Roads and Maritime Services/Sydney Airport Corporation Limited

Sydney Gateway Road Project

Environmental Impact Statement/ Preliminary Draft Major Development Plan

Chapter 10 Noise and vibration

November 2019

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Noise and vibration

This chapter describes the existing noise and vibration environment, identifies potential impacts during construction and operation, and provides measures to mitigate and manage the impacts identified. Further information is provided in Technical Working Paper 2 (Noise and Vibration).

The SEARs and MDP requirements relevant to noise and vibration are listed below. Full copies of the SEARs and MDP requirements, and where they are addressed in this document, are provided in Appendices A and B respectively.

Reference	Requirement	Where addressed
Key issue SEARs		
2	**Noise and vibration - amenity**	
2.1	The Proponent must assess construction and operational noise and vibration impacts in accordance with relevant NSW noise and vibration guidelines. The assessment must consider cumulative impacts from nearby key infrastructure proposals and take into consideration and address the noise impacts arising from the redistribution of traffic (including on local feeder roads), and operational plant and equipment. The assessment must also include consideration of impacts to sensitive receivers and include consideration of sleep disturbance (including the number of noise-awakening events), and, as relevant, the characteristics of noise and vibration (for example, low frequency noise).	The full assessment results are provided in Technical Working Paper 2 (Noise and Vibration), with a summary of the findings provided in this chapter, as indicated below.
2.2	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, as relevant);	Section 10.1 and 10.2.1
	(b) the intensity and duration of noise (both air and ground borne) and vibration impacts. This must include consideration of extended construction impacts associated with ancillary facilities (and the like) and construction fatigue;	Sections 10.1, 10.2.1, 10.4 and 10.7
	(c) the identification of receivers, existing and proposed, during the construction period;	Section 10.3.1
	(d) the nature of the impact and the sensitivity of receivers and level of impact;	Section 10.4
	(e) 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);	Section 10.7
	(f) noise impacts of out-of-hours works (including utility works), possible locations where out-of-hours works would be undertaken, the activities that would be undertaken, the estimated duration of those activities and justification for these activities in terms of the Interim Construction Noise Guideline (DECCW, 2009);	Out-of-hours works are described in section 8.3.3. The potential impacts of out-of-hours works are summarised in section 10.4.2
	(g) a cumulative noise and vibration assessment inclusive of impacts from the proposal, including concurrent construction activities within the proposal and the construction of other relevant development in the vicinity of the proposal;	Section 10.6

Reference	Requirement	Where addressed
	(h) details and analysis of the predicted effectiveness of mitigation measures to adequately manage identified impacts, including impacts as identified in (g), and any potential residual noise and vibration impacts following application of mitigation measures; and	Section 10.7
	(i) a description of how sensitive receiver feedback received during the preparation of the EIS has been taken into account (and would be taken into account post exhibition of the EIS) in the design of mitigation measures, including any tailored mitigation, management and communication strategies for sensitive receivers.	Section 10.7.1
2.3	The Proponent must demonstrate that blast impacts are capable of complying with the current guidelines, if blasting is required.	No blasting required
3	**Noise and Vibration - Structural**	
3.1	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 the structural integrity and heritage significance of items (including Aboriginal places and items of environmental heritage), including cumulative impacts resulting from the Botany Rail Duplication.	The full assessment results are provided in Technical Working Paper 2 (Noise and Vibration), with a summary of the findings provided in section 10.4 and 10.5.
3.2	The Proponent must demonstrate that blast impacts are capable of complying with the current guidelines, if blasting is required.	No blasting required
Major development plan requirements *(in accordance with Section 91 of the Airports Act)*		
91(1)(e)	If the development could affect noise exposure levels at the airport—the effect that the development would be likely to have on those levels.	Sections 10.4.6 and 10.5.2

10. Noise and vibration

10.1 Assessment approach

Major road projects have the potential to generate noise and vibration. As a result, noise and vibration assessments are a standard part of the environmental impact assessment process for infrastructure projects. The project site is located in a highly developed, urban area with a mix of transport, commercial, residential, industrial and recreational land uses. The noise environment is highly influenced by aircraft noise associated with the operation of Sydney Airport. By meeting noise and vibration management levels and implementing the recommended mitigation measures, the potential noise and vibration impacts of the project would be reduced.

An overview of the approach to the assessment is provided below, including the legislative and policy context and a summary of the assessment methodology.

10.1.1 Legislative and policy context to the assessment

The assessment has been undertaken in accordance with the SEARs and MDP requirements (provided in Appendices A and B) and with reference to the following:

- Relevant legislation, including the EP&A Act, the Airports Act and associated regulations
- *Environmental Criteria for Road Traffic Noise* (NSW EPA, 1999)
- *Environmental Noise Management Manual* (Roads and Traffic Authority, 2001)
- *Interim Construction Noise Guideline* (DECC, 2009)
- *NSW Road Noise Policy* (DECCW, 2011)
- *Preparing an Operational Noise and Vibration Assessment* (Roads and Maritime, 2011a)
- *Noise Criteria Guideline* (Roads and Maritime, 2015a)
- *Noise Mitigation Guideline* (Roads and Maritime, 2015b)
- *Construction Noise and Vibration Guideline* (Roads and Maritime, 2016b)
- *At-Receiver Noise Treatment Guideline* (Roads and Maritime, 2017b)
- *Model Validation Guideline* (Roads and Maritime, 2018c)
- *Noise Policy for Industry (*NSW EPA, 2017a)
- *Assessing Vibration: A Technical Guideline* (DEC, 2006a)
- *AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors*
- *BS7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2*
- *DIN4150: Part 3-2016 Structural vibration – Effects of vibration on structures*
- *ISO 9613 Acoustics – Attenuation of sound during propagation outdoors*
- *Sydney Airport Master Plan 2039* (SACL, 2019a)
- *Sydney Airport Environment Strategy 2019-2024* (SACL, 2019b).

10.1.2 Methodology

Study area

The study area for the noise and vibration assessment was developed based on the potential extent of the impacts of project activities, including:

- Construction activities at work sites and at the construction ancillary facilities (compounds), described in Chapter 8 (Construction)
- Construction haulage routes (described in Chapter 8)
- Noise generated by permanent operational infrastructure.

Once the potential extent of impacts was identified, the location of sensitive receivers was also considered. Noise sensitive receivers were identified using aerial photography and cadastral information, with discrete land uses determined by ground-truthing.

Within the study area, nine noise catchment areas were identified. These areas group receivers based on similar land uses and background noise environments.

The *NSW Road Noise Policy* (DECCW, 2011) (the Road Noise Policy) defines the assessment area for operational road traffic noise assessments as being 600 metres from the centreline of the outermost traffic lane on each side of a project alignment. The *Noise Criteria Guideline* (Roads and Maritime, 2015a) notes that the Road Noise Policy assessment area is likely to include other significant non-project roads (such as the Princes Highway in this case). As such, the assessment area may be reduced.

The study area and noise catchment areas are shown in Figure 10.1. Further information on the noise catchment areas is provided in section 10.3.2.

Key tasks

The assessment involved the following key tasks.

Tasks to define the assessment area, existing environment and potential noise sources

- Identifying and classifying sensitive receivers (including proposed receivers such as the new hotel to be constructed between Ninth and Seventh streets near Terminals 2/3), noise catchment areas and the assessment area (see Figure 10.1 and Figure 10.2)
- Characterising the existing noise environment based on attended and unattended noise measurements at representative locations in the study area (shown on Figure 10.2) in September and October 2018 – for receivers close to the project site, monitoring equipment was located (where possible) at those receivers with a direct line of sight to the project site
- Determining noise and vibration management levels/criteria in accordance with relevant guidelines
- Identifying potential noise sources during construction and operation
- Defining construction scenarios and developing representative ‘realistic worst-case’ scenarios with indicative durations (see Table 10.1), based on the assumption that several items of construction equipment would be used at the same time within individual construction scenarios
- Categorising the construction scenarios into ‘peak’ and ‘typical’ activities with ‘peak’ works representing the noisiest stages of the works involving equipment such as rockbreakers or concrete saws
- Identifying construction activities likely to occur outside standard construction hours (‘out-of-hours works’).

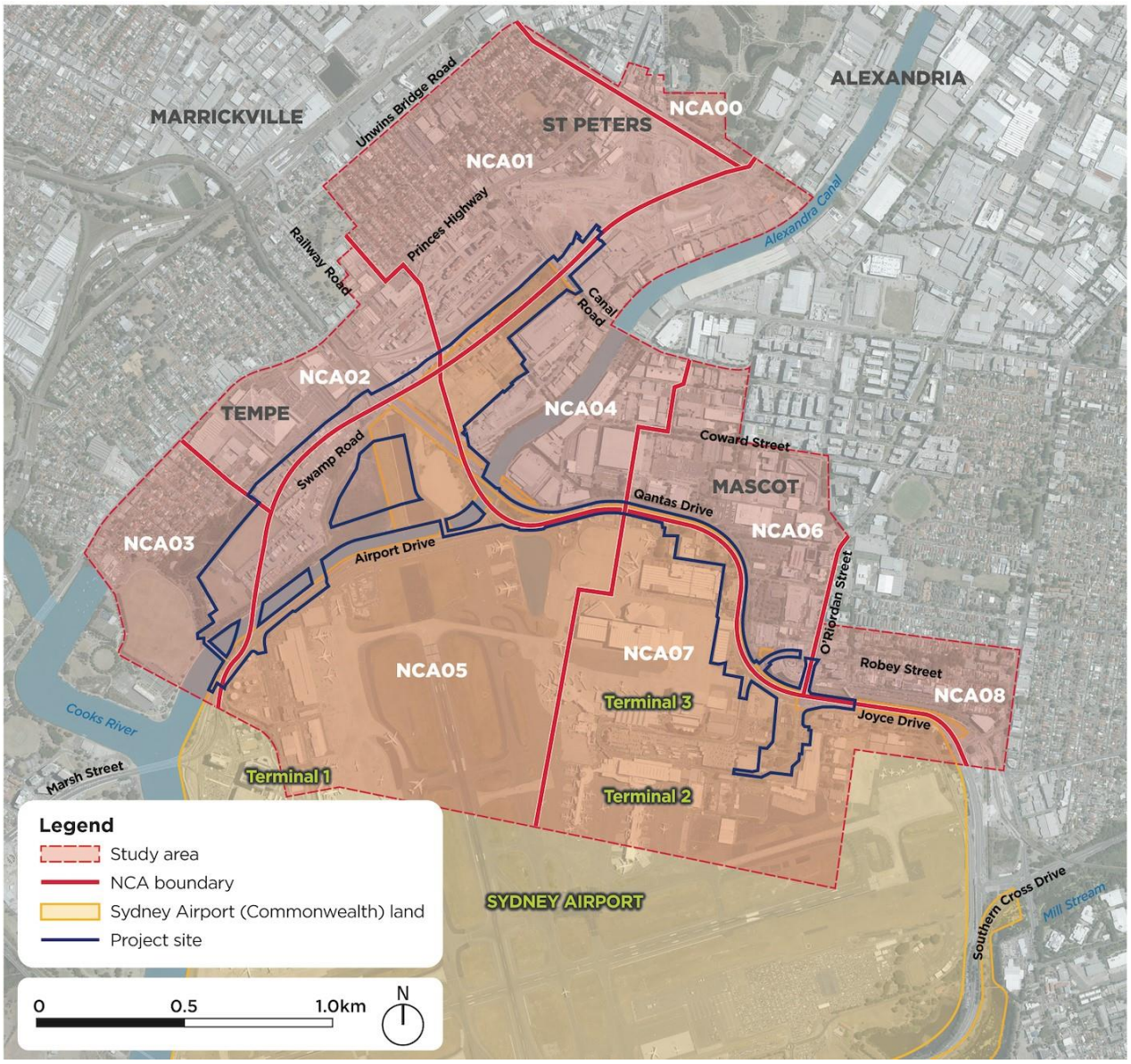

Figure 10.1 Study area and noise catchment areas

Impact assessment, including modelling tasks

- Developing a three-dimensional representation of the construction work areas and surrounding areas by digitising the local terrain, receiver buildings and structures
- Identify structures which are within the minimum vibration working distances
- Identifying noise modelling inputs and parameters
- Modelling to conservatively predict noise levels using *ISO 9613 Acoustics – Attenuation of sound during propagation outdoors* algorithms in the noise modelling software SoundPLAN
- Validating the operational road traffic noise model using existing noise measurements
- Assessing the significance of predicted noise and vibration levels by comparing them to the management levels/criteria
- Identifying the potential cumulative impacts of the project occurring with other nearby major projects consecutively (which can contribute to construction fatigue)
- Identifying feasible and reasonable measures to mitigate predicted exceedances of the management levels/criteria, including both standard and additional mitigation measures.

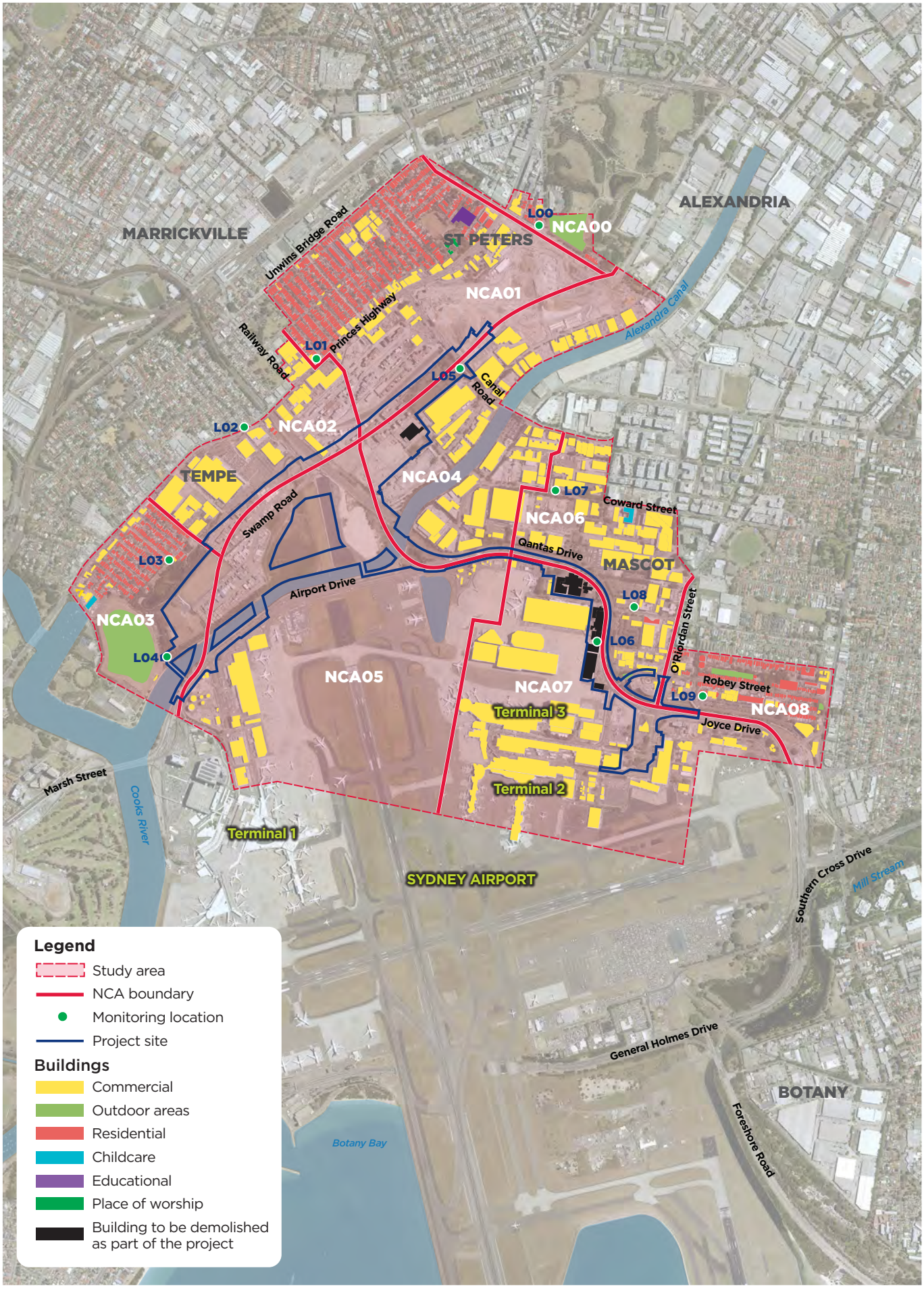

Figure 10.2 **Sensitive receivers and noise monitoring locations**

Noise modelling was also used to predict noise levels from ground-based airport activities emanating from Sydney Airport to surrounding receivers following the proposed removal of buildings south of Qantas Drive and the removal of Tyne Container Services operations to the west of Alexandra Canal. A number of scenarios were developed to assess the potential changes to noise impacts using the 'without project' and 'with project' scenarios (see section 10.2.2).

The expected duration of each construction scenario would vary depending on location. The indicative duration is shown in Table 10.1.

Table 10.1 Construction scenarios – indicative durations

Construction scenario	Activity	Noise catchment area					
		Northern lands	Works around the Botany Rail Line	Tempe Lands and Reserve	Airport Drive	Qantas Drive	Terminals 2/3 viaduct
Enabling works (including utilities)	Peak	6 months	2 months	2 months	3 months	3 months	6 months
	Typical	12 months	6 months	6 months	8 months	12 months	12 months
Compound establishment	Peak	6 months	-	1 month	-	-	1 month
	Typical	3 months	-	3 months	2 months	-	3 months
Compound operation		4 years	-	4 years	2.5 years	-	4 years
Site establishment		6 months	6 months	6 months	9 months	12 months	12 months
Demolition	Peak	6 weeks	-	-	-	18 months	6 months
	Typical	6 weeks	-	-	-	18 months	6 months
Bridges	Peak	6 months	12 months	9 months	18 months	-	6 months
	Typical	12 months	2 years	2 years	2.5 years	-	2.5 years
Road works	Peak	6 months	-	2 months	3 months	12 months	12 months
	Typical	3 years	12 months	2.5 years	12 months	18 months	2.5 years
	Dynamic compaction	-	-	3 months	-	-	-
Finishing works		6 months	3 months	6 months	6 months	6 months	12 months

10.1.3 Risks identified

An environmental risk assessment was undertaken as an input to the impact assessment (see Appendix G). This involved identifying potential environmental risks during construction and operation, and rating the potential risks according to likelihood, consequence and overall level of risk, in general accordance with *AS/NZS ISO 31000:2009 Risk management – Principles and guidelines*. Noise and vibration risks with an assessed risk rating of medium or above, identified by the environmental risk assessment, included:

- Elevated noise and vibration levels around construction sites, compounds, site accesses and haul routes
- Noise associated with out-of-hours work
- Impacts on amenity, particularly for residents, workers, hotel guests and users of recreation areas and other community facilities
- Vibration impacts (structural or cosmetic) on buildings and other structures
- Cumulative construction noise impacts with the Botany Rail Duplication and the operation of Sydney Airport
- Removal of potential noise shielding provided by buildings at the Sydney Airport Jet Base on Qantas Drive and increases in airport noise emissions emanating outside of the airport site
- Noise associated with elevated infrastructure (such as bridges).

The noise and vibration assessment included consideration of these potential risks.

10.2 Noise and vibration criteria

A summary of the criteria used to undertake the assessment is provided in this section. Detailed information is provided in section 3 of Technical Working Paper 2 (Noise and Vibration).

10.2.1 Construction

Amenity

Noise management levels – residential receivers

Project specific noise management levels were developed for sensitive receivers based on existing background noise levels (known as rating background levels or RBLs) in the study area and in accordance with the *Interim Construction Noise Guideline* (DECC, 2009) and the *Noise Policy for Industry* (NSW EPA, 2017a). The Airports Act does not contain specific assessment criteria for noise and vibration associated with works located on Sydney Airport land. However, the Airports (Environment Protection) Regulations 1997 includes criteria which is considered generally consistent with the Interim Construction Noise Guideline highly noise affected criteria. On this basis, the potential construction impacts have been assessed against the requirements of the Interim Construction Noise Guideline.

The noise management levels are defined as an allowable exceedance of the rating background level. The rating background level for each noise catchment area has been conservatively determined from the lowest measured background noise for the area (see section 10.3.3). Where construction noise levels are predicted or measured to be above the noise management levels, feasible and reasonable work practices are proposed to minimise noise emissions (see section 10.7.2).

The interim construction noise guideline provides an approach for determining noise management levels at residential receivers as shown in Table 10.2.

Table 10.2 Interim Construction Noise Guideline noise management levels for residential receivers

Time of day	Noise management level $L_{Aeq(15minute)}$	How to apply
Standard construction hours Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	RBL + 10 dB	▪ The noise affected level represents the point above which there may be some community reaction to noise ▪ Where the predicted or measured $L_{Aeq(15minute)}$ 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 75 dBA	▪ 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 restructuring 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.
Outside standard construction hours	RBL + 5 dB	▪ A strong justification would typically be required for works outside the recommended standard hours ▪ The proponent should apply all feasible and reasonable work practices to meet the noise affected level ▪ Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Table 10.3 shows the noise management levels for residential receivers for each noise catchment area (noise catchment areas described in section 10.3.2). The representative background monitoring locations for each noise catchment area are discussed in Technical Working Paper 2 (Noise and Vibration) and shown on Figure 10.2, and the existing noise levels are discussed in section 10.3.3. The sleep disturbance screening criteria are also provided in Table 10.3 and discussed further below.

Table 10.3 Noise management levels for residential receivers

Noise catchment area	Noise management level ($L_{Aeq(15\ minute)}$ – dBA)				Sleep disturbance screening criteria (RBL + 15 dB)
	Standard[1] construction hours (RBL + 10 dB)	Out-of-hours[2] (RBL + 5 dB)			
	Daytime	Daytime	Evening	Night-time	
NCA00	64	59	50	45	55
NCA01	75	70	67	58	68
NCA02	74	69	65	53	63
NCA03	52	47	45	43	53
NCA04	68	63	59	54	64
NCA05	73	68	65	57	67
NCA06	70	65	61	55	65

Noise catchment area	Noise management level ($L_{Aeq(15\ minute)}$ – dBA)				Sleep disturbance screening criteria (RBL + 15 dB)
	Standard[1] construction hours (RBL + 10 dB)	Out-of-hours[2] (RBL + 5 dB)			
	Daytime	Daytime	Evening	Night-time	
NCA07	73	68	65	57	67
NCA08	64	69	56	50	60

Notes: 1. Standard construction hours are 7am to 6pm Monday to Friday and 8am to 1pm Saturdays.
2. Daytime out-of-hours are 7am to 8am and 1pm to 6pm on Saturday, and 8am to 6pm on Sunday and public holidays; evening out-of-hours are 6pm to 10pm Monday to Saturday; and night-time out-of-hours are 10pm to 7am Monday to Saturday and 6pm to 8am on Sunday and public holidays.
3. RBL – rating background level.

Noise management levels – other sensitive receivers

Other sensitive receivers in the study area include educational facilities, medical facilities, places of worship, outdoor recreational areas and commercial properties. The Interim Construction Noise Guideline identifies internal or external noise management levels for identified land use types. These are shown in Table 10.4.

Table 10.4 Interim Construction Noise Guideline noise management levels for 'other sensitive' receivers

Land use	Noise management level $L_{Aeq(15minute)}$[1]
Classrooms at schools and other education institutions	Internal noise level 45 dBA[2]
Hospital wards and operating theatres	Internal noise level 45 dBA[2]
Places of worship	Internal noise level 45 dBA[2]
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion)	External noise level 60 dBA
Community centres	Refer to the recommended 'maximum' internal levels in AS/NZS 2107 for specific uses
Commercial	External noise level 70 dBA

Notes: 1. Applied when the property is in use.
2. The criteria is specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that all schools and places of worship have openable windows and external noise levels are 10 dB higher than the corresponding internal level, which is representative of windows being partially open to provide ventilation. Hospital wards are assumed to have fixed windows with 20 dB higher external levels.

The guideline also references *AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors* in terms of criteria for 'other sensitive' receivers not listed in the guideline, such as hotels and libraries. The criteria are shown in Table 10.5. In this assessment, fixed windows and a conservative 20 dB external to internal reduction factor have been assumed for these receiver types to convert internal noise level criteria to external facade criteria.

Table 10.5 AS/NZS 2107:2016 noise management levels for 'other sensitive' receivers

Use	Period	AS/NZS 2107 classification	Noise management level $L_{Aeq(15minute)}$
Hotel	Daytime and evening	Bars and lounges	Internal noise level 50 dBA[1]
	Night-time	Sleeping areas (hotels near major road)	Internal noise level 40 dBA[1]
Library	When in use	Reading areas	Internal noise level 45 dBA[1]

Note: 1. These receivers are assumed to have fixed windows with a conservative 20 dB reduction for external to internal noise levels.

Sleep disturbance

There is potential for sleep disturbance impacts where night works are located close to residential receivers. Where construction works are planned to extend over more than two consecutive nights, the Interim Construction Noise Guideline recommends an assessment of sleep disturbance impacts.

The Interim Construction Noise Guideline refers to the *Environmental Criteria for Road Traffic Noise* (NSW EPA, 1999) to assess the potential impacts of sleep disturbance. To limit the level of sleep disturbance, the L_1 level (or L_{Amax}) should not exceed the existing L_{A90} noise level by more than 15 dB (see Table 10.3).

Construction traffic noise

The potential noise impacts from construction traffic travelling on public roads are assessed in accordance with the Road Noise Policy and the *Construction Noise and Vibration Guideline* (Roads and Maritime, 2016b). Where existing road traffic noise levels are expected to increase by more than 2 dB as a result of construction traffic, further assessment is required (see section 10.4.4).

Ground-borne noise

Construction can also cause ground-borne noise impacts in nearby buildings when vibration generating equipment is used. The Interim Construction Noise Guideline and the Construction Noise and Vibration Guideline provide evening and night-time ground-borne noise management levels for residences to protect the amenity and sleep of affected residents. The ground-borne noise management levels are 40 A-weighted decibel (dBA) during the evening and 35 dBA during the night-time ($L_{Aeq(15minute)}$).

As the Construction Noise and Vibration Guideline does not provide guidance for acceptable ground-borne noise levels for commercial receivers, an internal noise management level of 60 dBA was adopted. This is consistent with similar recent infrastructure projects, such as M4-M5 Link. The ground-borne noise management levels only apply where internal ground-borne noise levels are higher than noise levels transmitted through the air.

Vibration – human comfort

The criteria for intermittent vibration from construction are based on the vibration dose value identified in *Assessing Vibration: A Technical Guideline* (DEC, 2006a) and are shown in Table 10.6. The vibration dose value applies to critical working areas, such as operating theatres or laboratories, residences, offices, educational institutions and places of worship, both during the day and during the night-time.

Table 10.6 Vibration dose values for intermittent vibration

Building type	Assessment period	Vibration dose value ($m/s^{1.75}$)	
		Preferred	Maximum
Critical working areas (eg operating theatres or laboratories)	Daytime or night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Daytime or night-time	0.40	0.80
Workshops	Daytime or night-time	0.80	1.60

Recommended minimum working distances for typical vibration intensive construction equipment for human comfort are shown in Table 10.7. These recommended distances, however, are a guide only.

The construction activities are generally not anticipated to result in continuous or impulsive vibration impacts. If design refinements result in the need for continuous or impulsive vibration impacts, relevant criteria are provided in section 3.2.2.4 of Technical Working Paper 2 (Noise and Vibration).

Table 10.7 Recommended minimum working distances for vibration intensive equipment – human comfort

Plant item	Rating description	Minimum distance (metres)
Vibratory roller	<50 kN (1-2 tonne)	15 to 20
	<100 kN (2-4 tonne)	20
	<200 kN (4-6 tonne)	40
	<300 kN (7-13 tonne)	100
	>300 kN (13-18 tonne)	100
	>300 kN (>18 tonne)	100
Small hydraulic hammer	300 kg (5 to 12 tonne excavator)	7
Medium hydraulic hammer	900 kg (12 to 18 tonne excavator)	23
Large hydraulic hammer	1,600 kg (18 to 34 tonne excavator)	73
Vibratory pile driver	Sheet piles	20
Piling rig – bored	≤ 800 mm	4
Jackhammer	Hand held	2

Vibration impacts on buildings and infrastructure

General buildings and pipework

The levels of vibration required to cause cosmetic damage tend to be at least an order of magnitude (ten times) higher than those at which people can perceive vibration. Cosmetic damage includes cracks or loosening of drywall surfaces, cracks in supporting columns and loosening of joints. Cosmetic damage vibration limits and minimum working distances are identified in the *Construction Noise and Vibration Guideline*, British Standard BS7385 *Part 2-1993 Evaluation and measurement for vibration in buildings Part* 2 and German Standard DIN4150: *Part 3-2016 Structural vibration – Effects of vibration on structures*.

BS7385 recommends vibration limits for transient vibration which are judged to give a minimal risk of vibration induced damage to affected buildings (see Table 14 of Technical Working Paper 2 (Noise and Vibration)). DIN4150 also provides guideline vibration limits for different buildings and buried pipework. Damage is not expected to occur where the values are complied with and the values are generally

recognised to be conservative. The DIN4150 values for structures are shown in Table 10.8 and short-term vibration on buried pipework shown in Table 10.9.

Table 10.8 DIN4150 guideline values for short-term vibration on structures

Group	Type of structure	Guideline values vibration velocity (mm/s)				
		Foundation, all directions at a frequency of:			Topmost floor, horizontal	Floor slabs, vertical
		1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	All frequencies	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40	20
2	Residential buildings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15	20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified as Group 1 or 2 and are of great intrinsic value (eg heritage listed buildings)	3	3 to 8	8 to 10	8	20[1]

Note: 1. It may be necessary to lower the relevant guideline value markedly to prevent minor damage.

Table 10.9 DIN4150 guideline values for short-term vibration on buried pipework

Pipe material	Guideline values vibration velocity at the pipe (mm/s)
Steel, welded	100
Vitrified clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
Masonry, plastics	80

Minimum working distances for typical vibration intensive construction equipment applicable for cosmetic damage are shown in Table 10.10. These criteria are specified in the *Interim Construction Noise Guideline* and must be complied with.

Table 10.10 Minimum working distances from vibration intensive equipment – cosmetic damage

Plant item	Rating description	Minimum distance (metres)	
		Residential and light commercial (BS7385)	Heritage items (DIN 4150, Group 3)
Vibratory roller	<50 kN (1-2 tonne)	5	11
	<100 kN (2-4 tonne)	6	13
	<200 kN (4-6 tonne)	12	15
	<300 kN (7-13 tonne)	15	31
	>300 kN (13-18 tonne)	20	40
	>300 kN (>18 tonne)	25	50
Small hydraulic hammer	300 kg (5 to 12 tonne excavator)	2	5
Medium hydraulic hammer	900 kg (12 to 18 tonne excavator)	7	15

Plant item	Rating description	Minimum distance (metres)	
		Residential and light commercial (BS7385)	Heritage items (DIN 4150, Group 3)
Large hydraulic hammer	1,600 kg (18 to 34 tonne excavator)	22	44
Vibratory pile driver	Sheet piles	2 to 20	5 to 40
Piling rig – bored	≤ 800 mm	2 (nominal)	5
Jackhammer	Hand held	1 (nominal)	3

Heritage buildings

As identified by BS7385, a heritage building should not be assumed to be more sensitive to vibration, unless it is structurally unsound. Heritage buildings are considered on a case-by-case basis. Where a heritage building is deemed to be sensitive, the Group 3 guidelines values in DIN4150 apply (see Table 10.8 and Table 10.10).

Sensitive equipment

Where vibration sensitive equipment (such as electron microscopes and microelectronics manufacturing equipment) is potentially affected by construction, vibration limits for the operation of the equipment should be taken from the manufacturer's data. If unavailable, generic vibration criteria values can be used (see section 3.2.2.6 of Technical Working Paper 2 (Noise and Vibration)).

10.2.2 Operation

Amenity impacts

Airborne noise

Criteria for noise and vibration in the Airports (Environment Protection) Regulations 1997 are less detailed and less stringent than those in the Road Noise Policy. On this basis, a conservative approach has been adopted and the potential road traffic noise impacts have been assessed against the more stringent requirements of the Road Noise Policy.

The Road Noise Policy is used to assess and manage potential airborne noise impacts from new and redeveloped road projects. The Noise Criteria Guideline provides a consistent approach to identifying road noise criteria for residential and 'other sensitive' land uses. The *Noise Mitigation Guideline* (Roads and Maritime, 2015b) recognises that the Noise Criteria Guideline criteria are not always practicable, and it is not always feasible or reasonable to expect that they can be achieved.

The Road Noise Policy and Noise Criteria Guideline use the following terms to describe and assess the impacts of road projects:

- 'No Build' – the assessment scenario used to predict noise levels if the project did not go ahead ('without project')
- 'Build' – the assessment scenario used to predict noise levels with the project ('with project').

The difference in noise levels between these assessment scenarios is used to determine the potential impact of the project. Both assessment scenarios undertaken for the project include the operation of other projects (the M5 East, New M5, M4-M5 Link and NorthConnex projects).

The project includes both redeveloped and new roads. The Noise Criteria Guideline provides criteria for residential receivers as shown in Table 10.11. The criteria are lower for the night-time due to the greater sensitivity of receivers to noise impacts during this period. The Road Noise Policy and Noise Criteria Guideline require noise to be assessed at project opening (indicatively year 2026 for this project) and for a

future design year, typically 10 years after opening (2036). The Noise Criteria Guideline requires transition zones to be applied at the point where road categories change to provide a smooth transition in noise criteria.

Table 10.11 Noise Criteria Guideline – criteria for residential receivers

Road category	Type of project/land use	Assessment criteria (dBA)	
		Daytime (7am – 10pm)	**Night-time (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)
	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15\ hour)}$ 60 (external)	$L_{Aeq(9\ hour)}$ 55 (external)
	Existing residences affected by both new roads and the redevelopment of existing freeway/arterial/sub-arterial roads in a transition zone[1]	Between $L_{Aeq(15\ hour)}$ 55-60 (external)	Between $L_{Aeq(9\ hour)}$ 50-55 (external)
	Existing residences affected by increases in traffic noise of 12 dB or more from redevelopment of existing freeway/arterial/sub-arterial roads[2]	Between $L_{Aeq(15\ hour)}$ 42-55 (external)	Between $L_{Aeq(9\ hour)}$ 42-50 (external)
	Existing residences affected by increases in traffic noise of 12 dB or more from redevelopment of existing freeway/arterial/sub-arterial roads[2]	Between $L_{Aeq(15\ hour)}$ 42-60 (external)	Between $L_{Aeq(9\ hour)}$ 42-55 (external)
Local roads	Existing residences affected by noise from new local road corridors	$L_{Aeq(1\ hour)}$ 55 (external)	$L_{Aeq(1\ hour)}$ 50 (external)
	Existing residences affected by noise from redevelopment of existing local roads	$L_{Aeq(15\ hour)}$ 60 (external)	$L_{Aeq(9\ hour)}$ 55 (external)
	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(15\ hour)}$ 60 (external)	$L_{Aeq(9\ hour)}$ 55 (external)

Notes: 1. The criteria assigned to the entire residence depend on the proportion of noise coming from the new and redeveloped roads.
2. The criteria at each facade are determined from the existing traffic noise level plus 12 dB.

The Noise Criteria Guideline does not consider commercial and industrial receivers as being sensitive to operational airborne road traffic noise impacts. However, criteria for ‘other sensitive’ receivers are identified in the Noise Criteria Guideline and are provided in Table 10.12.

Table 10.12 Noise Criteria Guideline – criteria for 'other sensitive' receivers

Existing sensitive land use	Assessment criteria (dB)		Additional considerations
	Daytime (7am – 10pm)	Night-time (10pm – 7am)	
School classrooms	$L_{Aeq(1\ hour)}$ 40 (internal)[1]	-	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 AS/NZS 2107:2016
Hospital wards	$L_{Aeq(1\ hour)}$ 35 (internal)	$L_{Aeq(1\ hour)}$ 35 (internal)	
Places of worship	$L_{Aeq(1\ hour)}$ 40 (internal)[1]	$L_{Aeq(1\ hour)}$ 40 (internal)[1]	The criteria are internal, ie 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 is in these areas that may be affected by road traffic noise.
Open space (active use)	$L_{Aeq(15\ hour)}$ 60 (external)	-	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.
Open space (passive use)	$L_{Aeq(15\ hour)}$ 55 (external)	-	Passive recreation is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion (eg playing chess, reading).
Child care facilities	Sleeping rooms $L_{Aeq(1\ hour)}$ 35 (internal)[1] Indoor play areas $L_{Aeq(1\ hour)}$ 40 (internal)[1] Outdoor play areas $L_{Aeq(1\ hour)}$ 55 (internal)	-	Multipurpose spaces (eg 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.
Aged care facilities	-	-	The criteria for residential land uses should be applied to these facilities.

Note: 1. The criteria are specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that all schools and places of worship have openable windows and external noise levels are 10 dB higher than the corresponding internal level, which is representative of windows being partially open to provide ventilation.

A number of hotels are located close to the project site, with certain hotels accommodating staff as their primary residence. The Noise Criteria Guideline criteria for residential receivers has been applied to these receivers, noting that only areas of primary residence require assessment.

The Noise Mitigation Guideline provides guidance in managing and controlling road traffic noise and describes the principles to be applied when reviewing noise mitigation. As the project progresses through the early design stages, various road design features (such as adjustments to vertical and horizontal alignments, road gradient modifications, traffic management and landscape mounds) are evaluated to assist with minimising road traffic noise. Following the use of the above measures, site specific 'additional noise mitigation measures' are then required to be investigated for receivers which have residual exceedances of the criteria.

When evaluating whether a receiver qualifies for consideration of additional noise mitigation, the Noise Mitigation Guideline considers how far above the criteria the noise level is, and how much a project

increases noise levels. The Noise Mitigation Guideline provides three triggers where a receiver may qualify for consideration of additional noise mitigation:

- Trigger 1 – the predicted 'with project' noise level exceeds the Noise Criteria Guideline controlling criteria and the noise level increase as a result of the project (ie the noise predictions for the 'with project' minus the 'without project) is greater than 2 dB
- Trigger 2 – the predicted 'with project' noise level is 5 dB or more above the Noise Criteria Guideline controlling criteria (ie exceeds the cumulative limit) and the receiver is significantly influenced by project road noise, regardless of the incremental impact of the project
- Trigger 3 – the noise level contribution from the road project is acute (daytime $L_{Aeq(15hour)}$ 65 dBA or higher, or night-time $L_{Aeq(9hour)}$ 60 dBA or higher) even if noise levels are controlled by a non-project road.

The eligibility of receivers for consideration of additional noise mitigation is determined before the effect of low noise pavement and noise barriers is included. The requirement for the project is to provide feasible and reasonable additional mitigation to eligible receivers with the aim of meeting the Noise Criteria Guideline controlling criteria.

Surrounding road network

Noise impacts can occur on the surrounding road network due to traffic redistribution where vehicles use different routes once the project is operational. The Noise Criteria Guideline criteria for residential receivers (see above) have been applied to the surrounding road network. There is considered to be an impact if a project generates an increase in road traffic noise of more than 2 dB above the existing situation.

Noise from ground-based airport activities

The project has the potential to alter noise emissions emanating from ground-based activities at Sydney Airport through the proposed removal of buildings adjacent to Qantas Drive and the removal of shipping containers at Tyne Container Services. Noise from ground-based airport activities includes construction works, road traffic, taxiing aircraft, ground running of aircraft engines and operation of aircraft auxiliary power units. Although the maximum level of noise emissions from Sydney Airport are set out in the Airports (Environment Protection) Regulations 1997, the regulation does not contain specific criteria for noise generated by ground-based airport activities. In the absence of any defined criteria relating to noise generated by aircraft on the ground, the Noise Policy for Industry has been referenced for the assessment of potential changes to aircraft related noise impacts, including engine ground running.

The Noise Policy for Industry describes trigger levels that indicate the noise level at which feasible and reasonable noise management measures should be considered. For potential noise impacts resulting from ground-based airport activities in areas near the airport, the Noise Policy for Industry 'intrusiveness' criteria are considered appropriate. The 'intrusiveness' of an industrial noise source is generally considered acceptable if the L_{Aeq} noise level of the source does not exceed the background noise level by more than 5 dB. These criteria only apply to residential receivers as shown in Table 10.13. The Noise Policy for Industry also includes amenity criteria for 'other sensitive' receivers. The amenity noise levels for receivers that would potentially be affected by altered noise generated by ground-based activities at Sydney Airport are provided in Table 10.14.

Table 10.13 Intrusiveness criteria – noise related to airport activities

Noise catchment area	Period	Measured noise level (dBA)		Project noise trigger levels $L_{Aeq(15minute)}$ (dBA)	
		Rating background level	$L_{Aeq(period)}$	Standard	Engine run up[2]
NCA03 (Tempe)	Daytime	42	61	47	52
	Evening	40	60	45	50
	Night-time	38	53	43	48
NCA06 and NCA08 (Mascot)[1]	Daytime	60	68	65	70
	Evening	58	66	63	68
	Night-time	53	64	58	63

Notes: 1. The noise monitoring at this location was affected by nearby construction works during the monitoring period. The background levels and criteria for this area should be reviewed and confirmed during detailed design.

2. Engine ground running would likely occur infrequently, especially during the night-time, and high power running would not occur every night. The Noise Policy for Industry allows an increase of the trigger levels by 5 dB increase due to the infrequent nature of the noise.

Table 10.14 Amenity criteria - 'other sensitive' receivers

Receiver type	Noise amenity area	Time of day	Recommended amenity noise level (dBA)	
			Standard[1]	Engine run up[2]
Hotel	Urban	Daytime	68	73
		Evening	58	63
		Night-time	53	58

Notes: 1. Set as being 5 dB above the recommended urban amenity noise level for a residence plus 3 dB to convert to a 15 minute level, as per the procedures in the Noise Policy for Industry.

2. Engine ground running would likely occur infrequently, especially during the night-time, and high power running would not occur every night. The Noise Policy for Industry allows an increase of the trigger levels by 5 dB increase due to the infrequent nature of the noise.

Vibration impacts

Vehicles are unlikely to cause vibration impacts at adjacent receivers unless there are road irregularities. The new and upgraded roads within the project site would be designed and constructed to avoid significant irregularities (see Chapter 7 (Project description)). As such, impacts from operational vibration are not anticipated.

10.3 Existing environment

10.3.1 Sensitive receivers

The nearest sensitive residential receivers are located in Mascot and Tempe, about 40 metres and 70 metres away from the construction footprint, respectively. Once operational, the nearest sensitive residential receivers to the project site would be located about 130 metres to the north-west on Smith and South streets in Tempe, and 90 metres to the north-east on Baxter Road.

Relatively large parts of the study area are subject to commercial or industrial land uses, particularly around Sydney Airport, in the western section of Mascot near Alexandra Canal, and along the Princes Highway. These uses include retail outlets, distribution warehouses, shipping container storage and areas of heavy industry, such as the Boral concrete processing and recycling sites. Other receivers within the study area include hotels, child care facilities, places of worship, schools, a medical facility and

recreation facilities. The identification of receivers includes consideration of some proposed developments in the vicinity of the project site, such as the proposed hotel between Seventh and Ninth streets.

All sensitive receivers are shown on Figure 10.2. The locations and types of 'other sensitive' receivers are described in detail in section 2.1 of Technical Working Paper 2 (Noise and Vibration) and also discussed in Chapter 19 (Land use and property) and 20 (Socio-economic impacts).

10.3.2 Noise catchment areas

Existing noise levels were determined based on monitoring undertaken at the nine noise catchment areas listed in Table 10.15 and shown in Figure 10.2.

Table 10.15 General characteristics of noise catchment areas

Noise catchment area	Description	Sydney Airport land[1]
NCA00	NCA00 is located to the north-east of St Peters interchange where the New M5 is being constructed. Residential receivers are located on Campbell Street/Road, facing St Peters interchange, but are more than 550 m from the project. Sydney Park, off Campbell Street, is also located within this catchment.	There is no Sydney Airport land within NCA00.
NCA01	This catchment is located north-west of Alexandra Canal and east of Reilly Lane, Sydenham. It is mainly residential with the exception of commercial receivers located along the Princes Highway. St Peters Anglican Church, St Peters Public School and St Peters Preschool are located in the north-east. The closest receivers to the project site are commercial receivers 160 m away on the Princes Highway.	Part of the southern boundary of the noise catchment area is located within Sydney Airport land.
NCA02	NCA02 is located in Tempe, north of Sydney Airport and west of Alexandra Canal. The southern section of the noise catchment area is mainly commercial and includes IKEA Tempe. Residential receivers are located further north of the Princes Highway. A Uniting Church, St Peter and St Paul Catholic Church and the True Buddhist Temple are located in the south-west of the catchment. Sydenham Green is located in the north-east.	There is no Sydney Airport land within NCA02.
NCA03	NCA03 is located in Tempe to the north-west of the project site. The catchment is mainly residential with the exception of commercial receivers along Princes Highway. Tempe Recreation Reserve is located about 130 m west of the project site at the closest point. The Guardian Early Learning Child Care Centre, Betty Spears Child Care Centre, Al Hijrah Mosque and numerous residential receivers are located in the north-west of the catchment.	There is no Sydney Airport land within NCA03.
NCA04	This catchment is north of Sydney Airport and Airport Drive in Mascot and includes commercial land uses. The nearest buildings are located close to the project site in the north and west of the catchment, and also along Airport Drive and Qantas Drive.	Part of the land located west of Alexandra Canal and north of Botany Rail Line is Sydney Airport land. Parts of Qantas Drive and areas to the south of the noise catchment area is Sydney Airport land.
NCA05	NCA05 covers the western section of Sydney Airport near Terminal 1.	The majority of the noise catchment area is located within Sydney Airport land with the exception of the Tyne Container Services site.

Noise catchment area	Description	Sydney Airport land[1]
NCA06	NCA06 is located to the north of Terminals 2/3 and Qantas Drive in Mascot. The catchment mainly includes commercial land uses with some residential receivers north of Coward Street. Aero Kids Early Learning Centre is located to the south of the residential receivers. Toybox Early Learning and Citygate Fellowship Church are located along Bourke Road. There are a number of hotels along the eastern border on O'Riordan Street, including the Stamford Plaza.	Land adjacent to Qantas Drive to the south and sections near Alexandra Canal to the north-west of the noise catchment area is Sydney Airport land.
NCA07	NCA07 covers the eastern and northern sections of Sydney Airport near Terminals 2/3 and includes the Sydney Airport Jet Base and Qantas Flight Training Centre. The project would include removing a number of the buildings at the Jet Base (including buildings at the Flight Training Centre). The catchment includes a number of hotels near the intersection of Qantas Drive, Joyce Drive and O'Riordan Street, including the Ibis, Mantra and a future hotel at Sydney Airport.	The majority of this noise catchment area is located within Sydney Airport land.
NCA08	This catchment is located in Mascot to the north-east of Sydney Airport. The area is mainly residential, with the nearest receivers located 90 m away on Baxter Road. The Quest, Citadines Connect and The Branksome hotels are located near O'Riordan Street. Mascot Public School is located in the north-east of the catchment on King Street. Robey Street Reserve and John Curtin Memorial Reserve are both located in the south of the noise catchment area.	There is a small section of Sydney Airport Land adjacent to Joyce Drive.

Note: 1. Sydney Airport land is described in Chapter 2 (Location and setting) and shown (with respect to the noise catchment areas) on Figure 10.1.

10.3.3 Existing noise levels

Existing noise levels in the study area are generally dominated by transportation noise, with road noise affecting most locations. Rail and aircraft noise also contribute to existing noise levels in certain areas, depending on the proximity to the Botany Rail Line and Sydney Airport. During the night-time, noise levels generally decrease due to reduced road traffic volumes on the surrounding road network and the limited number of flights occurring outside Sydney Airport's operational hours.

Existing noise levels are shown in Table 10.16. The existing noise levels were measured at those receivers considered to most represent the existing noise levels in each noise catchment area (shown on Figure 10.2). The measured noise levels were used to characterise the existing noise environment and to determine the criteria used to assess the potential impacts of the project.

Table 10.16 Existing noise levels/rating background levels

Noise catchment area	Address of the representative receiver where monitoring was undertaken	Measured noise level (dBA)		
		Day	Evening	Night
NCA00	18 Campbell Street, St Peters	54	45	40
NCA01	Princes Highway, St Peters	65	62	53
NCA02	535 Princes Highway, Tempe	64	60	48
NCA03	1 Fanning Street, Tempe	42	40	38
NCA03	Alexandra Canal, Tempe	53	53	46
NCA04	Canal Road, St Peters	58	54	49
NCA05 and NCA07[1]	Qantas Drive, Mascot	63	60	52

Noise catchment area	Address of the representative receiver where monitoring was undertaken	Measured noise level (dBA)		
		Day	Evening	Night
NCA06	39 Kent Road, Botany	60	56	50
NCA06	289 King Street, Mascot	60	58	53
NCA08	105 Baxter Road, Mascot	54	51	45

Note: 1. NCA05 and NCA07 are representative of Sydney Airport.

The existing maximum noise levels typically range from 70 to 90 dBA. Higher levels were measured at Princes Highway, St Peters (up to 96 dBA) and L06 at Qantas Drive, Mascot (up to 103 dBA) due to the proximity to adjacent roads. The higher end of the ranges would likely be from passing heavy vehicles and aircraft flyovers.

10.4 Assessment of construction impacts

10.4.1 Potential noise sources

Potential noise and vibration sources during construction include:

- Operation of mobile and stationary construction plant and equipment
- Operation of construction compounds and other ancillary facilities (known as fixed sources)
- Construction vehicle movements.

The assessment uses realistic worst-case scenarios to determine the impacts from the noisiest 15 minute period that is likely to occur for each work scenario, as required by the Interim Construction Noise Guideline. The scenarios were categorised into ‘peak’ and ‘typical’ activities, as discussed in section 10.1.2. The scenarios used to assess the potential noise impacts of construction include:

- Enabling works
- Compound establishment
- Compound operation
- Site establishment
- Demolition
- Bridge construction
- Road works
- Finishing works.

The characteristics of the noise and vibration emissions are a result of the equipment used to undertake the works. Equipment likely to be used during construction is described in Chapter 8 (Construction) and Technical Working Paper 2 (Noise and Vibration).

10.4.2 Predicted noise levels

An assessment of the predicted noise impacts was undertaken at potentially affected receivers in each noise catchment area. The predicted noise levels are representative of the worst-case situation where construction equipment is at the closest point to the most affected receiver. The calculations also assume that many items of construction equipment are used at the same time. Noise levels would, however, vary over the construction period, as the location of work would change and not all equipment would be in operation at all times.

Three categories of noise management level exceedances and associated levels of impact are shown in Table 10.17. The defined categories are associated with the likely subjective response of people affected

by the impacts. The subjective response would vary, depending on the nature of the noise and the period over which the impacts occur (such as during the daytime or evening/night-time).

Table 10.17 Noise management level exceedance categories

Exceedance of noise management level	Category
1 to 10 dB	Minor
11 to 20 dB	Moderate
More than 20 dB	High

Residential receivers

Standard construction hours

The noise management level exceedances during standard construction hours are shown in Table 10.18 for each construction scenario and corresponding noise catchment area. Only receivers with the potential to experience noise levels exceeding the noise management levels in noise catchment areas are shown in the table. As shown in the table, the potential impacts are associated with the noise catchment areas with the highest number of residential receivers, being NCA03 and NCA08. This is due to the lower noise management level criteria for residential receivers compared with other receiver types.

Other catchments either have no residential receivers or the receivers are located further from the works. The highest impacts are generally observed during ‘peak’ activities, which is due to the use of noise intensive equipment such as rockbreakers and concrete saws. This includes enabling works, compound establishment, site establishment, bridge construction and road works. For most scenarios, the ‘peak’ activity would only be required for a relatively short period of the total activity duration (see Table 10.1). As shown in Table 10.18, noise generated during the ‘typical’ activity do not exceed noise management levels.

The worst-case construction impacts are predicted during enabling works, with high numbers of minor exceedances predicted in both NCA03 and NCA08, and one moderate exceedance predicted in NCA08. This is mostly during ‘peak’ activity, which is proposed to be undertaken intermittently within a two to six month period. ‘Typical’ activity would result in substantially fewer impacts over a six to 12 month period. However, some residential receivers would also experience minor exceedances of the noise management level during site establishment activities.

There are a large number of receivers within NCA03 (to the north-west of the former Tempe landfill on South Street and Smith Street) that would experience minor exceedances of the noise management level during enabling works, compound establishment, site establishment, bridge construction and roadworks. Again, this is predicted to occur during the ‘peak’ activity of these construction scenarios. No exceedances of the noise management level are predicted during the ‘typical’ scenario within NCA03. Additionally, compound establishment and site establishment are relatively short duration activities.

Table 10.18 Number of receivers with predicted noise exceedances during standard[1] construction hours

Construction scenario	Activity	Noise catchment area					
		NCA03			NCA08		
		Minor	Moderate	High	Minor	Moderate	High
Enabling works	Peak	14	-	-	10	1	-
	Typical	-	-	-	-	-	-
Compound establishment	Peak	261	-	-	-	-	-
	Typical	-	-	-	-	-	-
Compound operation	-	-	-	-	-	-	-
Site establishment	-	74	-	-	1	-	-
Demolition	Peak	-	-	-	-	-	-
	Typical	-	-	-	-	-	-
Bridges	Peak	6	-	-	-	-	-
	Typical	-	-	-	-	-	-
Road works	Peak	161	-	-	-	-	-
	Typical	-	-	-	-	-	-
	Dynamic compaction	-	-	-	-	-	-
Finishing works	-	-	-	-	-	-	-

Note: 1. Standard construction hours are 7am to 6pm Monday to Friday and 8am to 1pm Saturdays.

Outside standard construction hours

Out-of-hours works would be required to construct the project (see section 8.3.3), to sustain the operation of the existing road network and minimise the potential for aviation and rail safety hazards. The potential for noise to exceed the criteria is greater during the evening and night-time periods than during the daytime, due to the more stringent (lower) criteria that apply during these times. It is noted, however, that the predictions do not take into account whether carrying out a particular work activity outside standard construction hours at a particular location is justified (as described above).

The noise management level exceedances during out-of-hours works are shown in Table 10.19 (daytime), Table 10.20 (evening), Table 10.21 (night-time) and Table 10.22 (sleep disturbance) for each construction scenario and corresponding noise catchment area. Only receivers exceeding the noise management levels in each noise catchment area are shown in the tables.

The worst-case impacts are predicted to be high for a small number of receivers in NCA08, with moderate impacts experienced for receivers in NCA03, NCA06 and NCA08 and minor impacts for receivers in NCA00, NCA02, NCA03, NCA06 and NCA08. Similar to works during standard construction hours, the highest impacts are generally predicted in the 'peak' scenario, with the worst-case construction impacts predicted during enabling works, compound establishment, site establishment, bridge construction and roadworks. Although the predicted noise exceedances would affect many residential receivers, particularly NCA03 in Tempe, it is anticipated the majority of the works would be able to be completed during standard construction hours (such as roadworks near NCA03, compound establishment and site establishment). As detailed in section 8.3.3, the types of out-of-hours activities proposed in these locations include some works associated with the Qantas Drive upgrade and extension and Terminal 1 connection works. These may be carried out over two weeks or up to three months (dependent on the proposed works and location).

The operation of the compound would impact residential receivers in NCA03 during the evening (20 receivers) and night-time (78 receivers) period, with a minor exceedance of the sleep disturbance criteria for 29 receivers. However, the majority of works near these receivers would be able to be

completed during standard construction hours. This would limit the need for compound operation during the evening and night-time period and the potential for sleep disturbance impacts for nearby receivers.

Road works are required along the entire road alignment and noise intensive works would be required at certain times in some locations.

Highly noise affected receivers

Residential receivers subject to noise levels of 75 dBA or greater are considered 'highly noise affected' by the Interim Construction Noise Guideline. The only residential receiver predicted to be highly noise affected (by 1 dB) by the project is located on Baxter Road in Mascot during 'peak' enabling works activities. Potential impacts would only occur when noise intensive works are being carried out near Baxter Road. This is only envisaged to be undertaken for relatively short periods (ie a couple of days) intermittently over a period of around three months. Works in other areas are not expected to result in highly noise affected noise levels at this receiver as a result of the increased separation distance and screening from existing structures.

Table 10.19 Number of receivers with predicted noise exceedances during daytime[1] out-of-hours works

Construction scenario	Activity	Noise catchment area								
		NCA03[2]			NCA06			NCA08		
		Minor	Moderate	High	Minor	Moderate	High	Minor	Moderate	High
Enabling works	Peak	248	-	-	1	-	-	23	2	-
	Typical	-	-	-	-	-	-	1	-	-
Compound establishment	Peak	348	29	-	-	-	-	-	-	-
	Typical	-	-	-	-	-	-	-	-	-
Compound operation	-	3	-	-	-	-	-	-	-	-
Site establishment	-	246	7	-	-	-	-	4	-	-
Demolition	Peak	-	-	-	-	-	-	-	-	-
	Typical	-	-	-	-	-	-	-	-	-
Bridges	Peak	194	-	-	-	-	-	-	-	-
	Typical	-	-	-	-	-	-	-	-	-
Road works	Peak	338	17	-	-	-	-	1	-	-
	Typical	-	-	-	-	-	-	-	-	-
	Dynamic compaction	14	-	-	-	-	-	-	-	-
Finishing works	-	-	-	-	-	-	-	-	-	-

Notes: 1. Daytime out-of-hours is 7am to 8am and 1pm to 6pm on Saturday, and 8am to 6pm on Sunday and public holidays.
2. Undertaking works outside of standard construction hours in the vicinity of this noise catchment are unlikely to be justified (for example are not within prescribed airspace) and are therefore likely to occur during standard construction hours.

Table 10.20 Number of receivers with predicted noise exceedances during evening[1] out-of-hours

Construction scenario	Activity	Noise catchment area											
		NCA00			NCA03[2]			NCA06			NCA08		
		Minor	Moderate	High	Minor	Moderate	High	Minor	Moderate	High	Minor	Moderate	High
Enabling works	Peak	8	-	-	324	-	-	1	-	-	42	6	-
	Typical	-	-	-	-	-	-	-	-	-	1	-	-
Compound establishment	Peak	-	-	-	-	-	-	-	-	-	-	-	-
	Typical	-	-	-	-	-	-	-	-	-	-	-	-
Compound operation	-	-	-	-	20	-	-	-	-	-	-	-	-
Site establishment	-	-	-	-	264	21	-	-	-	-	10	1	-
Demolition	Peak	-	-	-	-	-	-	-	-	-	-	-	-
	Typical	-	-	-	-	-	-	-	-	-	-	-	-
Bridges	Peak	-	-	-	286	-	-	-	-	-	3	-	-
	Typical	-	-	-	6	-	-	-	-	-	-	-	-
Road works	Peak	4	-	-	361	48	-	1	-	-	14	-	-
	Typical	-	-	-	3	-	-	-	-	-	-	-	-
	Dynamic compaction	-	-	-	40	-	-	-	-	-	-	-	-
Finishing works	-	-	-	-	12	-	-	-	-	-	-	-	-

Notes: 1. Evening out-of-hours is 6pm to 10pm Monday to Saturday.
2. Undertaking works outside of standard construction hours in the vicinity of this noise catchment is unlikely to be justified (for example are not within prescribed airspace) and is therefore likely to occur during standard construction hours.

Table 10.21 Number of receivers with predicted noise exceedances during night-time[1] out-of-hours

Construction scenario	Activity	Noise catchment area														
		NCA00			NCA02			NCA03[2]			NCA06			NCA08		
		Minor	Moderate	High	Minor	Moderate	High	Minor	Moderate	High	Minor	Moderate	High	Minor	Moderate	High
Enabling works	Peak	32	-	-	16	-	-	370	1	-	3	1	-	188	21	2
	Typical	-	-	-	-	-	-	-	-	-	-	-	-	7	1	-
Compound establishment	Peak	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Typical	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compound operation	-	-	-	-	-	-	-	78	-	-	-	-	-	-	-	-
Site establishment	-	-	-	-	-	-	-	287	59	-	1	-	-	33	2	-
Demolition	Peak	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Typical	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bridges	Peak	9	-	-	3	-	-	339	1	-	1	-	-	28	-	-
	Typical	-	-	-	-	-	-	53	-	-	-	-	-	1	-	-
Road works	Peak	31	-	-	18	-	-	303	117	-	1	-	-	84	-	-
	Typical	-	-	-	-	-	-	17	-	-	-	-	-	-	-	-
	Dynamic compaction	-	-	-	-	-	-	88	-	-	-	-	-	-	-	-
Finishing works	-	-	-	-	-	-	-	30	-	-	-	-	-	-	-	-

Notes: 1 Night-time out-of-hours is 10pm to 7am Monday to Saturday and 6pm to 8am on Sunday and public holidays.
2. Undertaking works outside of standard construction hours in the vicinity of this noise catchment is unlikely to be justified (for example are not within prescribed airspace) and is therefore likely to occur during standard construction hours.

Table 10.22 Number of receivers with predicted noise exceedances of sleep disturbance criteria

Construction scenario	Activity	Noise catchment area														
		NCA00			NCA02			NCA03[1]			NCA06			NCA08		
		Minor	Moderate	High	Minor	Moderate	High	Minor	Moderate	High	Minor	Moderate	High	Minor	Moderate	High
Enabling works	Peak	29	-	-	4	-	-	324	-	-	1	-	-	116	17	1
	Typical	-	-	-	-	-	-	-	-	-	-	-	-	10	1	-
Compound establishment	Peak	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Typical	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Compound operation	-	-	-	-	-	-	-	29	-	-	-	-	-	-	-	-
Site establishment	-	-	-	-	-	-	-	246	7	-	-	-	-	17	1	-
Demolition	Peak	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Typical	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bridges	Peak	-	-	-	-	-	-	194	-	-	-	-	-	8	-	-
	Typical	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Road works	Peak	31	-	-	18	-	-	303	117	-	1	-	-	84	-	-
	Typical	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
	Dynamic compaction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Finishing works	-	-	-	-	-	-	-	48	-	-	-	-	-	-	-	-

Note: 1. Undertaking works outside of standard construction hours in the vicinity of this noise catchment is unlikely to be justified (for example are not within prescribed airspace) and is therefore likely to occur during standard construction hours.

Other sensitive receivers

The predicted noise management level exceedances for 'other sensitive' receivers are shown on Figure 10.3. There were no predicted noise level exceedances for educational facilities, medical facilities or libraries within the study area.

Standard construction hours

During standard construction hours, the results show:

- Three hotels are predicted to be subject to high worst-case impacts, while two would be subject to moderate worst-case impacts in NCA06, NCA07 and NCA08
- Hotels located further north of the project site are predicted to experience a minor worst-case impact or noise below the relevant noise management level
- Coleman Reserve is predicted to experience high daytime impacts during 'peak' enabling works and moderate impacts during other works
- Three child care centres in NCA03 and NCA06 are predicted to experience minor worst-case impacts (when in use)
- Two places of worship in NCA01 and NCA02 are predicted to experience minor worst-case impacts (when in use).

It is noted that the majority of the 'other sensitive' receivers are located adjacent (or near) main roads and are already subject to relatively high existing noise levels. The unattended noise monitoring showed that existing noise levels next to main roads (65 to 75 dB during the daytime and 60 to 70 dB during the night-time) are comparable to, or higher than, the predicted construction noise levels for many of the assessed work scenarios. In this context, it is anticipated the predicted noise levels may not be noticeable to existing receivers.

Outside standard construction hours

Based on the predicted external noise levels, the closest hotels in NCA06 and NCA07 are likely to be subject to high worst-case impacts when noise intensive equipment is being used at the intersection of Qantas Drive, Joyce Drive and O'Riordan Street ('peak' activity). This is associated with 'peak' enabling works and 'peak' road works. However, the most affected hotels are expected to have high performance facades and glazing to mitigate high existing noise levels being near the airport. This will reduce construction noise to more acceptable (internal) levels during some works.

The worst-case noise levels and impacts would only be apparent for relatively short periods when noise intensive equipment is being used. There would also be periods when noise levels are lower than predicted and periods when no equipment is being used. Notwithstanding, it is still likely that regular night-time work would be required at the intersection of Qantas Drive, Joyce Drive and O'Riordan Street due to the need to maintain the function of the roads in this location.

The construction materials and insulation of the most affected rooms in the affected hotels have been recently investigated in consultation with the hotel operators to identify more realistic assumptions regarding external noise levels and the corresponding internal levels. These investigations have confirmed that for each affected hotel, the acoustic performance of the hotel facades used in the assessment is conservative (ie has underestimated the level of attenuation which would be achieved). As a result, the level of impact predicted is unlikely to be sustained at these receivers. The location-specific criteria for each hotel would be used in future construction noise assessments to inform the selection of appropriate mitigation measures (see NV4 in section 10.7.2).

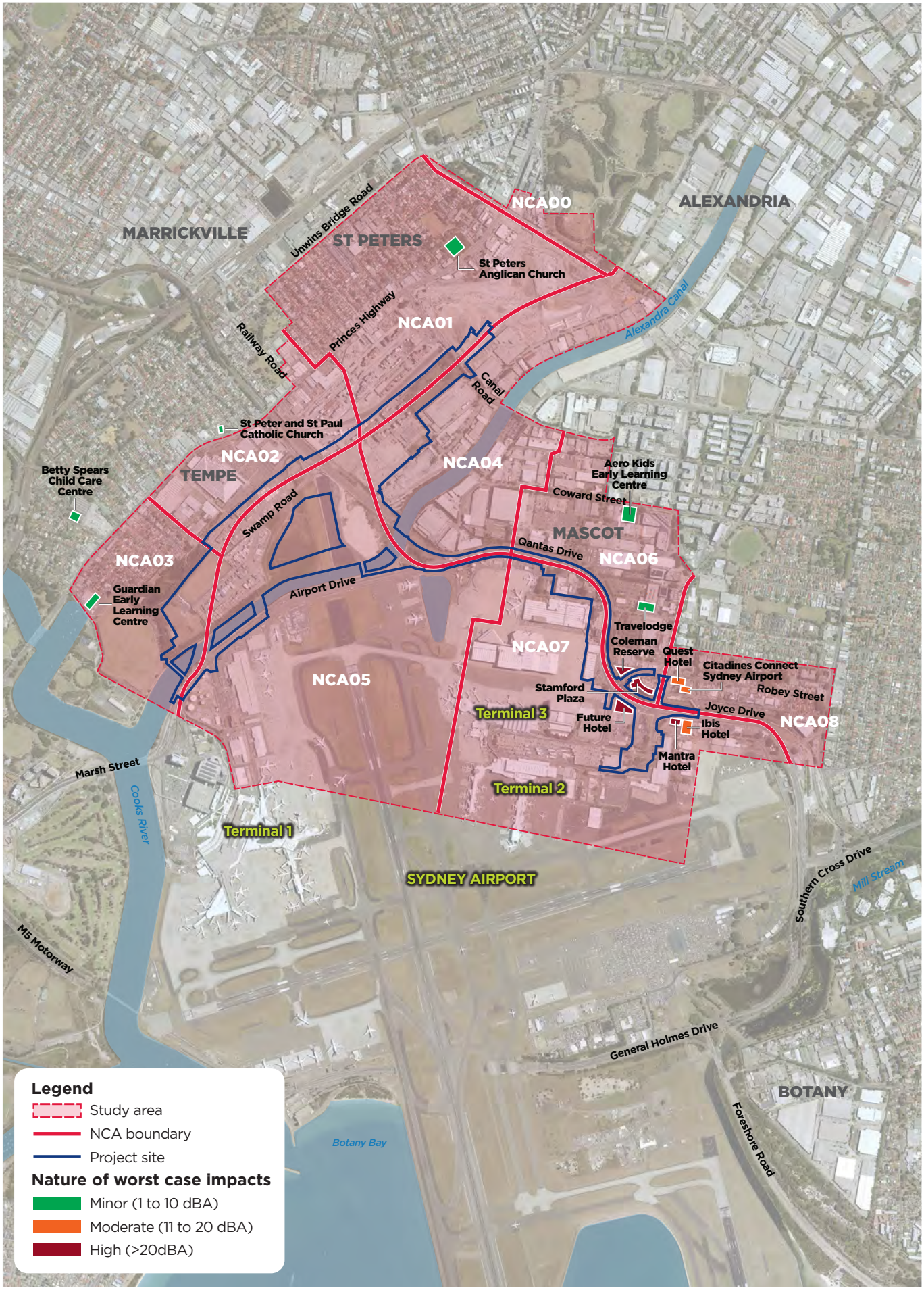

Figure 10.3 **Predicted worst-case impacts 'other sensitive' receivers**

Qantas Flight Training Centre

The Qantas Flight Training Centre operates 24 hours a day, seven days a week. The Flight Training Centre has several specialist flight simulators that are required to be kept operational to meet training needs. The simulators are highly sensitive to impacts from construction as they simulate aircraft warning sounds and physical feedback events that need to be easily discernible by pilots during training and certification. Other sections of the Flight Training Centre are used as training rooms, cabin crew simulation areas, pre-flight training areas and meeting/office rooms. The buildings at the Flight Training Centre would be removed during construction to allow Qantas Drive to be widened. Qantas is proposing to relocate the Flight Training Centre to a new site on the northern side of the rail corridor (see Chapter 19 (Land use and property)). There may be a period where construction noise and vibration has the potential to impact operations at the centre in its current location, particularly operation of the flight simulators.

Predicted construction noise impacts were identified for likely construction scenarios directly outside the Flight Training Centre in its current location, about 100 metres to the west of the Flight Training Centre, and about 300 metres west of the Flight Training Centre. The key findings of the assessment included:

- 'Peak' construction activities (comprising enabling works, demolition and road works) are predicted to result in high worst-case impacts where noise intensive equipment is used adjacent to the Flight Training Centre
- Moderate worst-case impacts are predicted during 'typical' activities (comprising enabling works, demolition and road works)
- The highest noise impacts are likely during building demolition activities
- When works are about 100 metres from the Flight Training Centre, the majority of the assessed scenarios resulted in no predicted exceedances or minor worst-case impacts, with the exception of moderate impacts during 'peak' enabling works
- When works are about 300 metres from the Flight Training Centre, there are no predicted exceedances, with the exception of 'peak' enabling works, where minor worst-case impacts are expected.

The impacts presented above are based on all construction equipment working simultaneously in each assessed scenario. There would frequently be periods when construction noise levels are much lower than the worst-case levels predicted. There would also be times when no equipment is being used and no impacts would occur. Conservative assumptions have also been made about the acoustic characteristics of the building and flight simulators.

Although high impacts (noise levels of 75 to 90 dB) are predicted when noise intensive works (peak activity) are occurring close to the Flight Training Centre in its current location, the Flight Training Centre is located adjacent to operational areas of the airport and a major road. Background noise monitoring in the vicinity identified existing daytime noise was regularly between 70 to 75 dBA, with maximum noise levels often above 100 dBA. The management approach for minimising impacts on the Flight Training Centre in its current location would be further developed during detailed design and construction planning in consultation with Qantas.

Commercial receivers

No commercial receivers are predicted to be subject to high worst-case impacts during construction. Moderate worst-case impacts are predicted at the nearest commercial receivers in NCA05, NCA06 and NCA07 during the 'peak' activities (comprising enabling works, demolition and road works). This includes DHL, the AMG Sydney and Qantas security building located at Lancastrian Road. Noise levels and exceedances are predicted to be minor or compliant with noise management levels at other times.

Ground-borne noise

There is potential for ground-borne noise impacts at nearby receivers when construction works requiring vibration intensive equipment occur nearby. The majority of the receivers in the study area are sufficiently distant from the works for ground-borne noise impacts to be minimal. Residential receivers near South and

Smith streets in NCA03 are predicted to have minor to moderate worst-case ground-borne noise impacts. However, airborne noise would likely be more dominant in this area. It is noted, however, the ground-borne noise criteria apply to works outside standard construction hours. Noise and vibration intensive works would not be justified in close proximity to these locations outside standard construction hours. As such, impacts associated with ground-borne noise outside standard construction hours at these locations are unlikely.

Stamford Plaza, The Mantra Hotel, Ibis Budget Sydney, the future airport hotel site, Quest Mascot and Citadines Connect Sydney Airport may experience high or moderate ground-borne noise impacts. High ground-borne noise impacts may also be experienced by a number of commercial buildings near the intersection of Qantas Drive, Joyce Drive and O'Riordan Street, and along Qantas Drive.

Mitigation and management measures to manage ground-borne noise impacts have been provided in section 10.7.2.

Qantas Flight Training Centre

Vibration intensive equipment would be used close to the Flight Training Centre (in its current location), such as during demolition of the adjacent building or during works to widen Qantas Drive. The Flight Training Centre may be affected by ground-borne noise. Impacts are predicted to be high when items such as rockbreakers are used (outside the centre in its current location). However, when the works are at least 100 metres away, the ground-borne noise levels are predicted to be much lower and would likely comply with the noise management levels.

Specific construction activities

Crushing and grinding

The project would use an area near the St Peters interchange connection to crush and grind material suitable for use as engineering fill. Crushing and screening already occurs near this location at Boral Recycling St Peters. Equipment likely to be required for the activity would include a rock crusher, front end loader, excavator and trucks. The assessment concluded that there would be no exceedances of noise management levels due to the separation distance from the nearest sensitive receivers.

Impact piling

Impact piling would be required during the construction of new bridge piers. This activity can generate high noise and vibration levels. However, it is generally only required for relatively short durations and would be undertaken during standard construction hours where possible. Impact piling may be required outside standard construction hours at a number of locations where the piling rigs could intrude in the prescribed airspace of Sydney Airport or where the piling rigs need to occupy existing roadways. Therefore they may be required to occur at night during the airport curfew and when traffic volumes are low.

During the daytime, the predicted worst-case impacts experienced by the nearest receivers in NCA03, NCA06 and NCA08 are generally moderate. However, the predicted worst-case impacts experienced by three receivers may be high. These receivers are located near the intersection of Qantas Drive, Joyce Drive and O'Riordan Street in NCA06 and NCA07. They include the future hotel site at Sydney Airport, AMG Sydney and DHL.

The predicted worst-case impacts at the nearest receivers when impact piling is required outside standard construction hours are predicted to be moderate. Some of the nearest receivers are commercial. However, many residential receivers in Tempe in NCA01, NCA02 and NCA03 are predicted to be impacted during piling for the freight terminal bridge.

It is noted, however, that impact methods would only be required to drive the pile sleeves into the upper layer of bedrock. The majority of the sleeve insertion would be undertaken in soft soils using non-impact methods, which would generate substantially less noise.

10.4.3 Sleep disturbance impacts

The results of the sleep disturbance screening assessment are provided in Table 10.22. The sleep disturbance criteria are likely to be exceeded when night works occur near residential receivers. The receivers that would potentially be affected by sleep disturbance impacts are generally the same receivers for which high night-time impacts have been predicted.

The highest number of residential receivers affected by night-time works are in NCA03 and NCA08. The majority of receivers would be impacted during the 'peak' activity of enabling works, site establishment, bridge construction, road works and finishing works, with moderate and minor exceedances. The exceptions to this are enabling works which would result in high exceedances of the noise management levels. These construction scenarios are of short duration with limited use of noisy equipment (peak activity). Impacts on NCA03 are considered to be reduced in number as works in the vicinity of NCA03 would likely be undertaken during standard construction periods as these works would not generally be justified being undertaken during the night-time period (eg works do not intrude into prescribed airspace or located on roads subject to high traffic volumes).

During the 'typical' activity, the number of affected receivers is substantially smaller and would experience minor exceedances, except during enabling works, when some moderate exceedances are predicted.

In addition to the peak scenarios outlined above, sleep disturbance exceedances may also be experienced during compound operation and road works as follows:

- Minor exceedances are predicted for receivers in NCA03 during compound operation
- During 'typical' road works near NCA03, only three receivers are predicted to be impacted (though such works are unlikely to be justified to occur during the night-time period).

The requirements for night-time works would be determined as the project progresses. All works outside standard construction hours that could affect the amenity of receivers would be appropriately justified. Mitigation and management measures would be implemented to reduce the potential for sleep disturbance impacts (see section 10.7).

10.4.4 Construction traffic noise

Construction related traffic has the potential to temporarily increase noise levels at receivers located close to the proposed construction haulage routes. The estimated construction traffic volumes outlined in Chapter 9 (Traffic, transport and access) have been used to determine whether a noticeable increase in road traffic noise (greater than 2 dB increase above the existing noise level) would occur.

The assessment concludes that noise generated by construction traffic is unlikely to result in a 2 dB increase. This is due to the high volumes of traffic that currently use the roads compared to the relatively small volume of construction vehicles.

10.4.5 Vibration impacts

The main potential sources of vibration during construction are from vibratory rollers, rockbreakers, vibratory piling, impact piling and during dynamic compaction. It is noted that existing ground conditions ie fill layers on top of sand would reduce the transmission of vibration, compared to rock. This may result in lower vibration levels than currently predicted at the affected receivers.

Human comfort vibration impacts

Certain receivers in the study area are within the human comfort minimum working distances (see Figure 10.4). Occupants of affected buildings may be able to perceive vibration impacts at times when vibration intensive equipment is used. Where impacts are perceptible, they would likely only be apparent during the relatively short times when equipment such as rockbreakers or vibratory rollers are used nearby.

Impact piling can also result in human comfort vibration impacts. The Construction Noise and Vibration Guideline does not provide a human comfort minimum working distance for this activity. The potential impacts would depend on the size of the equipment used.

The proximity of sensitive receivers to some of the locations where impact piling would be used means that human comfort impacts may be experienced. The majority of the piling would occur in soft soils using non-impact methods, which would generate substantially less vibration. Any perceivable vibration associated with impact piling would be short-lived.

Vibration impacts on buildings and infrastructure

Cosmetic damage

Most buildings are unlikely to suffer cosmetic damage due to the distance between work areas and the nearest receivers. However, some buildings and structures are within the recommended minimum working distances, particularly in the eastern section of the study area near Airport Drive and Qantas Drive (as shown in Figure 10.4). These include receivers in NCA06, NCA07 and NCA08. A number of buildings/items are also located within the cosmetic damage minimum working distances in NCA04 near Burrows Road South, NCA05 to the south of Airport Drive and NCA02 adjacent to the Botany Rail Line.

Impact piling, which would be required to construct bridge piers, can generate high vibration levels. The extent of the impacts would depend on the size of the equipment used. Given the proximity of certain buildings and structures to the bridge work areas, there is potential for cosmetic damage impacts from this activity.

Qantas Flight Training Centre

The Flight Training Centre, which has several specialist flight simulators and other equipment that are particularly sensitive to vibration, is located within both the cosmetic damage and human comfort minimum working distances in its current location (see section 10.2.1). Vibration intensive equipment would likely be required in close proximity to the Flight Training Centre at certain times, such as during demolition of buildings or works to widen Qantas Drive.

The requirement for vibration intensive works in this location would be reviewed during detailed design and construction planning. Alternative means of demolition, such as shear, pulveriser or ripper attachments to excavators, could be used to avoid hydraulic/pneumatic hammering. This would reduce airborne noise, ground-borne noise and potential vibration impacts.

Pipelines

As described in Chapter 8 (Construction), several pipelines are located within the project site, including:

- Jemena primary and secondary gas mains
- Qenos ethylene pipeline
- Fuel pipelines
- Sydney Airport water supply line
- Sydney desalination pipeline
- Sydney Water sewer and potable water pipelines.

Vibration intensive activities such as rockbreaking, vibratory rolling or vibratory/impact piling may occur near these pipelines. DIN4150 vibration criteria for buried pipework range from 50 mm/s to 100 mm/s depending on the pipe material and its age/condition. The potential for impact would depend on the final distance between the works and each pipeline, the type of equipment being used and the ground conditions. Consultation with the pipeline owners would also need to be undertaken to establish assessment criteria during detailed construction planning. Further information about potential risks to pipelines is provided in Chapter 23 (Health, safety and hazards).

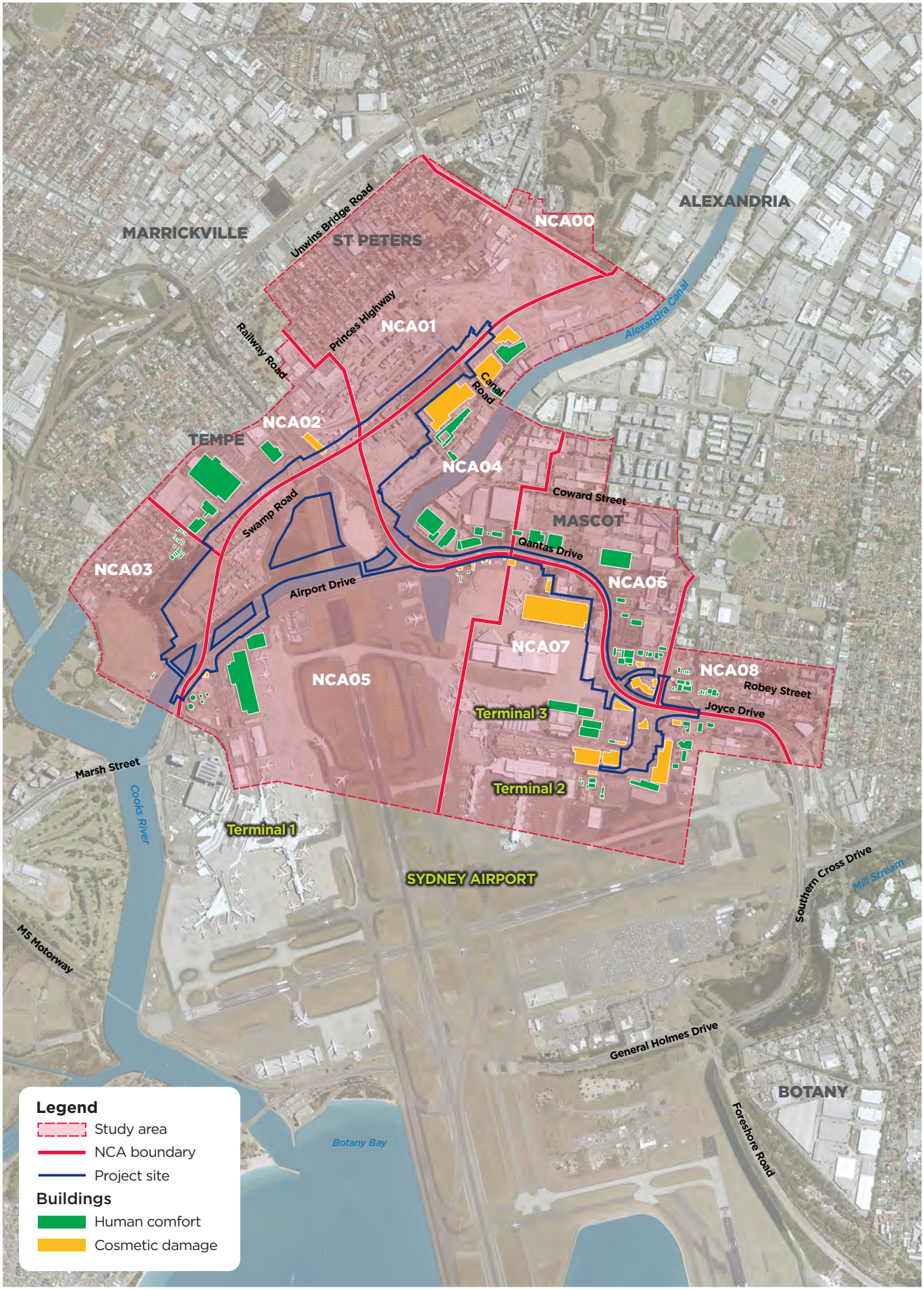

Figure 10.4 **Construction vibration assessment – buildings within minimum working distances**

Heritage structures

Heritage listed items located within the cosmetic damage minimum working distance are listed in Table 10.23. A full list of heritage items in the study area is provided in Chapter 17 (Non-Aboriginal heritage) as well as an assessment of impacts. There would be no impacts on recorded Aboriginal sites or places as none were identified within the project site (see Chapter 18 (Aboriginal heritage)).

As discussed in section 10.2.1, BS7385 specifies that a heritage building should not be assumed to be inherently more sensitive to vibration, unless it is structurally unsound. There are five heritage items within the cosmetic damage minimum working distance. Three are rail bridges and are not expected to be overly sensitive to potential vibration impacts from nearby construction works. Similarly, the Cooks River Intermodal Terminal and the features of heritage significance within are not expected to be overly sensitive to vibration.

Sections of Alexandra Canal are also within the minimum working distances. The canal walls may be susceptible to damage when vibration-generating construction works are carried out nearby, depending on the nature of the material and the distance from the activity.

Further information on potential impacts on heritage items is provided in Chapter 17 (Non-Aboriginal heritage).

Table 10.23 Heritage items within the cosmetic damage minimum working distances

Heritage item	Location
Cooks River Container Terminal	West of Canal Road, St Peters
Alexandra Canal (including sandstone walls)	Alexandra Canal, Mascot
Mascot (Sheas Creek) Underbridge	Extends over Alexandra Canal, Mascot
Mascot (Robey Street) Underbridge	Extends over Robey Street, Mascot
Mascot (O'Riordan Street) Underbridge	Extends over O'Riordan Street, Mascot

10.4.6 Summary of impacts on Sydney Airport (Commonwealth) land

Activities located adjacent to and within Sydney Airport have the potential to result in noise and vibration impacts at receivers located on Sydney Airport land. The potential noise and vibration construction impacts on Sydney Airport land would be located within NCA01, NCA04, NCA05, NCA06 and NCA07. A summary of the potential impacts identified by the assessment is provided in Table 10.24.

Table 10.24 Summary of impacts on Sydney Airport land

Area	Summary of impact
Hotels (Rydges Sydney Airport, Mantra Hotel, Ibis Budget Sydney Airport and a future hotel in NCA07)	High or moderate worst-case impacts are predicted when noise intensive equipment are used outside these receivers ('peak' activity). Impacts would be lower during 'typical' works when noise intensive equipment is not used. The hotels have been confirmed to have high performance facades such that this assessment is conservative and has overestimated the extent of impacts. This would be analysed further during detailed construction planning.
Qantas Flight Training Centre	High worst-case impacts are predicted when noise intensive equipment is used immediately outside the Flight Training Centre in its current location ('peak' activity). Where works are located at a distance of about 100 m from the centre, the impacts are predicted to comply with the noise management level, with one scenario (peak enabling works) representing the noisiest works and resulting in a moderate impact. Two scenarios (site establishment and peak road works) would result in a minor impact. Where works are located at a distance (ie greater than 300 m), the impacts are predicted to generally comply with the noise management level, with only one scenario (peak enabling works) resulting in a minor impact. This facility would be relocated by Qantas (separate to the project) during the construction period.

Area	Summary of impact
Commercial receivers (such as DHL, AMG Sydney and Qantas security building)	Construction is predicted to generally result in minor worst-case impacts at commercial receivers on Sydney Airport land. However, a number of buildings located close to work areas may experience moderate impacts during the noisiest works. Existing commercial receivers are located adjacent, or close to, main roads and Sydney Airport. As such, these receivers are subject to relatively high existing noise levels. The noise monitoring identified that the daytime and night-time noise levels are comparable to, or higher than, the predicted construction noise levels for many of the assessed work scenarios. Removing buildings adjacent to Qantas Drive would result in some receivers having line of sight to construction works on Qantas Drive (through removal of shielding). This would result in the receivers experiencing higher construction noise levels. It is noted that many of these buildings are already subject to noise generated by ground-based airport activities.
Ground-borne noise and vibration	The project would have the potential to affect structures on Sydney Airport land as a result of the use of noise intensive equipment, demolition of buildings and ground-borne noise during vibration intensive works. Certain buildings on Sydney Airport land would be potentially affected by ground-borne noise when vibration intensive works are occurring nearby. Similarly, certain buildings would be within the minimum working distances for human comfort and cosmetic damage. This means that there is potential for vibration impacts when works are occurring close to these receivers. The requirement for vibration intensive works near buildings on Sydney Airport land would be reviewed during detailed design when detailed construction planning is available.

The *Significant impact guidelines 1.2 – Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies* (DSEWPC, 2013) (Significant Impact Guidelines 1.2) is a guide to assessing whether impacts on people and communities are likely to be significant. Many of the receivers on Sydney Airport land are of commercial use with relatively low sensitivity. Certain sensitive receivers are likely to be highly impacted at certain times during construction, including a number of hotels at the intersection of Qantas Drive, Joyce Drive and O'Riordan Street. However, the number of affected receivers is relatively small and impacts would be reduced through the implementation of feasible and reasonable mitigation and management measures (see section 10.7.2). Existing noise levels around Sydney Airport are also high. Most areas are affected by traffic noise from nearby major roads, train movements on the Botany Rail Line and aircraft noise from Sydney Airport.

Overall, the potential noise and vibration impacts on Commonwealth land as a result of construction are not considered significant.

10.5 Assessment of operation impacts

10.5.1 Road traffic noise

The potential impacts of road traffic noise were predicted for sensitive receivers in the study area. Detailed information is provided in section 6.2 of Technical Working Paper 2 (Noise and Vibration).

For receivers that qualify for consideration of additional noise mitigation, potential mitigation measures would be considered in the following order of preference:

- At-source mitigation:
  - Quieter road pavement surfaces
- In-corridor mitigation:
  - Noise mounds
  - Noise barriers
- At-receiver mitigation:
  - At-property treatments.

Where additional mitigation is identified below, it would be subject to revised noise impact modelling during detailed design and a reasonable and feasible review in accordance with the Noise Mitigation Guideline.

Residential receivers

The worst-case predicted operational road noise levels (ie at the most affected residences) are summarised in Table 10.25 for the 2026 at-opening and 2036 future scenarios (2036 noise levels are shown in brackets). The table shows the predicted worst-case impacts in each noise catchment area, which typically affect receivers closest to the project site. The impacts from the project are predicted to be greatest in 2036, because of higher traffic volumes compared with 2026. The impact criteria are lower during the night-time period (10pm to 7am Monday to Saturday, and 6pm to 8am on Sunday and public holidays). As a result, this scenario will govern the requirements for mitigation.

The predicted change in noise levels in 2036 is shown in Figure 10.5 (for all receivers). This change is based on the difference between the 'with project' and 'without project' scenarios.

Many residential receivers in the study area are subject to relatively high existing road traffic noise impacts, which already exceed the Noise Criteria Guideline criteria in many cases. The project would introduce new sources of road traffic noise to some areas, with increases in road traffic noise levels greater than 2 dB predicted. To the north of the Princes Highway in NCA01, increases of up to 5 dB are predicted. The greatest increases in noise are predicted towards the north-west of the catchment, which is due to higher ground in this direction resulting in a line-of-sight to the project. A noise barrier is not considered feasible and reasonable in this location as it would provide less than 2 dB noise benefit to affected occupants.

Noise level increases of up to 13 dB are predicted in NCA03. Residential receivers on Smith Street and South Street are the most affected due to existing road traffic noise levels in this area being relatively low. These receivers would also face the roadway. A noise barrier is proposed near this location to a height of about five metres. The preliminary assessment concluded the barrier would reduce noise levels by up to 5 dB. Receivers further away from the roadway would be less affected as project noise levels reduce with distance and local noise sources become dominated by other existing roads, such as the Princes Highway.

Noise increases are predicted in NCA06, NCA07 and NCA08. The areas west of O'Riordan Street and south of the intersection of Qantas Drive, Joyce Drive and O'Riordan Street are predicted to receive increases of up to 4 dB. This is due to the increased traffic on Qantas Drive and the new viaduct to Sydney Airport Terminals 2/3. Residential receivers on Baxter Road in Mascot are predicted to experience increases of up to 3 dB due to traffic increases (particularly heavy vehicles) on Joyce Drive.

The option of providing a noise barrier at this location has been considered. However, a barrier is not considered feasible and reasonable. Utilities on the southern side of the rail corridor restrict potential locations for a noise barrier without further impacts to advertising structures. A noise barrier on the northern side of the rail corridor would require easements for maintenance access, restricting the amount of land available for future development.

Exceedances of the Noise Criteria Guideline cumulative limit criteria (see section 10.2.2) are predicted in the majority of catchments with residential receivers. The project is predicted to result in acute noise levels (daytime $L_{Aeq(15hour)}$ 65 dBA or higher, or night-time $L_{Aeq(9hour)}$ 60 dBA or higher) for residential receivers adjacent to Campbell Street in NCA00 and at one receiver in NCA06.

In summary, exceedances of the operational road traffic noise criteria are predicted at 231 residential receivers, of these:

- 215 are predicted to experience noise level increases of greater than 2 dB
- 34 are predicted to experience noise levels above the cumulative limit criteria
- Nine are subject to acute noise levels.

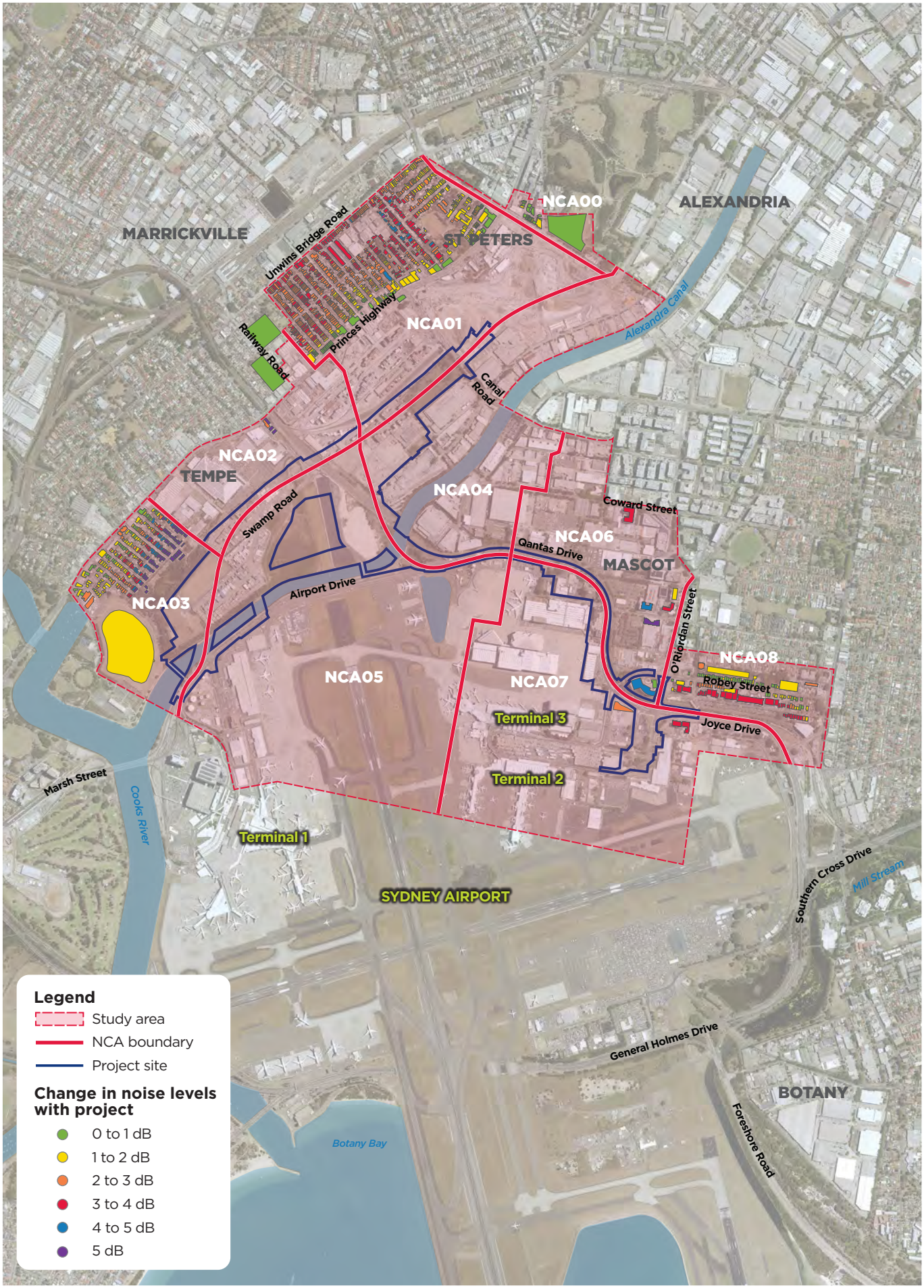

Figure 10.5 **Worst-case predicted change in operational noise levels in 2036 future design scenario**

Table 10.25 Predicted road traffic noise levels at the most affected residential receivers in each noise catchment area

Noise catchment area	Predicted noise level (dBA)[1] at the most affected receiver				Receivers eligible for consideration of additional noise mitigation			
	Without project		With project		Trigger 1 >2 dB	Trigger 2 cumulative	Trigger 3 acute	Total
	Day	Night	Day	Night				
NCA00	76 (77)	73 (73)	76 (76)	73 (73)	-	1	8	9
NCA01	59 (59)	54 (55)	60 (60)	56 (57)	71	12	-	78
NCA02	61 (61)	57 (58)	63 (63)	59 (60)	2	1	-	2
NCA03	51 (49)	47 (45)	62 (61)	58 (58)	119	19	-	119
NCA04[2]	-	-	-	-	-	-	-	-
NCA05[2]	-	-	-	-	-	-	-	-
NCA06	63 (63)	60 (59)	65 (66)	62 (63)	1	1	1	1
NCA07[2]	-	-	-	-	-	-	-	-
NCA08	67 (67)	64 (64)	69 (70)	66 (67)	22	-	-	22
Total receivers impacted								**231**

Notes: 1. Daytime and night-time are $L_{Aeq(15hour)}$ and $L_{Aeq(9hour)}$ noise levels, respectively The noise levels shown are predicted noise levels at project opening (year 2026) and future design (year 2036). The future design levels are shown in brackets.
2. Noise catchment area does not contain residential receivers.

Additional mitigation would be investigated during detailed design to minimise the potential impacts where feasible and reasonable. Options to mitigate the impacts identified include low noise pavement, noise barriers and at-property mitigation. Further information is provided in section 10.7.

Other sensitive receivers

Fifteen ‘other sensitive’ receiver buildings are predicted to experience exceedances of the operational road traffic noise criteria as shown in Table 10.26. These are detailed in section 6.2.2 of Technical Working Paper 2 (Noise and Vibration). The receivers include St Peters Public School, St Peters Anglican Church, Guardian Early Learning Centre, Aero Kids Early Learning Centre, Tempe Recreation Reserve, Coleman Reserve and a number of hotels.

Table 10.26 ‘Other sensitive’ receivers triggers

Noise catchment area	Receiver	Type	Noise Mitigation Guideline triggers		
			Trigger 1 > 2 dB	Trigger 2 cumulative	Trigger 3 acute
NCA01	St Peters Public School[1]	Educational	-	Y	-
	St Peters Anglican Church[1]	Place of worship	Y	Y	-
NCA03	Guardian Early Learning Centre	Childcare	Y	Y	-

Noise catchment area	Receiver	Type	Noise Mitigation Guideline triggers		
			Trigger 1 > 2 dB	Trigger 2 cumulative	Trigger 3 acute
NCA06	Aero Kids Early Learning Centre	Childcare	Y	Y	-
	Stamford Plaza Sydney Airport	Hotel	Y	Y	Y
	Travelodge	Hotel	Y	Y	Y
	Coleman Reserve	Outdoor passive	-	Y	Y
NCA07	Ibis Budget Sydney Airport	Hotel	Y	-	Y
	Mantra Hotel	Hotel	Y	-	Y
	Future airport hotel	Hotel	Y	Y	Y
NCA08	Quest Mascot (Hotel)	Hotel	-	-	Y
	Citadines Connect Sydney Airport	Hotel	Y	-	Y

Note: 1. Receiver consists of multiple structures with each structure considered as a separate part in the assessment.

Receivers eligible for consideration of additional noise mitigation

The sensitive receivers identified as eligible for consideration of additional noise mitigation in accordance with the Noise Mitigation Guideline are summarised in Table 10.27. A total of 246 sensitive receiver buildings are predicted to experience exceedances of the Noise Mitigation Guideline triggers. It is noted the hotels have been assessed as residential on the basis that they may be the primary residence for some patrons. Further investigation of hotels would be undertaken during detailed design. Only areas of permanent residence require assessment and consideration of mitigation.

The mitigation and management measures for the project are discussed in section 10.7.

Table 10.27 Receivers considered for 'additional noise mitigation'

Noise catchment area	Number of buildings (floors)[1] eligible for consideration of additional noise mitigation	
	Residential	Other sensitive
NCA00	9 (18)	- (-)
NCA01	78 (83)	5 (9)
NCA02	2 (2)	- (-)
NCA03	119 (131)	1 (1)
NCA04	- (-)	- (-)
NCA05	- (-)	- (-)
NCA06	1 (10)	4 (33)
NCA07	- (-)	3 (25)
NCA08	22 (34)	2 (13)
Sub total	**231 (278)**	**15 (81)**

Note: 1. The count of 'floors' represents separate floors within each building (in brackets). For some receivers there would likely be multiple units within the same floor, such as in residential apartment blocks.

Maximum road traffic noise levels

The introduction of the project into the study area may result in a change to the maximum noise levels experienced as a result of traffic. The predicted worst-case change is 17 dB in NCA03 due to the proximity to the project site. In other noise catchment areas, the predicted change would be less than 10 dB. Where large increases in maximum noise levels are predicted, the affected receivers are also likely to exceed the operational road traffic noise criteria and be eligible for consideration of additional noise mitigation.

10.5.2 Changes to noise levels generated by Sydney Airport

The project would potentially result in changes to noise levels emanating from operations at Sydney Airport. This is due to the removal of several buildings along Qantas Drive and the removal of containers located at the Tyne Container Services site which currently provide shielding to off-site receivers.

The Airports (Environment Protection) Regulations 1997 does not contain specific criteria for noise generated by ground-based airport activities. In the absence of a specific guideline, the Noise Policy for Industry has been adopted.

The potential impacts from these activities are predicted to be limited to receivers north of South Street in NCA03 and near O'Riordan Street in NCA06/NCA08.

The assessment modelled six scenarios identifying the following predicted worst-case changes in existing noise levels at adjacent receivers due to ground-based airport activities:

- The removal of shipping containers is predicted to result in noise level increases at residential receivers in NCA03 by up to 3 dB
- The removal of buildings adjacent to Qantas Drive is predicted to result in noise level increases of up to 16 dB at the Travelodge hotel and up to 11 dB at King Apartments in NCA06
- The predicted noise levels from ground-based airport activities at the nearest receivers are anticipated to exceed the Noise Policy for Industry criteria, especially during high noise generating activities such as aircraft engine running (particularly during the evening and night-time).

The larger increases in noise levels are generally predicted at the lower or middle floors of the affected multi-storey buildings. Upper floors are less impacted because these locations already have line of sight to the operational areas of the airport, over the buildings that are proposed to be removed.

During certain runway maintenance works, aircraft may infrequently operate during curfew hours at the very northern end of the north-south runway. Impacts at receivers in NCA03 could be changed as a result and due to the removal of the shipping containers in this location. The potential changes in noise levels are anticipated to be similar to those predicted above.

The existing noise levels from these activities are likely to already exceed the criteria at receivers in the vicinity of the project site. Noise monitoring data indicates noise levels near Qantas Drive are high, with frequent levels of 70 to 75 dBA and occasional levels of 80 dBA. Aircraft engine running is required for safety reasons and would likely occur infrequently, but especially during the night-time. High power running would not occur every night and engine ground running typically only lasts for a short period. The options for mitigating impacts are limited due to the high noise levels associated with aircraft engine noise. Measures include the investigation of physical screening options (or partial demolition of Jet Base buildings affected by the project), to minimise the transmission of noise generated by ground-based airport activities.

10.5.3 Summary of impacts on Sydney Airport (Commonwealth) land

Once the project is operational, there would be impacts on the hotels on Sydney Airport land (including the Mantra Hotel, Ibis Budget Sydney Hotel and the future airport hotel in NCA07). It is predicted that the road traffic noise levels at these hotels would increase by around 4 dB in 2036. This is due to the combined effect of increased traffic on Qantas Drive and the elevated access to Terminals 2/3. Based on more recent specific investigations of these hotels, the attenuation of the building facades has been underestimated in this assessment such that the level of impact would be reduced.

Road traffic noise levels at the Qantas Flight Training Centre are predicted to increase by around 3 dB in 2036 (based on the Flight Training Centre's current location). However, it is unlikely that the Flight Training Centre would be still operating at this location when the project opens, as it is proposed to be relocated by Qantas as part of a separate project.

The potential impacts on the commercial uses of Sydney Airport land have been assessed by predicting the changes in road traffic noise level resulting from the project. In 2036, the project would result in predicted increases in road traffic noise levels in most areas. This is due to a change in road layouts, widened roads moving traffic closer to receivers and increased traffic volumes as a result of traffic growth between 2026 and 2036. The highest increase in noise levels (up to 10 dB) is predicted for areas immediately west of Qantas Drive between Lancastrian Road and Robey Street. Other areas are predicted to experience increases of around 1 to 4 dB, depending on location.

The project would include removing some buildings within the Sydney Airport Jet Base on Sydney Airport land, and removing containers from the Tyne Container Services site to the west of Alexandra Canal. The removal of these structures would potentially change operational noise emissions emanating from Sydney Airport land. These impacts are discussed further in section 10.5.2.

Many of the receivers on Sydney Airport land are of commercial use with relatively low sensitivity. Certain receivers near the intersection of Qantas Drive, Joyce Drive and O'Riordan Street are likely to experience moderate increases in operational road traffic noise and/or high increases in operational noise due to ground-based airport activities. However, the number of affected receivers is relatively small and impacts would be reduced through the implementation of feasible and reasonable mitigation and management measures (see section 10.7.2). At-property mitigation would also be considered for residual impacts at eligible receivers if required.

The Significant Impact Guidelines 1.2 (DSEWPC, 2013) provide a guide to assessing whether impacts on people and communities are likely to be significant, including the impacts of Sydney Airport activities on the surrounding community (eg ground-based noise noise). Overall, the potential operational noise and vibration impacts of the project are not considered significant.

Consistency with the Sydney Airport Master Plan

Noise from ground-based activities at Sydney Airport is managed separately to noise from in-flight aircraft operations. The Airports (Environment Protection) Regulations 1997 does not contain specific criteria for ground-based airport activities. It sets out matters to be considered to determine whether noise is excessive. Accordingly, in this instance, criteria in the Noise Policy for Industry have been used to assess the potential changes to aircraft-related noise impacts. Section 14.6.4 of the *Sydney Airport Master Plan 2039* (SACL, 2019a) (the Master Plan) states that noise from developments at the airport should be assessed during the development approval process.

The *Sydney Airport Environment Strategy 2019-2024* (SACL, 2019b) (the Environment Strategy) underpins Sydney Airport Corporation Limited's commitment to continual improvement of environmental performance at the airport. Section 3.5 of the Environment Strategy identifies that the main contributors of ground-based noise includes construction and development activities. Strategies have been identified that are used to manage and reduce airport ground-based noise. The following strategies relevant to this project include:

- Continue to undertake regular monitoring of noise generated by ground-based sources at the airport
- Continue to ensure that noise from ground-based airport activities is assessed and managed for the construction and operational phases of development proposals
- Carry out operational noise modelling for major developments impacting airport operations, assess noise predictions against relevant criteria and develop appropriate noise management measures
- Continue to monitor noise complaints for ground-based activities at the airport.

This assessment and the mitigation and management measures provided in section 10.7.2 are consistent with both the Master Plan and the Environment Strategy. This assessment identifies and documents these aspects for consideration by stakeholders during the development determination process.

10.6 Cumulative impacts

10.6.1 Construction

Multiple projects are proposed close to the project site with similar timing for construction and/or operation. These include the Botany Rail Duplication, New M5, M4-M5 Link, and other projects listed in sections 5.1.4 and 9.2.7.

Cumulative construction noise impacts may occur if construction on these projects is undertaken at the same time as the project. There is also the potential for consecutive impacts if certain receivers are affected by extended impacts from one project occurring after another project (which can contribute to construction fatigue). This is discussed in detail in section 7 of Technical Working Paper 2 (Noise and Vibration).

Impacts are generally limited to the eastern part of the study area in NCA06, NCA07 and NCA08 where projects may overlap. The majority of this area is commercial. However, some residential receivers are located in these catchments and 'other sensitive' receivers (such as hotels) are located near the intersection of Qantas Drive, Joyce Drive and O'Riordan Street.

Receivers in these areas have been impacted by construction works since 2016 (Airport East and North roadworks) and would potentially be impacted by a number of successive projects in the future (such as the Sydney Gateway road project, Botany Rail Duplication and Sydney Airport ground access solutions and hotel project).

Mitigation and management measures provided in section 10.7 for other sources of noise would also reduce the cumulative and consecutive impacts on receivers in the study area. More specific measures would be developed as the design progresses and impacts from other projects (such as Botany Rail Duplication) are known. Roads and Maritime would ensure the construction contractor(s) for the Sydney Gateway road project consult with the contractors for the Botany Rail Duplication, to coordinate out-of-hours work and ensure appropriate respite is provided to affected receivers as far as possible.

10.6.2 Operation

Receivers near the intersection of Qantas Drive, Joyce Drive and O'Riordan Street would potentially be affected by noise from both the Botany Rail Duplication and the project. However, operational noise from each source would be different and result in different annoyance responses from affected communities. As such, a cumulative assessment of the potential combined operational impacts from these two projects is not possible. The Botany Rail Duplication would be a more intermittent noise source, but may be more annoying than more continuous traffic noise. The final operational mitigation strategy for each project should aim to maximise the benefits of mitigation for affected receivers.

A cumulative traffic scenario was modelled to include road traffic for the project, NorthConnex, M5 East, New M5 and M4-M5 Link and other major interfacing non-approved projects that may be operational in 2036. There are 225 receivers identified as eligible for consideration of additional noise mitigation as a result of this scenario. This is a lower number of receivers than in the operational noise assessment for 2036 for this project (see section 10.5.1) because less traffic is expected to use some of the roads around the project site when these other infrastructure projects become operational.

10.7 Management of impacts

10.7.1 Approach

Approach to mitigation and management

The Interim Construction Noise Guideline identifies that due to the nature of construction, it is inevitable that there will be impacts where construction occurs near sensitive receivers. During construction, there would be noise impacts on some receivers during certain times and during certain construction activities. There is also the potential for sleep disturbance impacts and vibration impacts on some receivers and buildings. Cumulative construction noise impacts may also occur if construction on adjacent or nearby projects is undertaken at the same time as the project.

Once operational, there would be exceedances of the operational road traffic noise criteria. Receivers that qualify for consideration of additional noise mitigation have been identified. Mitigation and management measures in section 10.7.2 are proposed to mitigate impacts that cannot be avoided.

Approach to managing the key potential impacts identified

Mitigation measures have been developed with the aim of minimising or mitigating, where practicable, noise and vibration impacts described in sections 10.4 and 10.5. A CEMP will be prepared to provide a centralised mechanism to manage the potential environmental impacts of construction. The CEMP will include a Construction Noise and Vibration Management Plan, which will define the processes, responsibilities and management measures that will be implemented during construction to manage noise and vibration. Further information on the CEMP, including the Construction Noise and Vibration Management Plan, is provided in Chapter 27 (Approach to environmental management and mitigation).

The construction noise assessment identified the potential for high impacts outside standard construction hours at a number of hotels, particularly around the entrance to Terminals 2/3. Due to the amount of night-works that would be required at this location and sensitivity of the hotels, further investigations have been conducted. The noise management levels for sleeping areas in hotels relate to internal noise in the rooms. The assessment has conservatively assumed a 20 dB reduction to estimate internal noise levels from external noise levels at the facade. The buildings are, however, well insulated acoustically due to their location and the adopted 20 dB reduction is considered conservative. Therefore, the assessment has overstated the likely realistic level of impact. Along with location-specific criteria at each hotel location, alternative methods of construction would also be investigated during detailed construction planning and noise intensive works would be limited where possible.

There is a need to maintain the operation of the affected road network at all times and avoid affecting airport operations. As such, work outside standard construction hours would be required. Works or activities that cannot be undertaken during standard construction hours would be scheduled as early as possible during the evening and/or night-time periods. Respite periods would also help to alleviate ongoing high noise impacts for certain receivers.

Specific concerns were raised by the community regarding potential noise impacts in Tempe and Mascot. It is noted that the majority of works near Tempe are likely to be completed during standard construction hours, with minimal requirement for evening or night-time works.

The Tempe and Mascot communities provided suggestions for reducing construction noise, including the provision of vegetated mounds instead of noise walls to help reduce some of the noise impacts. Residents requested that vegetation be planted close to noise mounds, where possible, to help reduce the potential visual impact and support local flora and fauna.

Roads and Maritime would continue to consult with the community and relevant councils during the detailed design phase to develop the urban design and landscape plan for the project (see section 7.12). This would include confirming the appearance of noise barriers and collecting community feedback on other proposed noise mitigation measures. Potentially affected communities would be notified about the engagement process by letterbox drops and invited to participate in the development of the urban design

and landscape plan. People on the contact list would also be informed of the consultation process and provided with an opportunity to input to the process.

As design progresses, the project would be refined where possible to reduce the potential operational impacts. Receivers qualifying for 'additional noise mitigation' once the project is built would be considered in the following order of preference:

- At-source mitigation (eg quieter road pavement surfaces)
- In-corridor mitigation (eg noise mounds and/or barriers)
- At-receiver mitigation (eg at-property treatments such as screening walls, ventilation systems, window glazing).

Noise mounds and/or barriers can provide significant noise reductions and also reduce both external and internal noise levels. Noise walls are typically most efficient when receivers are located at ground floor level. Where residual impacts remain after the use of at-source and in-corridor mitigation, or if a noise barrier is not considered feasible or reasonable, the final consideration is to use at-property mitigation.

Approach to managing other impacts

Due to the potential for high noise impacts on some hotels outside standard construction hours, location and activity specific noise and vibration impact assessments would be undertaken to confirm predicted noise impacts. The assessments would adopt the specific external noise criteria for each affected hotel (see Technical Working Paper 2) to more accurately assess the potential internal noise levels within the hotel rooms.

Other mitigation measures are provided in section 10.7.2.

Expected effectiveness

The measures provided in section 10.7.2 have been identified as an outcome of the noise and vibration assessment. The proposed mitigation measures have been developed based on best management practice, relevant standards and guidelines, and Roads and Maritime's experience delivering major road infrastructure projects. Similar mitigation and management measures have been used on comparable large road infrastructure projects such as the F6 extension, New M5, M4-M5 Link and M4 East.

The measures provide for the management of potential noise and vibration impacts through the implementation of various strategies and plans, in addition to ongoing design development and construction planning which have as a principle, aimed to avoid and minimise risks, as well as environmental impacts as far as possible. These processes also facilitate ongoing consultation with relevant stakeholders and provide the detail required to reduce noise and vibration impacts where possible.

10.7.2 List of mitigation measures

The mitigation and management measures that would be implemented to address potential noise and vibration impacts are listed in Table 10.28. These measures are consistent with the 'standard' and 'additional mitigation measures' provided in the Construction Noise and Vibration Guideline, where appropriate.

Table 10.28 Noise and vibration mitigation measures

Impact/issue	Ref	Mitigation measure	Timing
Managing the potential for noise and vibration impacts during construction	NV1	A Construction Noise and Vibration Management Plan will be prepared as part of the CEMP and implemented during construction. The plan will detail processes, responsibilities and measures to manage noise and vibration and minimise the potential for impacts during construction, consistent with the management approach and mitigation measures in Roads and Maritime's *Construction Noise and Vibration Guideline*.	Pre-construction, construction
	NV2	Location and activity specific noise and vibration impact assessments will be undertaken prior to those works (as a minimum): ■ With the potential to result in noise levels above 75 dBA at any receiver ■ That need to occur outside standard construction hours and are likely to result in noise levels greater than the relevant noise management levels ■ With the potential to exceed relevant performance criteria for vibration. The assessments will confirm predicted impacts at relevant receivers in the vicinity of the activities to assist with the selection of appropriate management measures. Monitoring will be carried out at the start of new noise and vibration intensive activities to confirm that actual levels are consistent with the predictions.	Pre-construction, construction
Potential operational noise impacts	NV3	An operational noise mitigation strategy will be developed and implemented as part of the design, including investigating the need for low noise pavements, noise barriers and at-property mitigation.	Detailed design
Potential impacts at hotels	NV4	The facades of hotels likely to be affected by construction will be assessed to confirm existing façade performance (external to internal noise transmission) in consultation with the hotel operators. Location and activity-specific noise and vibration impact assessments undertaken for works in the vicinity of hotels will adopt the results of the assessment for each affected hotel to assess potential internal noise levels within the hotel rooms more accurately (see Technical Working Paper 2).	Pre-construction, construction
Potential impacts at the Qantas Flight Training Centre	NV5	A construction strategy will be developed in consultation with Qantas to minimise potential impacts on training operations at the Qantas Flight Training Centre in its current location. It will include: ■ Confirming appropriate internal noise criteria for sensitive areas in the facility ■ Confirming building and simulator cabin acoustic performance ■ External criteria for noise and vibration ■ Working distances for noise and vibration intensive plant and activities ■ Alternative work methods that generate less noise and vibration and minimise vibration transmission ■ Real-time monitoring requirements.	Pre-construction, construction

Impact/issue	Ref	Mitigation measure	Timing
Construction management and scheduling	NV6	Investigate and implement alternative methods of demolition to avoid hydraulic/pneumatic hammering where high noise impacts are anticipated. Alternative methods could include shears, pulveriser or ripper attachments fitted onto the excavators.	Construction
	NV7	Noisy work and vibration intensive activities (those activities that exceed the vibration criteria) will be scheduled during standard construction hours as far as possible. Works or activities that cannot be undertaken during standard construction hours will be scheduled as early as possible during the evening and/or night-time periods. Respite measures will be implemented for noisy work and vibration intensive activities in a manner consistent with Roads and Maritime's *Construction Noise and Vibration Guideline*.	Construction
	NV8	Hoarding, or other shielding structures, will be used where receivers are impacted near fixed works areas. The barriers should be of solid construction with minimal gaps.	Construction
Management of the potential for vibration impacts during construction	NV9	Vibration generating activities will be managed to minimise the potential for impacts on structures and sensitive receivers, including maximising minimum working distances where practicable, or alternate methods to minimise vibration where minimum working distances cannot be achieved. Where alternatives cannot be implemented, vibration monitoring will be undertaken and receptors notified in advance of works. Vibration monitors will provide real-time notification of exceedances of levels approaching cosmetic damage and human comfort criteria.	Construction
Potential vibration impacts on pipelines	NV10	Prior to vibration intensive works in the vicinity of pipelines, the owners of each potentially affected pipeline will be consulted to confirm the potential for impacts from vibration and any appropriate criteria. Management protocols to protect the integrity of each affected pipeline, including monitoring requirements, will be developed in consultation with each asset owner as required, and implemented for all vibration intensive works in the vicinity of pipelines.	Pre-construction, construction
Potential impacts on buildings and structures	NV11	Building condition surveys will be completed before and after construction works where buildings or structures are within the minimum vibration working distances for cosmetic damage.	Pre-construction, construction
Potential vibration impact to heritage items	NV12	Prior to the commencement of vibration intensive works within the minimum working distances for cosmetic damage for heritage items, the potential for damage to the item will be assessed. Where there is potential for damage, alternative methods that generate less vibration will be investigated and substituted where practicable. Where residual cosmetic damage risks remain, condition surveys will be carried out and vibration monitoring with real-time notification of exceedance will occur during the activity. Site activities will be modified where practicable to avoid exceeding the cosmetic damage criteria. Any identified vibration-related damage to the items will be rectified.	Construction
Cumulative noise and vibration impacts	NV13	The likelihood of cumulative and consecutive construction noise impacts, particularly when undertaken outside standard construction hours, will be reviewed prior to construction and coordinated with other nearby projects to minimise impacts, where possible.	Pre-construction, construction
Noise impacts due to ground-based airport activities	NV14	Investigate reasonable and feasible options to reduce the propagation of noise from ground-based airport activities following removal of buildings as part of the project. This will include options to retain screening provided by existing buildings.	Detailed design

Impact/issue	Ref	Mitigation measure	Timing
Operational noise and vibration impacts of the project	NV15	Operational noise and vibration mitigation measures will be identified during detailed design. Requirements for at-property noise treatments in properties identified as 'eligible' in the noise and vibration assessment will be reviewed. The implementation of treatments will be undertaken in accordance with the *At-Receiver Noise Treatment Guideline* (Roads and Maritime, 2017b).	Detailed design
	NV16	Operational noise mitigation performance will be documented in an Operational Noise and Vibration Review conducted within 12 months of the commencement of operation. The need for additional mitigation or management measures to address identified operational performance issues and meet relevant operational noise criteria will be assessed and implemented where feasible and reasonable.	Operation

10.7.3 Managing residual impacts

Residual impacts are the impacts of the project that may remain after implementation of:

- Design measures to avoid and minimise impacts (see sections 6.4 and 6.5)
- Construction planning and management approaches to avoid and minimise impacts (see section 6.4 and 6.5)
- Specific measures to mitigate and manage the identified potential impacts (see section 10.7.2).

Despite the measures provided in Table 10.28, there would be some residual impacts. The urban nature of the study area means that many of the affected receivers are close to major existing roads and already subject to relatively high existing road traffic noise levels. The project would introduce new sources of construction noise and road traffic noise to some parts of the study area, mainly in the west around Tempe, while also widening and increasing traffic volumes on other existing roads, such as Qantas Drive and Joyce Drive. Standard mitigation measures during construction would aim to reduce noise levels. However, some areas may still experience noise level increases, particularly during the 'peak' activity of certain construction scenarios. The project is also predicted to result in increases in road traffic noise levels (ie greater than 2 dB) in certain areas. Some noise impacts may remain at project opening, depending on whether proposed mitigation measures are considered feasible and reasonable.