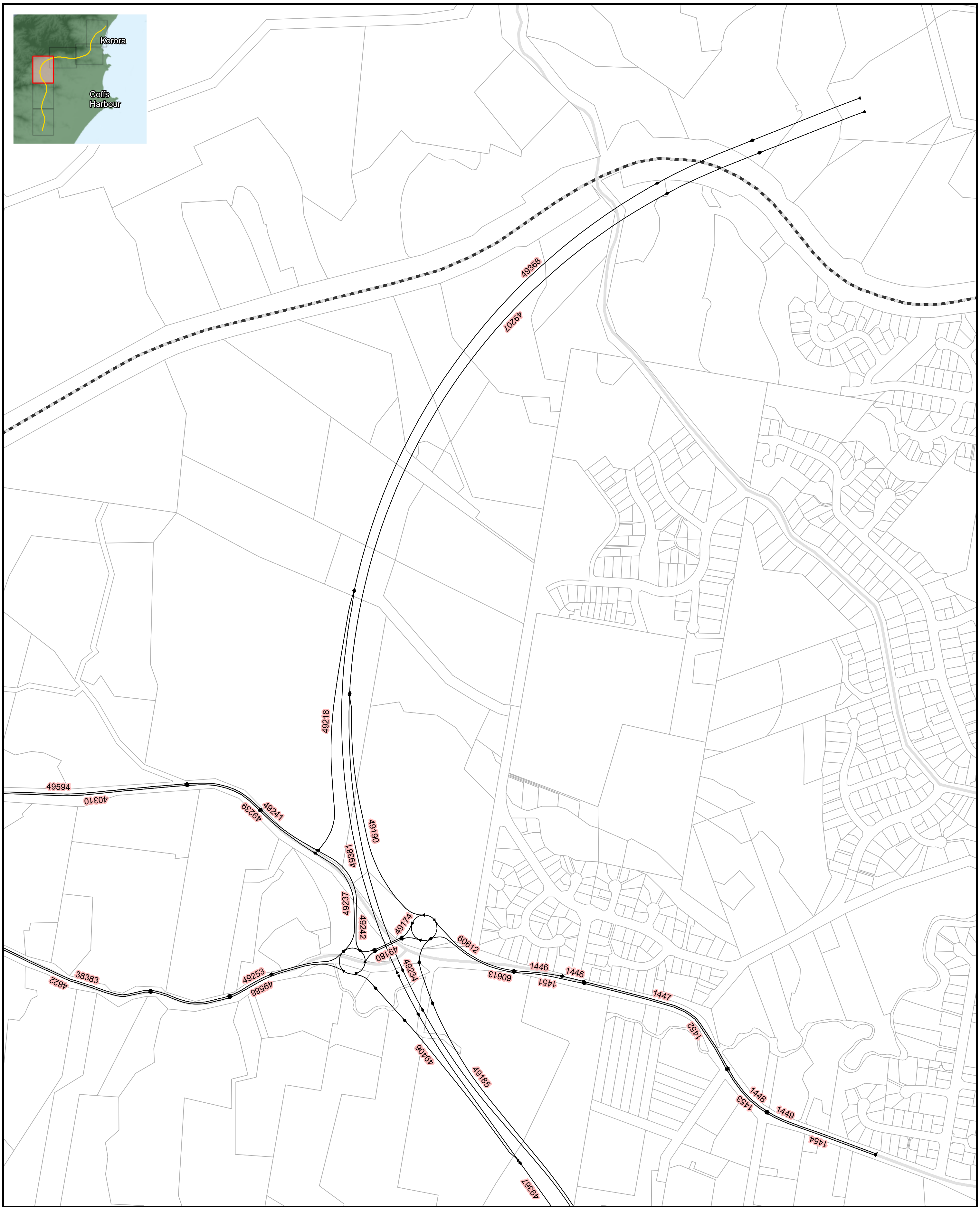


Legend

- North Coast Railway
- River (Major)
- Park / State forest

Coffs Harbour Bypass
Appendix F
Build scenario road string IDs - 02

0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N

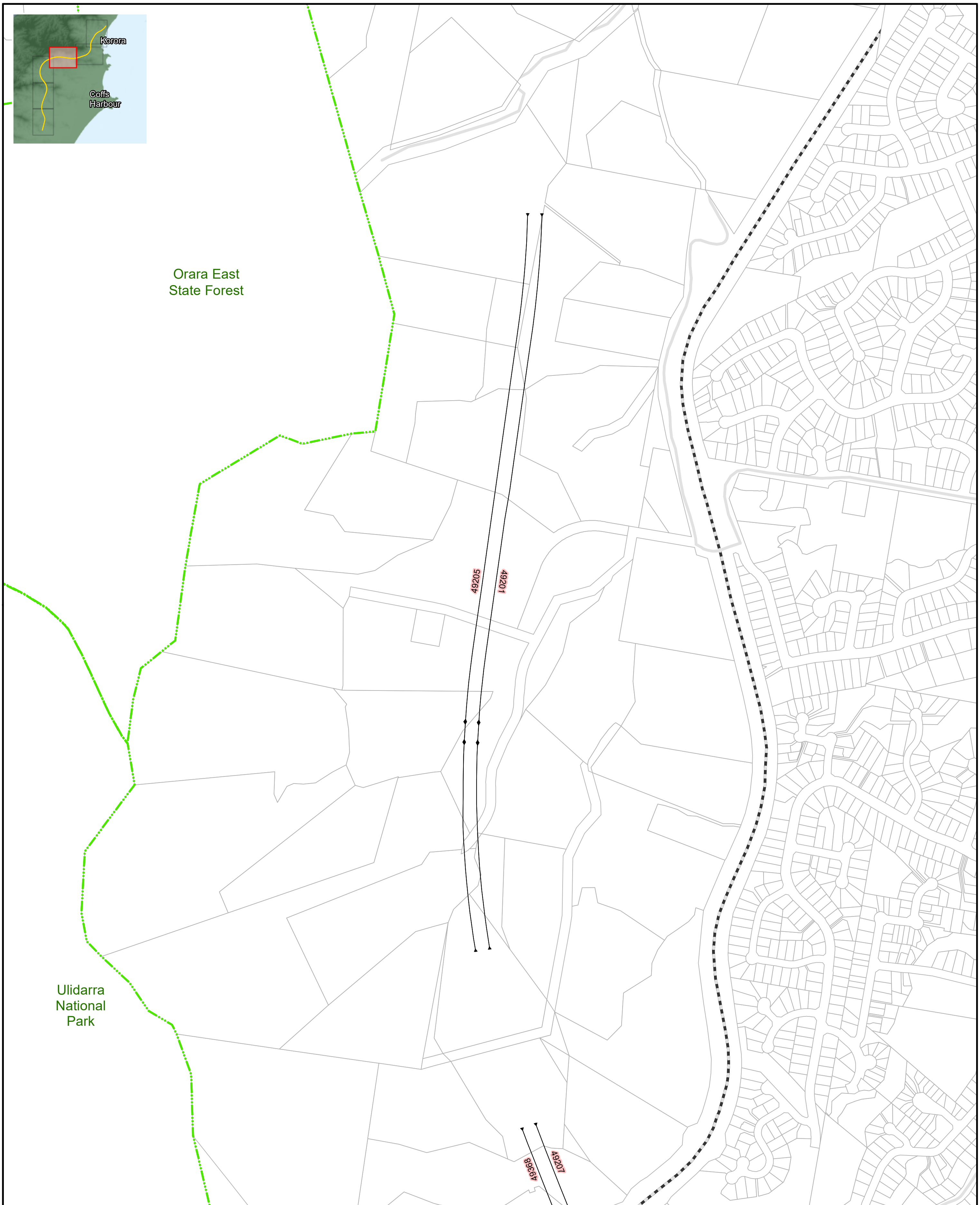


Legend

North Coast Railway
River (Major)
Park / State forest

Coffs Harbour Bypass
Appendix F
Build scenario road string IDs - 03

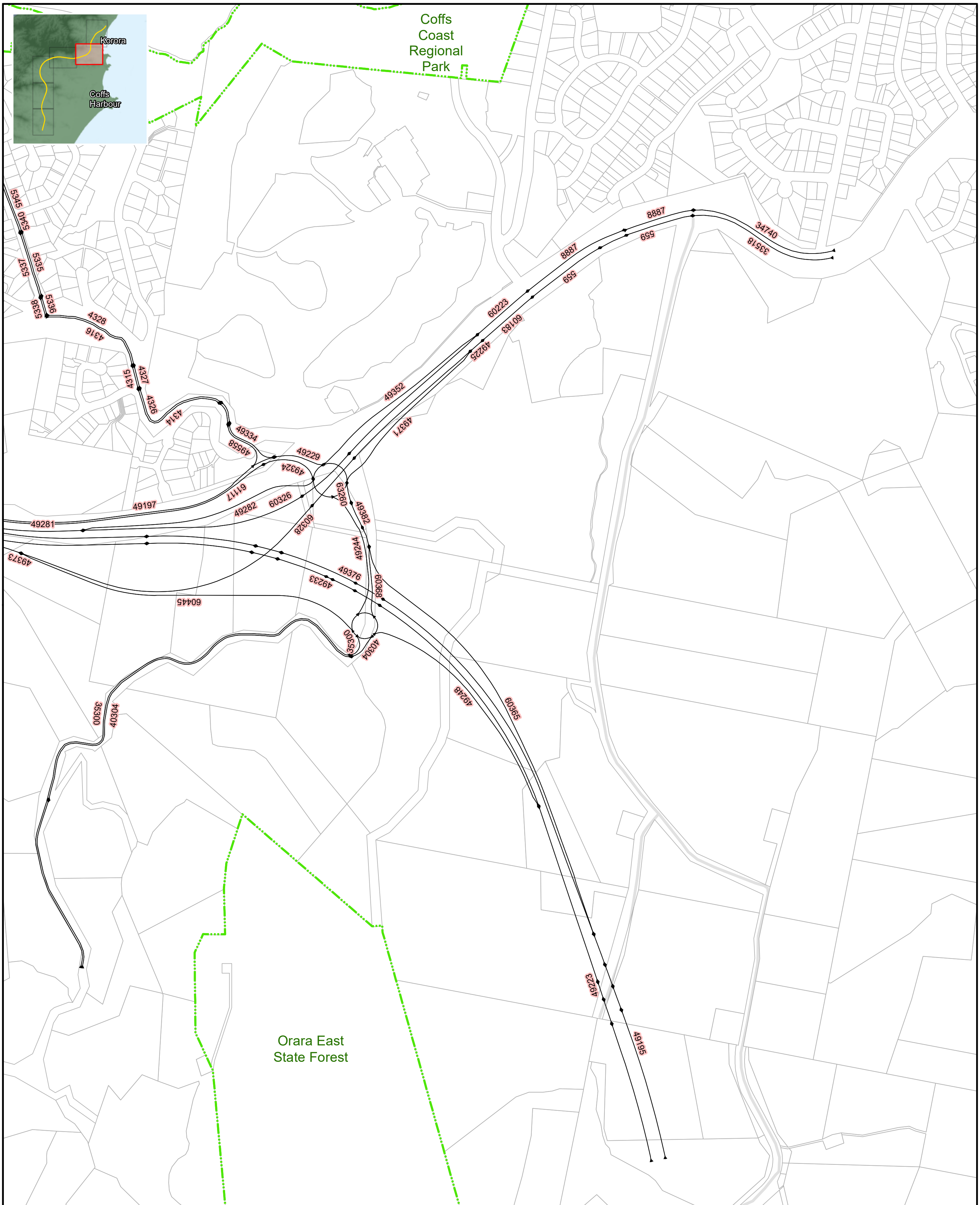
0 0.1 0.2 0.3 km
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56
N



Legend
- North Coast Railway
- River (Major)
- Park / State forest

Coffs Harbour Bypass
Appendix F
Build scenario road string IDs - 04

0 0.1 0.2 0.3 km
N
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56



Legend

North Coast Railway
River (Major)
Park / State forest

Coffs Harbour Bypass
Appendix F
Build scenario road string IDs - 05

0 0.1 0.2 0.3 km
N
Scale @A4: 1:10,000
GDA 1994 MGA Zone 56

Legend

North Coast Railway

River (Major)

Park / State forest

Coffs Harbour Bypass

Appendix F

Build scenario road string IDs - 06

0 0.1 0.2 0.3 km

Scale @A4: 1:10,000

GDA 1994 MGA Zone 56

N

F2 Traffic volumes

F2.1 Project Traffic Volumes

ID	No Build													Build													
	Speed km/h	2024 No Build						2034 No Build						Speed km/h	2024 Build						2034 Build					
		Daytime			Night-time			Daytime			Night-time				Daytime			Night-time			Daytime			Night-time		
		Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB		Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB
559	60	885	89	-1.8	320	49	-0.7	1055	100	-0.7	383	56	0.4	60	822	41	-3.0	284	16	-2.2	904	46	-2.6	312	17	-1.7
1139	50	31	3	-5.8	13	1	-5.6	43	4	-4.8	17	2	-4.5	-	-	-	-	-	-	-	-	-	-	-	-	-
1288	110	750	89	0.8	294	45	2.0	816	90	2.2	320	47	3.5	110	754	88	0.4	300	45	1.6	823	92	1.8	328	47	3.1
1446	70	206	13	-3.2	93	5	-3.2	209	15	-2.3	94	5	-2.4	70	260	11	-2.7	111	4	-2.9	287	12	-2.5	121	4	-2.6
1447	70	237	12	-2.8	103	4	-2.7	247	14	-1.7	107	5	-1.6	70	234	10	-2.6	101	3	-2.8	257	12	-2.5	109	4	-2.6
1448	70	237	12	-2.9	102	4	-2.8	246	14	-1.7	106	5	-1.6	70	234	10	-2.6	102	3	-2.8	256	12	-2.5	108	4	-2.6
1449	70	252	13	-3.0	109	4	-2.9	260	15	-1.9	112	5	-1.8	70	240	10	-2.6	104	3	-2.8	264	12	-2.7	112	4	-2.8
1451	70	162	11	-2.4	70	4	-2.3	168	14	-1.4	72	5	-1.3	70	256	13	-2.7	115	5	-2.4	263	24	-3.4	116	9	-3.2
1452	70	159	11	-2.8	72	4	-2.8	163	13	-2.0	74	5	-2.1	70	229	12	-2.5	101	4	-2.2	240	22	-3.5	104	8	-3.3
1453	70	159	11	-2.8	72	4	-2.8	163	13	-2.0	73	5	-2.1	70	230	12	-2.5	101	4	-2.2	239	23	-3.4	104	8	-3.1
1454	70	168	11	-2.8	76	4	-2.8	172	13	-2.0	77	5	-2.1	70	233	11	-2.5	103	4	-2.2	241	22	-3.3	105	8	-3.1
1534	40	111	15	-3.0	49	5	-3.2	101	14	-2.0	41	4	-2.4	40	79	16	-2.5	35	7	-1.9	93	16	-2.1	45	9	-0.9
1536	40	137	16	-3.4	60	5	-3.6	131	20	-2.8	54	7	-3.2	40	149	21	-3.1	65	9	-2.4	171	30	-2.5	83	16	-1.3
1537	40	125	10	-3.0	55	3	-3.2	127	21	-3.3	52	7	-3.7	40	207	28	-3.5	91	12	-2.7	239	45	-3.8	116	21	-2.4
1538	40	131	10	-3.0	55	3	-3.2	136	21	-3.3	56	7	-3.7	-	-	-	-	-	-	-	-	-	-	-	-	-
1542	40	113	28	-4.2	47	10	-4.1	128	28	-3.9	53	10	-3.7	40	87	21	-4.2	42	7	-4.5	98	19	-3.5	47	6	-4.0
1543	40	85	13	-5.0	35	5	-5.0	109	18	-2.3	45	7	-2.1	40	125	17	-5.3	60	6	-5.6	155	22	-2.9	74	7	-3.4
2544	50	3	0	-6.6	1	0	-6.6	6	0	0.0	3	0	0.0	50	4	0	-6.6	2	0	-6.6	5	0	0.0	2	0	0.0
2546	50	154	4	-6.6	62	1	-6.6	181	7	-6.6	74	3	-6.6	50	157	3	-6.6	64	1	-6.6	190	7	-6.6	78	2	-6.6
3711	60	641	84	-1.8	218	44	-0.7	708	96	-0.4	236	53	0.7	60	503	38	-3.3	203	11	-3.9	576	40	-2.8	232	12	-3.6
3712	60	791	114	-2.2	275	55	-1.0	876	125	-0.8	303	64	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-
3813	80	185	12	-2.5	83	4	-2.4	188	15	-1.9	84	5	-1.9	-	-	-	-	-	-	-	-	-	-	-	-	-
3814	80	195	12	-2.5	88	4	-2.4	201	15	-1.9	91	5	-1.8	-	-	-	-	-	-	-	-	-	-	-	-	-
3820	80	157	12	-1.9	68	4	-1.6	164	14	-0.7	70	5	-0.5	-	-	-	-	-	-	-	-	-	-	-	-	-
4314	50	125	2	-6.6	44	1	-6.6	121	2	-6.6	42	1	-6.6	50	98	1	-6.6	33	0	-6.6	99	2	-6.6	35	1	-6.6
4315	50	125	2	-6.6	44	1	-6.6	121	2	-6.6	42	1	-6.6	50	98	1	-6.6	33	0	-6.6	100	2	-6.6	35	1	-6.6
4316	50	108	3	-6.6	38	1	-6.6	107	2	-6.6	37	1	-6.6	50	77	1	-6.6	26	0	-6.6	82	2	-6.6	28	1	-6.6
4326	50	89	3	-6.6	32	1	-6.6	108	3	-6.6	39	1	-6.6	50	97	5	-6.6	36	2	-6.6	111	6	-3.4	40	2	-3.0
4327	50	89	3	-6.6	32	1	-6.6	108	3	-6.6	38	1	-6.6	50	97	5	-6.6	36	2	-6.6	110	6	-3.4	40	2	-3.0
4328	50	75	2	-6.6	27	1	-6.6	87	1	-6.6	31	0	-6.6	50	79	3	-6.6	28	1	-6.6	87	3	-1.9	31	2	-1.5
4821	40	11	0	0.0	5	0	0.0	14	0	0.0	6	0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-
4822	40	1	3	-6.6	0	1	-6.6	2	2	-6.6	1	1	-6.6	40	1	2	-6.6	1	1	-6.6	2	4	-6.6	1	2	-6.6
5335	50	18	1	-6.6	6	0	-6.6	22	0	0.0	7	0	0.0	50	21	1	-6.6	7	0	-6.6	24	0	0.0	8	0	0.0
5336	50	41	2	-6.6	14	1	-6.6	46	0	0.0	15	0	0.0	50	45	2	-6.6	16	1	-6.6	50	0	0.0	17	0	0.0
5337	50	15	0	0.0	5	0	0.0	17	0	0.0	5	0	0.0	50	15	0	0.0	5	0	0.0	20	0	0.0	6	0	0.0
5338	50	37	0	0.0	12	0	0.0	39	0	0.0	12	0	0.0	50	42	0	0.0	14	0	0.0	45	0	0.0	15	0	0.0
5340	50	15	0	0.0	5	0	0.0	17	0	0.0	5	0	0.0	50	15	0	0.0	5	0	0.0	20	0	0.0	6	0	0.0
5345	50	18	1	-6.6	6	0	-6.6	22	0	0.0	7	0	0.0	50	21	1	-6.6	7	0	-6.6	24	0	0.0	8	0	0.0
5470	50	132	24	-4.7	56	9	-4.6	204	31	-2.7	87	11	-2.5	-	-	-	-	-	-	-	-	-	-	-	-	-
6656	50	173	29	-4.5	71	9	-5.2	242	39	-3.3	104	12	-4.3	-	-	-	-	-	-	-	-	-	-	-	-	-
7396	100	591	73	0.6	240	39	1.9	629	77	2.2	254	44	3.4	100	582	71	0.5	237	36	1.6	643	76	2.1	260	40	3.3
7397	100	534	86	0.4	236	47	1.8	573	110	2.0	253	63	3.3	100	568	86	0.3	243	45	1.7	656	117	1.8	284	63	3.2
8346	80	741	89	-0.3	273	50	0.9	875	96	0.9	322	55	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
8887	60	976	101	-2.1	375	50	-1.1	1084	110	-1.0	416	55	0.1	60	867	48	-2.9	309	18	-2.5	944	53	-3.1	335	20	-2.7
8897	80	836	96	-0.6	328	48	0.5	906	98	0.6	355	50	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-
9601	60	962	102	-2.1	371	50	-1.0	1070	107	-0.9	412	54	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-
9743	110	647	86	1.1	238	49	2.4	771	92	2.5	283	53	3.8	110	655	84	0.6	243	47	1.9	774	92	1.9	288	52	3.3
27407	60	672	112	-1.8	262	57	-0.8	683	118	-0.7	260	62	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-
27784	100	759	108	0.2	323	56	1.6	805	134	1.7	342	72	3.1	100	862	113	0.1	369	57	1.5	971	143	1.6	419	75	3.0
31742	50	31	0	-6.6	12	0	-6.6	43	1	-6.6	17	0	-6.6	-	-	-	-	-	-	-	-	-	-	-	-	-
33518	60	905	89	-1.8	327	49	-0.7	1095	101	-0.8	397	56	0.4	60	838	40	-3.0	290	15	-2.2	933	46	-2.6	322	17	-1.7
34473	40	160	31	-4.3	67	11	-4.2	180	31	-3.0	75	11	-2.8	40	102	21	-4.2	49	7	-4.6	118	17	-3.2	57	6	-3.7
34680	60	564	100	-1.8	202	54	-0.7	591	113	-0.6	210	64	0.6	60	417	38	-3.1	178	14	-2.4	463	45	-2.0	196	15	-1.5
34740	60	993	104	-2.1	382	51	-1.1	1126	111	-1.0	432	56	0.1	60	879	49	-2.9	313	18	-2.5	970	55	-3.1	344	20	-2.7
35300	-	-	-	-	-	-	-	-	-	-	-	-	-	50	32	3	-5.6	13	1	-5.4	42	4	-4.7	17	2	-4.4
38383	-	-	-	-	-	-	-	-	-	-	-	-	-	40	3	0	0.0	2	0	0.0	7	0	0.0	3	0	0.0
39503	50	48	0	-6.6	23	0	-6.6	93	1	-6.6	43	0	-6.6	50	46	0	-6.6	22	0	-6.6	92	1	-6.6	44	0	-6.6
39509	50	175	1	-6.6	73	0	-6.6	218	2	-3.3	93	1	-3.4	50	175	1	-6.6	73	0	-6.6	218	2	-3.3	93	1	-3.4
40304	-	-	-	-	-	-	-	-	-	-	-	-	-	50	28	0	-6.6	12	0	-6.6	43	1	-6.6	16	0	-6.6
40310	-	-	-	-	-	-	-	-	-	-	-	-	-	80	149	9	-1.4	65	3	-1.2	154	12	-0.2	66	4	-0.1

ID	No Build													Build												
		2024 No Build						2034 No Build							2024 Build						2034 Build					
		Daytime			Night-time			Daytime			Night-time				Daytime			Night-time			Daytime			Night-time		
	Speed km/h	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Speed km/h	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB
49174	-	-	-	-	-	-	-	-	-	-	-	-	-	70	267	15	-2.9	118	5	-2.9	285	17	-2.1	124	6	-2.1
49180	-	-	-	-	-	-	-	-	-	-	-	-	-	70	122	6	-2.6	53	2	-2.5	133	10	-3.8	57	4	-3.7
49185	-	-	-	-	-	-	-	-	-	-	-	-	-	60	208	15	-4.0	97	5	-3.8	213	21	-3.8	98	7	-3.6
49190	-	-	-	-	-	-	-	-	-	-	-	-	-	60	60	4	-4.0	25	1	-4.0	77	3	-5.5	30	1	-5.3
49195	-	-	-	-	-	-	-	-	-	-	-	-	-	110	439	76	0.3	197	40	1.6	514	80	2.2	230	46	3.4
49196	-	-	-	-	-	-	-	-	-	-	-	-	-	100	961	94	0.2	391	45	1.4	1036	107	1.6	418	54	2.9
49197	-	-	-	-	-	-	-	-	-	-	-	-	-	50	155	5	-4.8	58	2	-4.8	174	5	-5.2	64	2	-5.2
49201	-	-	-	-	-	-	-	-	-	-	-	-	-	110	439	75	0.2	197	39	1.6	516	81	2.2	231	46	3.5
49205	-	-	-	-	-	-	-	-	-	-	-	-	-	110	453	67	0.5	189	40	1.8	523	78	2.1	217	49	3.4
49207	-	-	-	-	-	-	-	-	-	-	-	-	-	110	437	76	0.2	196	40	1.6	513	78	2.2	229	45	3.5
49208	-	-	-	-	-	-	-	-	-	-	-	-	-	100	863	113	0.1	369	57	1.5	973	143	1.6	420	76	3.0
49218	-	-	-	-	-	-	-	-	-	-	-	-	-	60	66	4	-4.8	27	1	-4.8	70	6	-4.1	29	2	-4.0
49223	-	-	-	-	-	-	-	-	-	-	-	-	-	110	451	67	0.5	188	40	1.8	519	78	2.1	215	49	3.4
49225	-	-	-	-	-	-	-	-	-	-	-	-	-	60	836	41	-3.0	289	16	-2.1	938	48	-2.6	324	18	-1.7
49229	-	-	-	-	-	-	-	-	-	-	-	-	-	50	255	9	-5.6	89	3	-5.9	289	11	-4.4	99	4	-4.8
49233	-	-	-	-	-	-	-	-	-	-	-	-	-	110	170	50	0.9	71	32	2.1	202	61	2.5	85	41	3.7
49234	-	-	-	-	-	-	-	-	-	-	-	-	-	110	375	72	0.4	171	38	1.7	435	77	2.4	198	45	3.6
49237	-	-	-	-	-	-	-	-	-	-	-	-	-	70	169	10	-2.2	73	3	-2.0	184	15	-1.2	78	5	-1.1
49239	-	-	-	-	-	-	-	-	-	-	-	-	-	70	147	10	-2.1	64	3	-1.9	156	12	-0.7	67	4	-0.6
49241	-	-	-	-	-	-	-	-	-	-	-	-	-	70	181	12	-3.1	82	4	-3.1	187	15	-2.5	85	5	-2.6
49242	-	-	-	-	-	-	-	-	-	-	-	-	-	70	138	9	-2.9	64	3	-3.0	144	11	-2.4	66	4	-2.6
49244	-	-	-	-	-	-	-	-	-	-	-	-	-	50	284	18	-4.5	117	7	-3.2	319	22	-3.2	126	11	-1.8
49248	-	-	-	-	-	-	-	-	-	-	-	-	-	60	256	16	-3.3	106	6	-1.9	289	18	-2.2	115	9	-0.7
49253	-	-	-	-	-	-	-	-	-	-	-	-	-	40	11	0	0.0	5	0	0.0	14	0	0.0	6	0	0.0
49257	-	-	-	-	-	-	-	-	-	-	-	-	-	110	653	89	0.6	273	55	1.8	771	100	1.9	325	63	3.3
49263	-	-	-	-	-	-	-	-	-	-	-	-	-	110	752	92	0.4	300	46	1.6	825	92	1.8	329	48	3.1
49264	-	-	-	-	-	-	-	-	-	-	-	-	-	110	577	87	0.1	266	44	1.4	640	99	1.9	292	54	3.2
49281	-	-	-	-	-	-	-	-	-	-	-	-	-	100	509	27	-0.1	185	11	0.6	530	28	-1.0	193	11	-0.4
49282	-	-	-	-	-	-	-	-	-	-	-	-	-	80	55	0	0.0	19	0	0.0	59	0	0.0	20	0	0.0
49287	-	-	-	-	-	-	-	-	-	-	-	-	-	110	576	88	0.1	265	45	1.5	637	102	1.8	291	55	3.2
49292	-	-	-	-	-	-	-	-	-	-	-	-	-	110	754	91	0.4	301	46	1.6	820	91	1.8	327	47	3.1
49313	-	-	-	-	-	-	-	-	-	-	-	-	-	110	360	66	0.6	154	39	1.9	392	78	2.4	167	49	3.6
49320	-	-	-	-	-	-	-	-	-	-	-	-	-	110	340	51	1.1	138	34	2.2	375	54	2.8	149	39	3.8
49324	-	-	-	-	-	-	-	-	-	-	-	-	-	50	296	6	-6.1	100	2	-6.1	304	7	-6.6	103	3	-6.6
49334	-	-	-	-	-	-	-	-	-	-	-	-	-	50	97	5	-6.6	36	2	-6.6	110	6	-3.4	40	2	-3.0
49352	-	-	-	-	-	-	-	-	-	-	-	-	-	60	419	20	-4.1	147	6	-4.3	471	23	-3.1	161	8	-3.3
49362	-	-	-	-	-	-	-	-	-	-	-	-	-	40	131	17	-5.4	61	6	-5.6	161	22	-2.9	75	7	-3.5
49367	-	-	-	-	-	-	-	-	-	-	-	-	-	110	551	77	0.4	232	44	1.7	628	87	2.3	261	54	3.5
49368	-	-	-	-	-	-	-	-	-	-	-	-	-	110	454	68	0.5	189	41	1.8	524	79	2.1	218	50	3.4
49371	-	-	-	-	-	-	-	-	-	-	-	-	-	60	388	10	-5.2	134	4	-4.8	417	15	-4.2	144	5	-3.4
49373	-	-	-	-	-	-	-	-	-	-	-	-	-	100	487	32	-0.2	170	13	0.9	571	34	0.3	199	13	1.6
49376	-	-	-	-	-	-	-	-	-	-	-	-	-	110	245	63	0.6	114	34	1.9	292	64	2.6	134	39	3.8
49380	-	-	-	-	-	-	-	-	-	-	-	-	-	60	220	23	-3.7	111	8	-3.5	251	25	-2.8	125	8	-2.6
49381	-	-	-	-	-	-	-	-	-	-	-	-	-	110	389	64	0.6	163	40	1.9	455	73	2.3	189	48	3.5
49382	-	-	-	-	-	-	-	-	-	-	-	-	-	50	241	12	-5.9	99	5	-5.7	277	15	-4.0	115	6	-3.6
49406	-	-	-	-	-	-	-	-	-	-	-	-	-	60	170	12	-3.3	73	4	-3.1	183	14	-0.9	76	5	-0.7
49455	-	-	-	-	-	-	-	-	-	-	-	-	-	110	551	77	0.4	232	44	1.7	629	86	2.2	262	54	3.5
49465	-	-	-	-	-	-	-	-	-	-	-	-	-	110	657	83	0.6	244	46	1.8	778	93	1.9	290	53	3.3
49472	-	-	-	-	-	-	-	-	-	-	-	-	-	60	210	29	-3.2	93	11	-2.1	257	31	-1.6	113	13	-0.3
49558	-	-	-	-	-	-	-	-	-	-	-	-	-	50	98	1	-6.6	33	0	-6.6	101	2	-6.6	35	1	-6.6
49579	40	7	2	-6.6	4	1	-6.6	9	3	-6.6	4	1	-6.6	-	-	-	-	-	-	-	-	-	-	-	-	-
49588	-	-	-	-	-	-	-	-	-	-	-	-	-	40	8	2	-6.6	4	1	-6.6	7	3	-6.6	3	2	-6.6
49594	80	184	13	-2.6	83	4	-2.5	187	15	-1.9	84	5	-1.9	80	182	13	-2.6	83	4	-2.5	187	15	-1.9	85	5	-1.9
49597	80	150	10	-1.5	65	3	-1.3	156	11	-0.4	67	4	-0.2	-	-	-	-	-	-	-	-	-	-	-	-	-
49606	40	87	13	-5.0	36	5	-5.2	114	19	-2.3	47	6	-2.5	-	-	-	-	-	-	-	-	-	-	-	-	-
49627	50	115	22	-4.0	49	7	-4.5	171	29	-3.8	74	10	-4.4	-	-	-	-	-	-	-	-	-	-	-	-	-
53452	50	46	2	-6.6	19	1	-6.6	95	3	-6.6	40	1	-6.6	50	44	2	-6.6	20	1	-6.6	97	4	-6.6	41	1	-6.6
53455	50	2	0	-6.6	1	0	-6.6	5	0	0.0	3	0	0.0	50	2	0	-6.6	1	0	-6.6	5	0	0.0	3	0	0.0
53493	-	-	-	-	-	-	-	-	-	-	-	-	-	50	98	15	-4.3	42	5	-4.8	156	27	-3.3	68	9	-3.9
55523	-	-	-	-	-	-	-	-	-	-	-	-	-	60	359	31	-3.3	153	11	-3.0	416	46	-2.3	178	16	-2.0

ID	No Build													Build													
		2024 No Build						2034 No Build							2024 Build						2034 Build					
		Daytime			Night-time			Daytime			Night-time				Daytime			Night-time			Daytime			Night-time		
	Speed km/h	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Speed km/h	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB
55562	-	-	-	-	-	-	-	-	-	-	-	-	-	60	560	43	-3.3	227	13	-4.0	637	47	-2.8	257	14	-3.6
55571	-	-	-	-	-	-	-	-	-	-	-	-	-	60	257	24	-3.7	104	7	-3.9	325	33	-1.8	126	9	-2.6
55582	-	-	-	-	-	-	-	-	-	-	-	-	-	80	498	46	-1.7	213	18	-0.6	571	65	-0.6	248	26	0.6
55606	-	-	-	-	-	-	-	-	-	-	-	-	-	80	627	44	-1.9	255	13	-2.3	667	52	-1.0	271	15	-1.6
55878	60	552	98	-1.7	198	53	-0.6	584	113	-0.5	207	64	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-
55879	60	692	89	-1.9	236	46	-0.7	765	100	-0.7	255	54	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-
55882	100	758	108	0.2	323	55	1.6	802	133	1.7	340	71	3.1	-	-	-	-	-	-	-	-	-	-	-	-	-
55890	60	295	14	-3.9	166	5	-4.1	299	13	-4.0	168	5	-4.4	-	-	-	-	-	-	-	-	-	-	-	-	-
55891	60	244	22	-5.3	144	8	-5.0	295	24	-4.2	180	9	-3.2	-	-	-	-	-	-	-	-	-	-	-	-	-
55925	50	234	28	-4.3	98	10	-4.3	294	43	-3.2	124	15	-3.4	-	-	-	-	-	-	-	-	-	-	-	-	-
55927	60	891	94	-1.9	357	46	-0.9	945	107	-0.8	375	54	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-
56244	80	901	88	-0.4	327	48	0.8	1024	98	0.8	371	55	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-
56250	50	87	2	-6.6	32	1	-6.6	108	3	-6.6	39	1	-6.6	-	-	-	-	-	-	-	-	-	-	-	-	-
56251	50	125	2	-6.6	44	1	-6.6	121	2	-6.6	42	1	-6.6	-	-	-	-	-	-	-	-	-	-	-	-	-
60183	-	-	-	-	-	-	-	-	-	-	-	-	-	60	835	41	-3.0	289	16	-2.1	938	47	-2.6	324	18	-1.7
60223	-	-	-	-	-	-	-	-	-	-	-	-	-	60	876	48	-2.9	313	18	-2.5	945	52	-3.0	335	19	-2.6
60326	-	-	-	-	-	-	-	-	-	-	-	-	-	80	455	27	-1.0	165	11	-0.4	473	28	-1.9	172	11	-1.3
60328	-	-	-	-	-	-	-	-	-	-	-	-	-	80	456	30	-1.1	159	12	-0.1	536	34	-0.6	186	13	0.6
60365	-	-	-	-	-	-	-	-	-	-	-	-	-	80	193	11	-3.2	79	4	-2.5	221	14	-1.5	92	6	-0.7
60368	-	-	-	-	-	-	-	-	-	-	-	-	-	50	48	1	-6.6	21	0	-6.6	61	1	-6.6	23	0	-6.6
60445	-	-	-	-	-	-	-	-	-	-	-	-	-	60	25	1	-3.8	11	1	-3.3	30	1	-5.5	13	0	-5.3
60612	-	-	-	-	-	-	-	-	-	-	-	-	-	70	253	11	-2.7	108	4	-2.9	281	12	-2.5	118	4	-2.6
60613	-	-	-	-	-	-	-	-	-	-	-	-	-	70	254	13	-2.7	114	5	-2.4	263	24	-3.4	117	8	-3.2
60697	-	-	-	-	-	-	-	-	-	-	-	-	-	50	107	19	-4.4	45	7	-4.3	174	28	-3.1	74	10	-2.9
60736	-	-	-	-	-	-	-	-	-	-	-	-	-	60	415	38	-3.1	177	14	-2.4	459	44	-2.0	194	15	-1.5
60753	-	-	-	-	-	-	-	-	-	-	-	-	-	60	310	15	-3.9	135	5	-3.7	306	16	-3.9	133	5	-3.7
60759	-	-	-	-	-	-	-	-	-	-	-	-	-	60	240	16	-5.0	104	6	-4.5	298	18	-3.8	131	7	-2.7
61117	-	-	-	-	-	-	-	-	-	-	-	-	-	50	192	5	-5.8	71	2	-5.4	193	5	-6.6	70	2	-6.6
63260	-	-	-	-	-	-	-	-	-	-	-	-	-	50	240	12	-5.9	99	5	-5.7	277	15	-4.0	115	6	-3.6
63327	-	-	-	-	-	-	-	-	-	-	-	-	-	40	200	25	-3.6	87	10	-3.0	227	40	-3.5	104	17	-2.5

ID	No Build														Build												
	Speed km/h	2024 No Build						2034 No Build							Speed km/h	2024 Build						2034 Build					
		Daytime			Night-time			Daytime			Night-time					Daytime			Night-time			Daytime			Night-time		
		Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB			Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB
559	60	838	161	-2.3	1837	116	-1.1	953	178	-1.5	2189	133	0.1		60	767	89	-2.6	1739	53	-3.0	888	102	-2.5	1881	57	-2.0
1139	50	78	2	-2.3	41	9	-6.6	119	2	0.9	46	10	-6.6		-	-	-	-	-	-	-	-	-	-	-	-	-
1288	110	1759	137	0.1	741	125	1.4	1868	119	0.8	857	144	3.1		110	1773	134	-0.3	740	123	1.0	1885	121	0.4	871	144	2.7
1446	70	553	19	-2.2	212	23	-3.0	548	31	-0.9	233	16	-3.4		70	542	18	-2.5	389	16	-1.6	586	19	-1.9	472	20	-2.2
1447	70	583	18	-2.1	225	22	-2.9	599	30	-0.9	238	16	-3.4		70	543	16	-2.3	309	16	-1.6	592	17	-1.7	374	20	-2.2
1448	70	582	17	-2.4	225	22	-2.9	597	30	-0.9	238	16	-3.4		70	545	16	-2.3	309	16	-1.6	589	17	-1.7	374	20	-2.2
1449	70	617	19	-2.6	240	22	-2.9	630	29	-1.0	251	18	-3.5		70	563	16	-2.3	313	16	-1.6	619	17	-2.3	374	20	-2.2
1451	70	153	20	-2.7	403	16	-1.6	192	25	-1.6	382	19	-0.7		70	501	23	-2.9	484	19	-1.6	515	54	-3.0	533	21	-3.6
1452	70	153	21	-2.8	447	15	-1.4	198	25	-1.6	419	19	-0.7		70	363	19	-2.6	484	18	-1.4	391	48	-3.1	530	21	-3.6
1453	70	154	21	-2.8	447	15	-1.4	198	25	-1.6	418	19	-0.7		70	362	19	-2.6	487	18	-1.4	389	48	-3.1	528	22	-3.0
1454	70	162	21	-2.8	470	15	-1.4	208	25	-1.6	442	19	-0.7		70	359	18	-2.5	503	18	-1.4	390	48	-3.1	535	20	-2.8
1534	40	192	27	-2.8	171	21	-2.7	197	24	-2.3	147	22	-1.2		40	92	19	-3.1	139	19	-2.1	125	27	-0.9	135	17	-2.0
1536	40	212	29	-2.4	237	22	-4.5	219	34	-2.9	230	33	-2.1		40	163	26	-2.5	271	25	-4.0	186	41	-1.8	293	38	-1.6
1537	40	129	21	-2.7	283	12	-2.8	144	30	-4.2	291	37	-2.3		40	160	42	-4.0	442	25	-2.9	168	53	-4.1	501	57	-2.1
1538	40	128	21	-2.7	286	12	-2.8	143	30	-4.2	293	37	-2.3		-	-	-	-	-	-	-	-	-	-	-	-	-
1542	40	162	65	-4.5	209	23	-2.9	156	60	-3.8	268	26	-3.5		40	192	52	-4.4	125	16	-3.0	213	47	-3.5	134	11	-4.0
1543	40	203	24	-3.9	75	17	-6.6	214	33	-1.7	146	25	-2.7		40	342	35	-4.6	114	21	-6.6	394	44	-2.7	156	25	-3.4
2544	50	7	0	0.0	3	1	-6.6	8	0	0.0	11	0	0.0		50	9	0	0.0	3	1	-6.6	10	0	0.0	10	0	0.0
2546	50	452	7	-6.6	230	5	-6.6	425	10	-6.6	342	11	-6.6		50	473	7	-6.6	229	5	-6.6	465	10	-6.6	346	11	-6.6
3711	60	1243	135	-2.6	929	119	-1.3	1315	152	-1.2	1057	133	0.1		60	1100	70	-3.4	644	54	-2.9	1177	77	-2.5	789	54	-2.6
3712	60	1322	201	-3.0	1315	141	-1.3	1386	218	-1.5	1520	154	0.0		-	-	-	-	-	-	-	-	-	-	-	-	-
3813	80	490	19	-1.6	193	20	-2.1	479	31	-0.6	218	16	-2.7		-	-	-	-	-	-	-	-	-	-	-	-	-
3814	80	522	19	-1.6	203	20	-2.1	524	31	-0.6	226	16	-2.7		-	-	-	-	-	-	-	-	-	-	-	-	-
3820	80	155	21	-2.2	383	16	-0.9	189	25	-1.0	373	19	0.1		-	-	-	-	-	-	-	-	-	-	-	-	-
4314	50	180	3	-6.6	244	3	-6.6	196	2	-6.6	215	3	-6.6		50	97	3	-6.6	205	0	0.0	92	5	-6.6	218	0	0.0
4315	50	180	3	-6.6	243	3	-6.6	196	2	-6.6	215	3	-6.6		50	97	3	-6.6	205	0	0.0	92	5	-6.6	219	0	0.0
4316	50	179	5	-6.6	201	3	-6.6	196	3	-6.6	178	3	-6.6		50	90	3	-6.6	155	0	0.0	90	5	-6.6	174	0	0.0
4326	50	205	5	-6.6	102	3	-6.6	262	3	-6.6	108	5	-6.6		50	241	7	-6.6	93	8	-6.6	279	5	-6.6	101	12	-2.6
4327	50	206	5	-6.6	101	3	-6.6	260	3	-6.6	108	5	-6.6		50	241	7	-6.6	93	8	-6.6	277	5	-6.6	101	12	-2.6
4328	50	163	3	-6.6	92	3	-6.6	197	0	0.0	96	2	-6.6		50	191	3	-6.6	76	8	-6.6	213	1	-6.6	81	9	-1.8
4821	40	33	0	0.0	11	0	0.0	48	0	0.0	8	0	0.0		-	-	-	-	-	-	-	-	-	-	-	-	-
4822	40	1	3	-6.6	1	3	-6.6	0	5	-6.6	6	3	-6.6		40	1	3	-6.6	2	3	-6.6	0	5	-6.6	6	3	-6.6
5335	50	52	2	-6.6	12	0	0.0	55	0	0.0	20	0	0.0		50	59	2	-6.6	14	0	0.0	59	0	0.0	22	0	0.0
5336	50	116	3	-6.6	32	3	-6.6	127	0	0.0	37	0	0.0		50	129	3	-6.6	36	4	-6.6	139	0	0.0	41	0	0.0
5337	50	14	0	0.0	32	0	0.0	22	0	0.0	30	0	0.0		50	12	0	0.0	34	0	0.0	19	0	0.0	40	0	0.0
5338	50	31	0	0.0	87	0	0.0	35	0	0.0	84	0	0.0		50	33	0	0.0	98	0	0.0	40	0	0.0	100	0	0.0
5340	50	14	0	0.0	32	0	0.0	22	0	0.0	30	0	0.0		50	12	0	0.0	34	0	0.0	19	0	0.0	40	0	0.0
5345	50	52	2	-6.6	12	0	0.0	55	0	0.0	20	0	0.0		50	59	2	-6.6	14	0	0.0	59	0	0.0	22	0	0.0
5470	50	180	49	-4.3	243	25	-4.7	290	52	-2.2	370	45	-2.6		-	-	-	-	-	-	-	-	-	-	-	-	-
6656	50	365	46	-4.6	179	44	-4.1	435	70	-3.0	314	48	-3.3		-	-	-	-	-	-	-	-	-	-	-	-	-
7396	100	1180	117	0.0	745	97	1.1	1205	113	1.5	835	113	2.7		100	1163	117	0.0	760	99	1.1	1197	113	1.5	911	117	2.8
7397	100	682	82	-0.5	1117	157	1.0	738	117	0.8	1212	186	2.7		100	784	89	-0.4	1089	154	1.0	931	143	0.8	1238	188	2.6
8346	80	658	161	-0.8	1544	115	0.5	803	170	0.2	1792	128	2.0		-	-	-	-	-	-	-	-	-	-	-	-	-
8887	60	2284	146	-2.8	991	153	-1.7	2495	135	-1.9	1123	187	-0.6		60	1982	96	-2.9	906	52	-2.8	2104	92	-3.4	1036	72	-2.7
8897	80	1918	144	-1.3	869	137	-0.1	2056	130	-0.7	970	157	1.5		-	-	-	-	-	-	-	-	-	-	-	-	-
9601	60	2237	147	-2.7	987	154	-1.7	2468	132	-1.9	1122	180	-0.5		-	-	-	-	-	-	-	-	-	-	-	-	-
9743	110	578	156	0.7	1346	110	1.9	715	160	1.8	1572	124	3.5		110	562	156	0.1	1388	105	1.4	673	155	1.1	1635	131	3.0
27407	60	1121	134	-2.6	1258	196	-1.3	1146	148	-1.7	1318	202	-0.2		-	-	-	-	-	-	-	-	-	-	-	-	-
27784	100	993	126	-0.6	1542	183	0.9	1075	157	0.6	1644	221	2.5		100	1226	142	-0.7	1615	177	0.8	1406	187	0.7	1802	218	2.4
31742	50	27	1	-6.6	74	0	0.0	48	1	-6.6	93	1	-6.6		-	-	-	-	-	-	-	-	-	-	-	-	-
33518	60	851	161	-2.3	1886	116	-1.1	977	177	-1.5	2290	135	0.1		60	764	88	-2.6	1787	52	-3.0	878	101	-2.4	1971	57	-2.0
34473	40	207	72	-4.9	317	27	-2.4	227	73	-3.2	371	26	-1.9		40	194	52	-5.0	178	18	-2.3	245	49	-3.2	175	5	-3.8
34680	60	854	108	-2.8	1141	180	-1.3	885	131	-1.7	1244	188	0.0		60	570	73	-3.0	861	47	-2.2	615	79	-2.5	988	59	-1.3
34740	60	2334	147	-2.8	1016	159	-1.7	2621	138	-2.0	1167	189	-0.6		60	2017	95	-2.9	925	55	-2.9	2185	95	-3.5	1055	73	-2.7
35300	-	-	-	-	-	-	-	-	-	-	-	-	-		50	86	2	-2.3	38	7	-6.6	117	2	0.9	45	10	-6.6
38383	-	-	-	-	-	-	-	-	-	-	-	-	-		40	11	0	0.0	3	0	0.0	27	0	0.0	3	0	0.0
39503	50	145	1	-6.6	52	0	0.0	290	0	0.0	103	2	-6.6		50	145	1	-6.6	52	0	0.0	290	0	0.0	103	2	-6.6
39509	50	362	2	-6.6	271	1	-6.6	476	1	-6.6	323	6	-2.6		50	362	2	-6.6	271	1	-6.6	476	1	-6.6	323	6	-2.6
40304	-	-	-	-	-	-	-	-	-	-	-	-	-		50	28	1	-6.6	69	0	0.0	48	1	-6.6	95	1	-6.6
40310	-	-	-	-	-	-	-	-	-	-	-	-	-		80	152	18	-1.9	370	12	-0.3	180	23	-0.1	355	17	0.3

ID	No Build													Build												
		2024 No Build						2034 No Build							2024 Build						2034 Build					
		Daytime			Night-time			Daytime			Night-time				Daytime			Night-time			Daytime			Night-time		
	Speed km/h	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Speed km/h	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB
49174	-	-	-	-	-	-	-	-	-	-	-	-	-	70	576	20	-1.6	394	28	-2.6	603	30	-0.9	452	24	-2.1
49180	-	-	-	-	-	-	-	-	-	-	-	-	-	70	157	9	-1.1	281	11	-3.4	206	22	-3.3	271	9	-4.4
49185	-	-	-	-	-	-	-	-	-	-	-	-	-	60	505	22	-3.6	339	24	-3.2	485	47	-2.9	412	20	-3.7
49190	-	-	-	-	-	-	-	-	-	-	-	-	-	60	106	8	-3.0	127	5	-5.3	142	5	-5.5	163	5	-5.3
49195	-	-	-	-	-	-	-	-	-	-	-	-	-	110	909	94	-0.6	597	131	0.8	1090	97	1.2	693	137	2.7
49196	-	-	-	-	-	-	-	-	-	-	-	-	-	100	1952	152	-0.4	1222	133	0.9	1962	181	1.0	1433	143	2.3
49197	-	-	-	-	-	-	-	-	-	-	-	-	-	50	334	7	-6.6	193	8	-3.0	400	8	-4.7	189	9	-4.8
49201	-	-	-	-	-	-	-	-	-	-	-	-	-	110	913	91	-0.8	595	133	0.8	1100	95	1.2	692	141	2.7
49205	-	-	-	-	-	-	-	-	-	-	-	-	-	110	658	113	-0.3	753	85	1.4	699	119	1.0	931	106	3.2
49207	-	-	-	-	-	-	-	-	-	-	-	-	-	110	907	94	-0.8	592	133	0.8	1094	89	1.2	686	139	2.8
49208	-	-	-	-	-	-	-	-	-	-	-	-	-	100	1227	143	-0.7	1618	178	0.8	1408	187	0.7	1806	219	2.4
49218	-	-	-	-	-	-	-	-	-	-	-	-	-	60	158	10	-4.3	78	4	-5.3	158	17	-3.7	87	2	-5.3
49223	-	-	-	-	-	-	-	-	-	-	-	-	-	110	655	113	-0.3	751	83	1.4	696	119	1.0	923	107	3.1
49225	-	-	-	-	-	-	-	-	-	-	-	-	-	60	824	88	-2.6	1726	54	-2.9	953	107	-2.5	1921	58	-2.0
49229	-	-	-	-	-	-	-	-	-	-	-	-	-	50	579	14	-6.6	283	15	-4.4	677	13	-5.3	289	21	-3.4
49233	-	-	-	-	-	-	-	-	-	-	-	-	-	110	166	78	0.1	341	68	1.8	188	88	1.4	413	87	3.7
49234	-	-	-	-	-	-	-	-	-	-	-	-	-	110	800	86	-0.8	460	128	0.9	955	84	1.3	525	139	2.9
49237	-	-	-	-	-	-	-	-	-	-	-	-	-	70	201	19	-2.6	386	14	-1.3	249	31	-1.5	386	18	-0.1
49239	-	-	-	-	-	-	-	-	-	-	-	-	-	70	153	18	-2.5	360	13	-1.1	182	23	-0.7	357	17	0.0
49241	-	-	-	-	-	-	-	-	-	-	-	-	-	70	484	19	-2.2	193	20	-2.8	479	32	-1.3	219	16	-3.4
49242	-	-	-	-	-	-	-	-	-	-	-	-	-	70	378	12	-1.7	140	17	-2.6	383	22	-1.0	159	14	-3.2
49244	-	-	-	-	-	-	-	-	-	-	-	-	-	50	565	34	-4.3	436	24	-5.1	596	33	-3.1	527	33	-3.7
49248	-	-	-	-	-	-	-	-	-	-	-	-	-	60	488	32	-3.3	414	18	-3.5	504	30	-2.8	516	24	-1.8
49253	-	-	-	-	-	-	-	-	-	-	-	-	-	40	33	0	0.0	11	0	0.0	48	0	0.0	8	0	0.0
49257	-	-	-	-	-	-	-	-	-	-	-	-	-	110	565	154	0.1	1381	105	1.3	660	159	1.0	1637	132	2.9
49263	-	-	-	-	-	-	-	-	-	-	-	-	-	110	1759	138	-0.3	747	128	1.0	1886	122	0.4	876	144	2.7
49264	-	-	-	-	-	-	-	-	-	-	-	-	-	110	1304	109	-0.9	801	152	0.7	1441	130	0.8	938	161	2.6
49281	-	-	-	-	-	-	-	-	-	-	-	-	-	100	1215	58	-0.4	468	25	0.6	1249	55	-1.5	510	32	-0.2
49282	-	-	-	-	-	-	-	-	-	-	-	-	-	80	130	0	0.0	45	0	0.0	145	0	0.0	46	0	0.0
49287	-	-	-	-	-	-	-	-	-	-	-	-	-	110	1295	107	-0.9	804	156	0.7	1432	133	0.7	937	167	2.6
49292	-	-	-	-	-	-	-	-	-	-	-	-	-	110	1767	139	-0.3	747	126	1.0	1873	121	0.4	872	142	2.6
49313	-	-	-	-	-	-	-	-	-	-	-	-	-	110	617	62	-0.2	605	128	1.0	688	83	1.2	694	139	3.0
49320	-	-	-	-	-	-	-	-	-	-	-	-	-	110	533	67	0.5	497	78	1.6	542	80	2.0	615	75	3.5
49324	-	-	-	-	-	-	-	-	-	-	-	-	-	50	416	9	-6.6	530	8	-5.1	441	15	-6.6	544	4	-6.6
49334	-	-	-	-	-	-	-	-	-	-	-	-	-	50	241	7	-6.6	93	8	-6.6	277	5	-6.6	101	12	-2.6
49352	-	-	-	-	-	-	-	-	-	-	-	-	-	60	883	39	-3.6	532	25	-3.9	953	36	-2.9	620	37	-2.4
49362	-	-	-	-	-	-	-	-	-	-	-	-	-	40	342	35	-4.6	113	21	-6.6	395	44	-2.7	157	26	-3.1
49367	-	-	-	-	-	-	-	-	-	-	-	-	-	110	725	125	-0.3	1038	98	1.3	762	124	1.4	1272	128	3.1
49368	-	-	-	-	-	-	-	-	-	-	-	-	-	110	664	113	-0.3	753	86	1.4	701	121	1.0	934	107	3.2
49371	-	-	-	-	-	-	-	-	-	-	-	-	-	60	469	16	-5.5	715	19	-4.7	536	39	-4.3	742	13	-3.1
49373	-	-	-	-	-	-	-	-	-	-	-	-	-	100	400	75	0.1	1050	37	0.1	475	73	0.7	1228	46	1.0
49376	-	-	-	-	-	-	-	-	-	-	-	-	-	110	548	77	-0.3	280	104	1.1	631	67	1.7	364	112	3.1
49380	-	-	-	-	-	-	-	-	-	-	-	-	-	60	684	48	-3.9	196	26	-3.3	751	50	-2.6	248	29	-2.9
49381	-	-	-	-	-	-	-	-	-	-	-	-	-	110	511	103	-0.1	674	83	1.5	542	104	1.4	849	105	3.3
49382	-	-	-	-	-	-	-	-	-	-	-	-	-	50	443	17	-6.6	412	28	-5.3	564	34	-4.1	441	24	-3.3
49406	-	-	-	-	-	-	-	-	-	-	-	-	-	60	214	21	-3.9	366	16	-2.4	222	22	-1.1	416	23	-0.7
49455	-	-	-	-	-	-	-	-	-	-	-	-	-	110	727	126	-0.3	1036	99	1.3	766	122	1.4	1273	127	3.1
49465	-	-	-	-	-	-	-	-	-	-	-	-	-	110	565	154	0.2	1391	104	1.3	670	157	1.0	1648	132	2.9
49472	-	-	-	-	-	-	-	-	-	-	-	-	-	60	194	59	-3.7	527	25	-1.8	228	44	-2.5	658	49	-0.5
49558	-	-	-	-	-	-	-	-	-	-	-	-	-	50	97	3	-6.6	205	0	0.0	93	5	-6.6	222	0	0.0
49579	40	7	3	-6.6	18	3	-6.6	8	5	-6.6	19	3	-6.6	-	-	-	-	-	-	-	-	-	-	-	-	-
49588	-	-	-	-	-	-	-	-	-	-	-	-	-	40	8	3	-6.6	19	3	-6.6	6	5	-6.6	20	4	-6.6
49594	80	488	20	-1.7	193	20	-2.1	477	32	-0.6	219	16	-2.7	80	488	20	-1.7	193	20	-2.1	477	32	-0.6	219	16	-2.7
49597	80	152	18	-1.9	362	13	-0.4	183	20	-0.5	353	15	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-
49606	40	203	24	-3.9	75	17	-6.6	214	33	-1.7	146	25	-2.7	-	-	-	-	-	-	-	-	-	-	-	-	-
49627	50	213	35	-3.9	154	35	-3.7	299	55	-3.8	253	39	-3.0	-	-	-	-	-	-	-	-	-	-	-	-	-
53452	50	66	2	-6.6	89	4	-6.6	119	6	-6.6	212	4	-6.6	50	68	2	-6.6	88	4	-6.6	129	6	-6.6	214	5	-6.6
53455	50	7	1	-6.6	3	0	0.0	14	0	0.0	9	0	0.0	50	7	1	-6.6	3	0	0.0	14	0	0.0	9	0	0.0
53493	-	-	-	-	-	-	-	-	-	-	-	-	-	50	194	27	-4.5	121	23	-3.5	297	53	-3.0	202	34	-2.9
55523	-	-	-	-	-	-	-	-	-	-	-	-	-	60	717	57	-3.2	524	34	-3.0	782	74	-1.9	662	68	-1.7

ID	No Build													Build													
	Speed km/h	2024 No Build						2034 No Build						Speed km/h	2024 Build						2034 Build					
		Daytime			Night-time			Daytime			Night-time				Daytime			Night-time			Daytime			Night-time		
		Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB		Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB	Hourly peak number of light vehicles	Hourly peak number of heavy vehicles	Heavy vehicle correction dB
55562	-	-	-	-	-	-	-	-	-	-	-	-	-	60	1206	81	-3.5	738	58	-2.9	1298	96	-2.6	875	58	-2.4
55571	-	-	-	-	-	-	-	-	-	-	-	-	-	60	458	48	-3.4	440	35	-3.2	516	66	-2.1	606	49	-1.5
55582	-	-	-	-	-	-	-	-	-	-	-	-	-	80	608	81	-1.9	1015	48	-0.6	718	102	-0.7	1112	82	0.3
55606	-	-	-	-	-	-	-	-	-	-	-	-	-	80	1417	83	-2.1	722	58	-1.1	1410	101	-0.9	827	65	-0.5
55878	60	836	105	-2.6	1118	176	-1.3	870	129	-1.8	1233	190	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-
55879	60	1337	143	-2.7	1008	124	-1.4	1424	168	-1.5	1139	130	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-
55882	100	988	125	-0.7	1545	184	0.9	1064	155	0.7	1644	219	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-
55890	60	575	29	-4.0	363	14	-2.6	553	25	-4.2	421	15	-2.6	-	-	-	-	-	-	-	-	-	-	-	-	-
55891	60	333	34	-5.5	400	30	-4.9	426	43	-4.4	453	22	-3.3	-	-	-	-	-	-	-	-	-	-	-	-	-
55925	50	255	57	-4.3	481	28	-3.4	355	65	-2.9	575	65	-2.7	-	-	-	-	-	-	-	-	-	-	-	-	-
55927	60	1846	148	-2.6	1098	134	-1.4	1840	184	-1.4	1266	138	-0.3	-	-	-	-	-	-	-	-	-	-	-	-	-
56244	80	821	156	-0.9	1909	116	0.4	944	172	0.0	2150	131	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-
56250	50	203	5	-6.6	98	2	-6.6	265	3	-6.6	105	5	-6.6	-	-	-	-	-	-	-	-	-	-	-	-	-
56251	50	181	3	-6.6	244	3	-6.6	195	2	-6.6	216	3	-6.6	-	-	-	-	-	-	-	-	-	-	-	-	-
60183	-	-	-	-	-	-	-	-	-	-	-	-	-	60	822	88	-2.6	1725	54	-2.9	953	106	-2.5	1921	58	-2.0
60223	-	-	-	-	-	-	-	-	-	-	-	-	-	60	1964	97	-3.0	955	50	-2.8	2060	90	-3.4	1085	69	-2.6
60326	-	-	-	-	-	-	-	-	-	-	-	-	-	80	1082	58	-1.3	422	25	-0.3	1106	55	-2.4	463	32	-1.1
60328	-	-	-	-	-	-	-	-	-	-	-	-	-	80	352	72	-0.8	1005	35	-0.7	416	72	-0.3	1180	45	0.0
60365	-	-	-	-	-	-	-	-	-	-	-	-	-	80	371	16	-3.4	314	26	-2.4	473	32	-1.5	328	24	-0.5
60368	-	-	-	-	-	-	-	-	-	-	-	-	-	50	68	3	-6.6	97	1	-6.6	92	2	-6.6	113	1	-6.6
60445	-	-	-	-	-	-	-	-	-	-	-	-	-	60	48	3	-2.5	43	2	-5.3	62	1	-5.5	48	1	-5.3
60612	-	-	-	-	-	-	-	-	-	-	-	-	-	70	523	18	-2.5	384	16	-1.6	566	19	-1.9	468	20	-2.2
60613	-	-	-	-	-	-	-	-	-	-	-	-	-	70	501	23	-2.9	480	19	-1.6	517	54	-3.0	533	21	-3.6
60697	-	-	-	-	-	-	-	-	-	-	-	-	-	50	136	40	-3.9	205	18	-4.7	232	47	-2.7	331	41	-2.7
60736	-	-	-	-	-	-	-	-	-	-	-	-	-	60	568	73	-3.0	856	46	-2.2	614	78	-2.5	977	58	-1.2
60753	-	-	-	-	-	-	-	-	-	-	-	-	-	60	725	27	-3.9	401	19	-3.1	684	28	-4.3	477	20	-2.6
60759	-	-	-	-	-	-	-	-	-	-	-	-	-	60	316	28	-5.5	485	20	-4.1	436	39	-3.9	575	16	-2.7
61117	-	-	-	-	-	-	-	-	-	-	-	-	-	50	321	6	-6.6	326	8	-5.1	344	10	-6.6	316	4	-6.6
63260	-	-	-	-	-	-	-	-	-	-	-	-	-	50	442	17	-6.6	411	28	-5.3	564	34	-4.1	440	24	-3.3
63327	-	-	-	-	-	-	-	-	-	-	-	-	-	40	160	42	-4.0	442	25	-2.9	169	53	-4.1	503	57	-2.1

F2.2 Validation Traffic Volumes

Associated logger location for validation	Section	Direction	Speed km/h	2016 Validation					
				Daytime			Night-time		
				Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB	Hourly average number of light vehicles	Hourly average number of heavy vehicles	Heavy vehicle correction dB
1, 11	Pacific Highway 700m South of Stadium Dr	NB	93.2	761	99	-0.3	138	41	1.6
	Pacific Highway 700m South of Stadium Dr	SB	103.5	752	117	0.0	123	33	1.4
2	North Boambee Road - 100m West of Highlander Drive	WB	74.7	10	2	-0.5	2	0	0.0
	North Boambee Road - 100m West of Highlander Drive	EB	76.0	10	2	-4.4	2	0	0.0
4, 5	Coramba Road	WB	81.0	166	13	-3.3	16	2	-3.8
	Coramba Road	EB	77.8	160	16	-2.9	28	3	-4.0
	Bennetts Road 200m West of Coramba road	WB	64.3	8	1	-5.1	1	0	0.0
	Bennetts Road 200m West of Coramba road	EB	67.2	7	1	-4.9	1	0	0.0
8, 9, 10, 14, 15, 18	Pacific Highway - 200m north of Charlesworth Bay Rd	NB	84.9	822	108	-0.2	151	38	0.9
	Pacific Highway - 200m north of Charlesworth Bay Rd	SB	84.4	761	145	-1.0	157	39	-0.3
	Pacific Highway - Adjacent to Fern Tree Place	NB	78.0	822	66	-0.7	119	48	0.8
	Pacific Highway - Adjacent to Fern Tree Place	SB	81.0	806	85	-1.0	133	44	-0.3
	Pacific Highway - Adjacent to end of Coachmens Close	NB	90.7	918	126	-0.5	181	43	1.2
	Pacific Highway - Adjacent to end of Coachmens Close	SB	109.3	663	122	0.3	143	24	2.2