

12. Noise and vibration

12.1 Existing environment and background

This chapter draws on information from Appendix K (Noise and vibration assessment).

12.1.1 Overview

The study area (see Figure 12-1) covers those locations where people and properties maybe impacted by noise and/or vibration.

Central Station is Australia's busiest transport interchange. As such, the level of activity, people, and transport movements in and around Central Station means it is noisier than some other quieter parts of the Central Business District (CBD). It is also noisier at night and over the weekend compared to other parts of the CBD because of the continuous operation of trains, buses, and other forms of transport.

Most of the buildings close to the project area are commercial (including offices and retail stores) in nature. This is particularly true along the frontage of the main roads. Other noise and vibration sensitive receivers include the hotels and other short-stay accommodation near the project area, and residents in surrounding apartment buildings and houses setback from Central Station in Surry Hills (see Table 12-1).

Appendix K (Noise and vibration assessment) uses five noise catchment areas (NCAs) to represent groups of similar receivers in the local area and also groups them per their location. The assessment focuses on assessing the worst-case potential impact on receivers in each catchment, but it then provides the same level of mitigation to all receivers.

Section 12.1.2 below provides more detail on the noise and vibration study area, NCAs, and surrounding receivers.

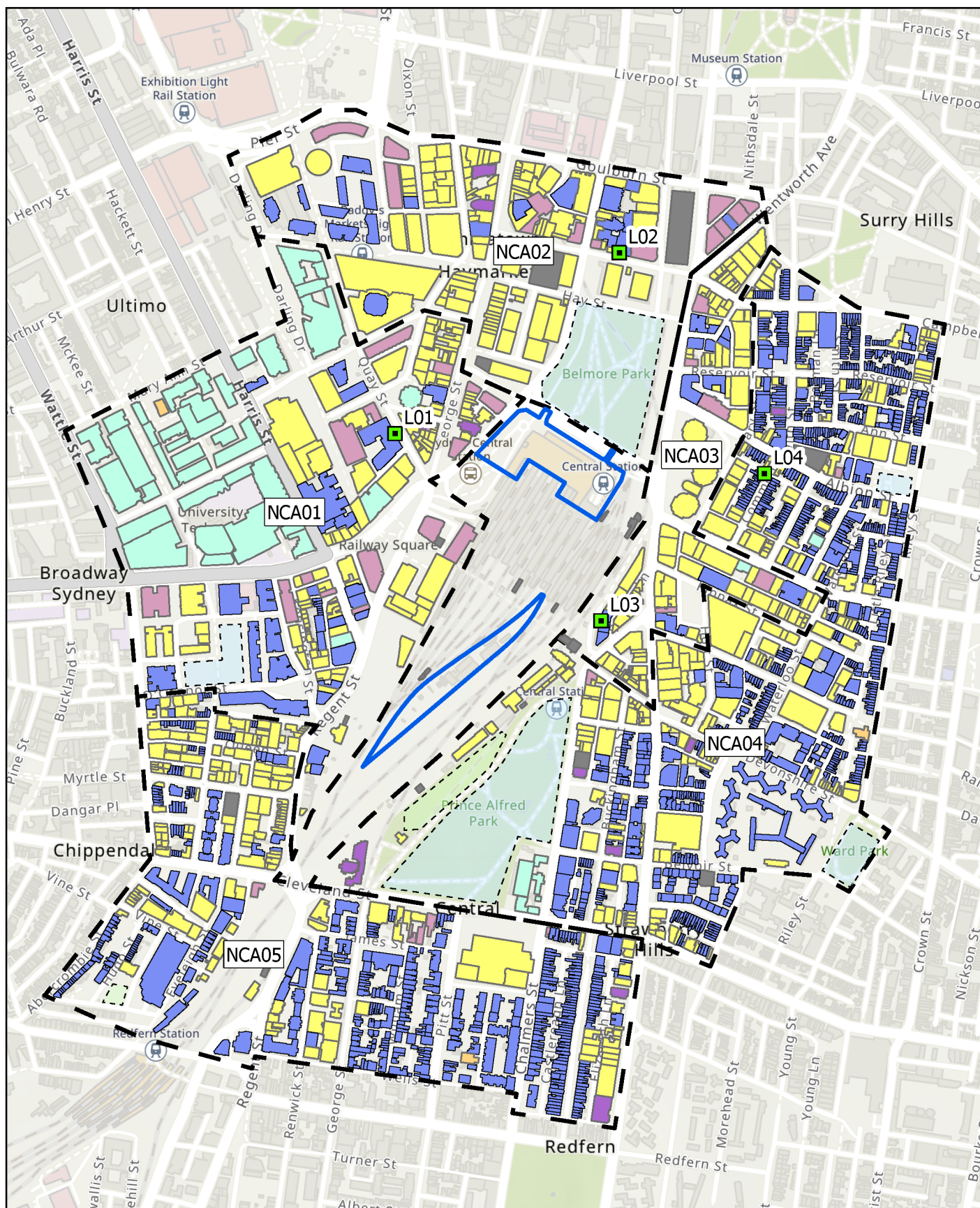
12.1.2 Sensitive receivers

Sensitive receivers have been categorised as residential buildings, commercial/industrial properties, or 'other sensitive' land uses, which includes educational institutions, child-care centres, hotels, places of worship, and outdoor recreation areas (see Figure 12-1).

Some buildings contain more than one use, such as residential apartments that have commercial uses on the ground floor. In these instances, they have been categorised based on the most noise sensitive use in the building. The sensitive receivers in each NCA are described in Table 12-1.

Table 12-1: Noise catchment areas

NCA and direction	Description
West NCA01	<p>The closest receivers are generally commercial, but the catchment also includes several hotels and places of worship. The key receivers in the catchment are TAFE NSW Ultimo and University of Technology Sydney (UTS), which occupy a large part of the NCA further to the west.</p> <p>The closest residents are in apartments around 150 metres away on George Street. As they live close to Central Station it is often noisy due to the activity in the area.</p>
North NCA02	<p>The closest receivers are generally commercial, but the catchment also includes Belmore Park directly to the north and the Capitol Theatre around 200 metres away.</p> <p>The closest residents are in apartments around 300 metres away on Campbell Street. Again, because these residents live close to Central Station on a main road it is often noisy due to the activity in the area.</p>
East NCA03	<p>The closest receivers are generally commercial. The nearest residents are in apartments around 150 metres northeast on Elizabeth Street and southeast on Chalmers Street. Their proximity to Central Station means they live in a noisy area.</p>
East NCA04	<p>A feature of this catchment is the low-density residential housing setback from Central Station and shielded by the high-rise buildings in NCA03. The closest residents are around 250 metres away. These residents live in a quieter neighbourhood setting away from Central Station.</p>
South NCA05	<p>The catchment is away from Central Station and closer to the Sydney Trains Yard construction compound. The closest residents are around 150 metres from the Sydney Trains Yard and 600 metres from the main project area. These residents live in a quieter area because they are further away from the activity around the CBD and Central Station.</p>



Coordinate System: GDA2020 MGA Zone 56



0 110 220 Metres

Scale at A4

1:9,000

Esri Community Maps Contributors, Geoscape, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS, Esri, Geoscience Australia, NASA, NGA, USGS

Prepared by: MD
Checked by: CS
Approved by: CS

Legend

Construction footprint

NCAs

Noise Monitoring Locations

Receiver types

Residential

Commercial

Childcare

Hotel

Educational

Place of Worship

Outdoor Active

Outdoor Passive

Other

Sydney Terminal Building Revitalisation Project

Figure 12-1: Study area, noise catchment areas and surrounding receivers

Project Number: 287415

Drawings / Design Prepared By

ARUP

Client

NSW
GOVERNMENT

Transport
for NSW

12.1.3 Existing noise and vibration levels

Noise from the construction and operation of the project is considered to be industrial noise and are therefore assessed using the [Noise Policy for Industry](#) (NSW Environment Protection Authority (EPA), 2017a). As such, the noise was monitored in accordance with the procedures outlined in the [Noise Policy for Industry](#) (NSW EPA, 2017a). Measurements were made near key receivers in the NCAs that would likely be most affected by construction of the project (see Figure 12-1).

Existing noise levels were monitored between 11 October and 1 November 2022. They were used to set project-specific levels above which management measures need implementing to reduce the project's impact.

The results are summarised in Table 12-2. The monitoring results reflect the high level of activity in the area during the day, evening and night periods, with the noise levels mainly being affected by road and rail transport and general urban hum. Central Station also experiences relatively high ambient vibration levels from the movement of trains particularly during the day with increased station operations, decreasing at night once trains either stop running or reduce in frequency.

Table 12-2: Noise monitoring results

NCA	Location ID	Address	Noise level (dBA) ^{1,2}					
			Background noise (RBL)			Average noise (LAeq)		
			Day	Evening	Night	Day	Evening	Night
NCA01	L01	107–121 Quay Street, Haymarket	57	57	50	64	63	60
NCA02	L02	303–321 Castlereagh Street, Haymarket	59	58	53	62	61	59
NCA03	L03	38 Chalmers Street, Surry Hills	53	53	48	61	61	59
NCA04	L04	201 Commonwealth Street, Surry Hills	50	49	44	59	57	55

Note 1: The rating background (noise) levels and LAeq have been determined with reference to the procedures in the [Noise Policy for Industry](#)

Note 2: Daytime is 7am to 6pm, evening is 6pm to 10pm and night-time is 10pm to 7am.

12.1.4 Policy and planning setting

The assessment considered the following relevant policies and guidelines:

- BS7385 Part 2–1993 Evaluation and measurement for vibration in buildings Part 2 (British Standards Institute, 1993)
- DIN 4150: Part 3–2016 Structural vibration – Effects of vibration on structures (Deutsches Institute fur Normung, 1999)
- [Assessing Vibration: a technical guideline](#) (Department of Environment and Conservation, 2006)
- [Interim Construction Noise Guideline](#) (Department of Environment and Climate Change, 2009)
- [Road Noise Policy](#) (Department of Environment, Climate Change and Water (DECCW), 2011)
- [Guideline for Child Care Centre Acoustic Assessment Version 2.0](#) (Association of Australasian Acoustical Consultants, 2013)
- AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors (Standards Australia, 2016)
- [Noise Policy for Industry](#) (NSW EPA, 2017a)
- [Construction Noise and Vibration Strategy](#) (CNVS) (Transport for NSW, 2019b)
- [Central Precinct Renewal Program Noise and Vibration Assessment](#) (Transport for NSW, 2022i).

12.2 Assessment of potential impacts

12.2.1 Construction

Noise intensive activities would only take place for short periods during construction, and consistent with other development, there would be long periods where construction activities and noise levels would be much lower. There would also be periods when no work would be carried out on site. Given the nature of the project, there would also be times when work would be carried out inside, in enclosed areas, or locations that are shielded such as works within the Sydney Terminal Building and Central Electric Building.

A model was used to predict the potential construction noise impact of this for each of the NCAs. It considered representative activities and scenarios associated with noise-intensive periods and those activities that would typically occur for much of the construction program (see Section 5.3.10 of the EIS).

A summary is provided below with more detail included in Appendix K (Noise and vibration assessment).

Residents

Noise intensive work | Day (7am to 6pm)

Noise impacts are generally only predicted at the closest few receivers (that is, less than 10), when noise intensive work is required externally. Peak scenarios such as 'demolition and hazmat removal', which use noise intensive equipment such as hydraulic hammers and concrete saws, are predicted to result in higher noise impacts, with intermittent impacts potentially lasting up to 22 months.

Typical work | Day (7am to 6pm)

As these works are quieter and include things like deliveries and unloading, they are predicted to comply with the management levels at all receivers during the day-time period and are predicted to have relatively minor impacts at the closest few receivers during the night-time period.

During the daytime, work at the Sydney Trains Yard is also predicted to comply with the management levels at all residential receivers.

Out of hours work

The majority of work required for the project would be carried out during standard NSW EPA construction hours, which are as follows:

- 7am to 6pm Monday to Friday
- 8am to 1pm Saturdays
- No work on Sundays or public holidays.

Certain work and deliveries may need to occur outside standard hours. Out of hours work may be required in some cases to minimise disruptions to customers, pedestrians, motorists and nearby sensitive receivers; and to ensure the safety of railway workers and operational assets. This is consistent with the [Interim Construction Noise Guideline's](#) recognition of public infrastructure work being required out of hours to minimise disruption to services, support worker safety and shorten the length of the project.

Further discussion of impacts of out of hours work is discussed below.

Typical work | Evening (6pm to 10pm) and night (10pm to 7am)

Evening ambient noise levels are quite similar to those experienced during the day reflecting the busy urban environment and human activity. Worst-case noise impacts at residential receivers during the evening is predicted at up to 54 receivers (one to five decibels (dB) above the noise management level (NML)) surrounding the Sydney Terminal Building, Eddy Avenue Plaza, and the Central Electric Building.

Noise impacts at night have the potential to be more widespread due to it being quieter at night. Worst-case night-time noise impacts at residential receivers are predicted at up to 105 receivers when noise intensive work is being completed at the Sydney Terminal Building, Eddy Avenue Plaza, and the Central Electric Building. Some of the night-time works at the Sydney Terminal Building is scheduled to last up to 20 months for various scenarios (see Section 5.3.10 of the EIS). Night work in the Eddy Avenue Plaza and at the Central Electric Building is scheduled to only take around two months (see Section 5.3.10 of the EIS).

During the night-time, worst-case impacts associated with work at the Sydney Trains Yard are predicted to be 'noticeable' (one to five decibels) at up to nine of the closest residential receivers.

Most sleep disturbance impacts are predicted to be relatively minor in magnitude, being only one to five decibels above the sleep disturbance screening criteria level for up to 50 residential receivers.

An external awakening reaction level of 65dBA (conservatively assuming open windows) has been adopted to inform the assessment. Construction maximum noise events are only predicted to exceed the awakening reaction level at nine residential receivers in NCA04. Maximum noise events are only predicted to reach these levels during the demolition scenario when work is required externally at Eddy Avenue Plaza and the Central Electric Building, which is expected to

last for about two months. However, existing maximum noise levels are already frequently in this range based on the monitoring conducted for the project.

The number of potential night-time awakenings would depend on several factors, including the type of equipment being used, the duration of the noisy external work and the background noise levels at the time of the work. Further investigation of the potential for awakenings would be completed as the project progresses and detailed construction planning information becomes available.

Other noise sensitive receivers

Many of the receivers closest to the project are commercial or 'other sensitive' uses such as hotels, places of worship, recreational areas, and educational and health facilities. These receivers are predicted to be affected by the construction program when activities are taking place nearby. The nearest commercial and 'other sensitive' receivers are predicted to be impacted when they are in use and noisy construction work is being completed at the Sydney Terminal Building. Worst-case 'highly intrusive' and 'moderately intrusive' impacts are predicted at:

- 'Highly intrusive' (>20dB) at Christ Church St Laurence, immediately west of the project in NCA01
- 'Moderately intrusive' (11–20dB) at one UTS building, west of the project in NCA01
- 'Moderately intrusive' (11–20dB) at Belmore Park, immediately north of the project in NCA02
- 'Moderately intrusive' (six to 15dB) during the night-time at the Sydney Central YHA Hostel, Wake Up! Sydney Hostel and 790 on George Backpackers, west of the project in NCA01.

There are also a number of isolated receivers which are distant from the project that are predicted to be impacted (see Section 5.2.1 of Appendix K (Noise and vibration assessment)), whereas closer receivers are not. This generally occurs where the impacted receivers are taller than the surrounding buildings so that they have a direct line of sight to the project over the intervening buildings. Distant 'other sensitive' receivers are also more likely to be impacted during the daytime period due to the NMLs for these receivers categorised as being more stringent than the NMLs for surrounding commercial and residential receivers.

Other noise impacts

Internal noise

There would be times when noise intensive equipment such as concrete saws or jackhammers would be used inside the Sydney Terminal Building. This may result in potential noise impacts on people in and around Central Station, including construction workers, staff, office workers, commuters, and rough sleepers.

The NSW Work Health and Safety Regulation 2017 includes a L_{Aeq} (eight-hour) noise limit of 85dBA, which sets a noise limit over an eight-hour period. The potential for occupational health and safety noise impacts would be further reviewed by the construction contractor as the project progresses.

Ground borne noise

Ground-borne noise is noise caused by ground vibration and is typically characterised as low frequency "rumbling" noise. No ground borne noise impacts are predicted at the surrounding receivers from vibration generating activities as the vibration generating plant and equipment coupled with their location means receivers would not hear ground borne noise. However, people may hear ground borne noise within the commercial and commuter areas of Central Station when vibration generating work is taking place depending on the proximity to the works.

Road traffic noise

Section 9.2.1 notes that there is predicted to be up to 20 to 30 heavy vehicles and around 50 light vehicles arriving and leaving site every day during construction. They would travel on roads that typically carry upwards of 5,000 vehicles per day (see Table 9-1). Road traffic noise impacts only occur where the change in traffic increases (or decreases) the noise levels by two decibels ([Road Noise Policy](#), DECCW, 2011). This is equivalent to around a 60 per cent change in traffic. As the traffic would only increase by around two per cent, and that there are no proposed diversions that could temporarily transfer traffic to other roads in the CBD, there is no potential for any significant road traffic noise impacts.

Construction noise fatigue

Projects constructed consecutively (or sequentially) can result in construction activities occurring over an extended period of time with little or no break in construction activities, potentially causing increased impacts and construction fatigue for local communities. Where concurrent construction work is being completed, the worst-case construction noise levels could theoretically increase by around three decibels. While the likelihood of worst-case noise levels being generated by concurrent construction work is considered low, the potential impact on those affected by the noise should still be considered. Instead of increasing overall noise levels, the impact of concurrent construction activities may primarily be an increase in the duration and annoyance of noise impacts for those nearby. Potential cumulative noise impacts and management measures are discussed further in Chapter 22 (Cumulative impacts).

Vibration

All surrounding receivers are above the cosmetic damage and human comfort minimum working distances for vibration intensive equipment. The minimum working distances for both cosmetic damage (from BS 7385 and DIN 4150) and human comfort (from the [Assessing Vibration Guideline](#)) are calculated from empirical data which suggests that where work is further from receivers than the quoted minimum distances then vibration impacts are not considered likely.

The only receiver identified near the project with potentially vibration sensitive equipment (for example, CT scanners or other sensitive medical equipment) is the Sydney Dental Hospital which is around 100 metres southeast of the project at 2 Chalmers Street, Surry Hills. The Sydney Dental Hospital is far enough away from the construction activities that it would not be affected by vibration levels and would comply with the vibration criteria for sensitive equipment (VC-A) specified in the [CNVS](#) (Transport for NSW, 2019b).

Heritage items

There is potential for vibration impacts at the Sydney Terminal and Central Railway Stations Group heritage listed area, given the project is located within this area. BS 7385: Evaluation and Measurement of Vibration in Buildings recommends a 25 millimetres per second peak particle velocity criteria to avoid cosmetic damage for reinforced or framed structures, industrial and heavy commercial buildings. It is unlikely that the proposed construction equipment will induce the level of vibration specified in the [CNVS](#) outside of the areas where it is actively being used for construction. Cosmetic damage is, therefore, considered unlikely to occur at the project area and surrounds.

Notwithstanding, attended vibration measurements would be completed at the start of any proposed vibration intensive work to confirm the vibration levels produced by the equipment are appropriate.

12.2.2 Operation

The only noise generating equipment installed as part of the project would be the air cooled chillers and centrifugal pumps for the hot water system on the roof of the Sydney Terminal Building and exhaust fans. The noise generated from the mechanical plant is predicted to comply with the predicted day, evening and night-time noise levels at the closest sensitive receivers (see Section 6 of Appendix K (Noise and vibration assessment)).

12.3 Environmental management measures

Noise and vibration impacts will be addressed in the form of management measures. Measures to minimise impacts relating to traffic and air quality are addressed in other impact chapters and have not been included here. Table 12-3 lists the measures to manage noise and vibration impacts specifically.

Table 12-3: Environmental management measures – noise and vibration

Ref	Impact / Uncertainty	Environmental management measure	Timing
NV01	Impact Operational mechanical plant and equipment	The selection and treatment of air-cooled chillers and centrifugal pumps for the hot water system on the roof of the Sydney Terminal Building and exhaust fans will be evaluated during detailed design to ensure noise emission levels are within criteria.	Detailed design
NV02	Impact Construction noise and vibration	<p>A Construction Noise and Vibration Management Plan (CNVMP) will be prepared and implemented as part of the Construction Environmental Management Plan. The plan will:</p> <ul style="list-style-type: none"> Identify nearby sensitive receivers Describe the activities, construction equipment and work hours that will be completed and quantify resulting impacts at sensitive receivers Include noise and vibration management criteria and relevant licence and approval conditions Include measures to manage noise and vibration and minimise the potential for impacts during construction, aligned with the results of community consultation, and consistent with the management approach and mitigation measures in the CNVS (Transport for NSW, 2019b) Set out the requirements for noise and vibration monitoring Set out the procedures for handling complaints 	Pre-construction

Ref	Impact / Uncertainty	Environmental management measure	Timing
		<ul style="list-style-type: none"> Provide details on how respite will be applied where ongoing high impacts are seen at certain receivers in accordance with the CNVS Include any requirements contained within the <u>Central State Significant Precinct study</u> and supporting technical documents where applicable. <p>The CNVMP will consider cumulative construction impacts and the likelihood for 'construction fatigue' from consecutive projects in the areas that have substantial night-time work.</p>	
NV03	Impact Construction noise	Where noise impacts are predicted, the work will be scheduled within standard construction hours, where possible. If it is not possible then the activities will be completed as early as possible in each work shift. Appropriate respite will be introduced in accordance with the <u>CNVS</u> .	Construction
NV04	Impact Construction noise	<p>Specific consultation will be carried out with nearby sensitive health facilities, educational and place of worship receivers. Noise intensive work that is predicted to impact such receivers will be scheduled outside of particularly sensitive periods, such as exams or religious services, where possible.</p> <p>Hotels and temporary accommodation will be included in the consultation where predicted (night-time) noise impacts may affect the amenity of guests.</p>	Construction
NV05	Impact Construction noise and vibration	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 and that appropriate mitigation measures from the <u>CNVS</u> have been implemented.	Construction
NV06	Impact Heritage items	<p>The following measures will be implemented for significant heritage fabric within the Sydney Terminal Building and Central Railway Stations Group heritage area, including the existing rail tunnels and infrastructure, where vibration-generating activities cannot take place without maintaining the safe working distances set out in the <u>CNVS</u>:</p> <ul style="list-style-type: none"> Dilapidation/condition surveys will be carried out before and after work. The survey will include details of any structurally elements that are found to be structurally unsound and/or considered to be particularly sensitive to vibration Where any structures are considered structurally unsound or particularly sensitive to vibration, the more stringent DIN 4150 (Deutsches Institute fur Normung, 1999) Group 3 guideline values will be applied Attended vibration monitoring will be carried out at the start of any new vibration intensive work activity that cannot take place at a safe working distance to confirm the vibration levels produced by the equipment are appropriate Further attended and/or unattended monitoring will be carried out where vibration intensive equipment is being used near structurally unsound infrastructure and/or locations particularly sensitive to vibration The potential for vibration impacts on heritage structures will be reviewed during detailed design when construction planning is available to verify the assessment. 	Construction
NV07	Impact Internal noise	The following measures will be implemented to manage noise impacts within the project area:	Construction

Ref	Impact / Uncertainty	Environmental management measure	Timing
		<ul style="list-style-type: none"> Schedule noise intensive work for off-peak commuter times when the area is less busy Use the minimum practical size of equipment, including silenced compressors, generators, and dust extractors, where noisy work is required while the station is open Use path controls, such as mobile hoarding, to isolate noise intensive activities from publicly accessible locations. This includes work within the Sydney Terminal Building and Eddy Avenue Plaza. 	
NV08	Uncertainty Construction noise and vibration	<p>Location and activity-specific noise and vibration impact assessments will be carried out where:</p> <ul style="list-style-type: none"> There is the potential to result in noise levels above 75dBA at any sensitive receiver Work is scheduled outside of standard construction hours and likely to result in noise levels greater than the relevant NML Activities that have the potential to exceed relevant criteria for vibration. <p>The assessments will confirm the predicted impacts at the relevant receivers to help with the selection of appropriate management measures, consistent with the requirements of the <u>CNVS</u>.</p>	Construction