Integrated Management System

Planning Approval Consistency Assessment Form

SM ES-FT-414

Sydney Metro Integrated Management System (IMS)

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Prepared by:	AFJV
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1. Existing Approved Project

Planning approval reference details (Application/Document No. (including modifications)):

- CSSI 10038 Sydney Metro West Concept and Stage 1 (11 March 2021)
- Administrative Modification 1 (28 July 2021)
- Modification 2 Clyde stabling and maintenance facility (3 June 2022)
- Administrative Modification 3 (4 July 2022)
- Administrative Modification 4 (22 December 2022)

Date of determination:	Determination: 11 March 2021 Date of modifications: • Modification 1: 28 July 2021 • Modification 2: 3 June 2022 • Modification 3: 4 July 2022 • Modification 4: 22 December 2022	Type of planning approval:	Critical State Significant Infrastructure (CSSI) (EP&A Act Division 5.2)

Relevant background information (including EA, REF, Submissions Report, Director General's Report, MCoA):

- Sydney Metro West Concept and Stage 1, Environment Impact Statement, April 2020
- Sydney Metro West Concept and Stage 1, Amendment Report, November 2020
- Sydney Metro West Concept and Stage 1, Submissions Report, November 2020
- Sydney Metro West Concept and Stage 1 - Assessment Report (SSI 10038), March 2021
- Sydney Metro West Concept and Stage 1, Conditions of Approval (CoA), released on 11 March 2021 and updated on 28 July 2021 (Modification 1), 3 June 2022 (Modification 2), 4 July 2022 (Modification 3) and 22 December 2022 (Modification 4).

Description of existing approved project you are assessing for consistency:

Sydney Metro West (the Concept)
Sydney Metro West (the Concept) would involve the construction and operation of a metro rail line around 24 kilometres long between Westmead and Hunter Street in the Sydney CBD. The key components are expected to include (as described in Chapter 6 of the Environmental Impact Statement (EIS)):
• Construction and operation of new passenger rail infrastructure between Westmead and the central business district of Sydney, including:
  ○ Tunnels, stations (including surrounding areas) and associated rail facilities
  ○ Stabling and maintenance facilities (including associated underground and overground connections to tunnels)
• Modification of existing rail infrastructure (including stations and surrounding areas)
• Ancillary development.
 	
Sydney Metro West - all major civil construction works between Westmead and The Bays (the approved project)
The Sydney Metro West Project Concept; and all major civil construction works between Westmead and The Bays, including station excavation and tunnelling was determined on 11 March 2021. The scope of Stage 1 of the planning approval process for Sydney Metro West (the approved project) is described in Chapter 9 of the EIS, with the key features including:
• Tunnel excavation including tunnel support activities between Westmead and The Bays
• Station excavation for new metro stations at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock and The Bays
• Shaft excavation for services facilities
• Civil work for the stabling and maintenance facility at Clyde.
 	
To construct the above, the Sydney Metro West Stage 1 is divided into multiple packages, each with their own design and construction scope. The package relevant to this Consistency Assessment is the Central Tunnel Package (CTP) which involves the design and construction of 11km of twin tunnels and underground station excavations from The Bays to Sydney Olympic Park. The overall design and construction timeframe is approximately 3.5 years from July 2021.
 	
This consistency assessment is relevant to the Five Dock Station. The Five Dock Station is described in Section 9.5.8 of the EIS. The Five Dock Station would require two construction sites, a western construction site and an eastern construction site (refer to Figure1-1).

Figure 1-1: Five Dock eastern and western construction site locations

The construction site would be used to excavate Five Dock Station cavern using a mined technique. Shafts would be excavated within the two construction sites to the station cavern to provide access during construction. The construction sites would include spoil storage and removal, water supply, water treatment and disposal, material storage and office facilities and worker amenities. The excavations would require the removal of about 165,000 cubic metres of spoil.

2. Description of proposed change which is the subject of this assessment

Overview

For the construction of the Approved Project, stations as well as services facility shafts, tunnel dives and TBM launch shafts would need to be excavated from the surface down. The EIS for the approved project considered that excavation would be completed within acoustic sheds or below acoustic panels (or other acoustic measures) at sites where 24/7 excavation works are proposed including the Five Dock Station construction sites. At sites without acoustic sheds or panels, noisy excavation works would typically be restricted to the daytime.

During the preparation of the EIS, it was assumed that excavation at the Five Dock eastern and western sites would be required to occur 24 hours a day, seven days a week. Table 21 of the Environmental Impact Statement - Noise and Vibration Technical Paper states:

> *Main excavation (referred to as 'excavation' hereon) involves excavation to a depth where blasting can be performed, if it is suitable for that site. Excavation would be completed within acoustic sheds or below acoustic panels (or other acoustic measures) at sites where 24/7 excavation works are proposed including Westmead metro station, Olympic Park metro station, Burwood North Station, Five Dock Station and The Bays Station construction sites.*
>
> *At sites without acoustic sheds or panels, noisy excavation works would typically be restricted to the daytime.*

Change in construction sequencing at Five Dock

During detailed construction planning, it has been identified that 24/7 works for the excavation of the shaft at the western construction site is not required. There has been an opportunity to improve the sequence of work at the Five Dock western construction site to eliminate the requirement for general out of hours shaft excavation.

The construction methodology anticipated that road headers would be launched from both the eastern and western sites at Five Dock to excavate the cavern between the two sites, once the shafts have been excavated. The eastern site had a shorter demolition program compared to the western site, and installation of an acoustic shed has been completed at the eastern site to facilitate the 24/7 excavation. Excavation of the shaft at the eastern site is anticipated to be completed well in advance of the western site. This will enable roadheader excavations for tunnelling of the cavern to commence several months earlier at the eastern site than the western site. As a result, the new proposed sequence is that the roadheaders for the cavern will now only be launched from the eastern site and tunnelling support will be provided from this site. Some tunnelling works would be required at the western face of the western shaft at invert level to excavate the western cavern. This will occur after the cavern excavation breaks through from the eastern site and is required to facilitate the tunnel boring machine (TBM) being passed through. These activities would only be undertaken during standard construction hours unless they are deemed to be low noise impact works for airborne noise as defined in condition of approval D37(b).

As a result of the change in methodology, shaft excavations and associated spoil management at the western site will now only be required to be undertaken during standard construction hours specified in condition of approval D35. No roadheader tunnelling for the construction of the cavern from the western site would be required outside of standard construction hours unless they are deemed to be low noise impact work for airborne noise.

Change in noise mitigation strategy at Five Dock – western construction site

During detailed construction planning for the Five Dock western construction site, taking into consideration the construction program, working hours and traffic management; it was determined that shaft excavation works and spoil haulage is now only required during standard construction hours. Shaft excavations at the western site will only be undertaken during the standard construction hours in condition of approval D35 of the Approved Project unless they are considered to be low noise impact work for airborne noise. As a result, an acoustic shed is no longer justified as the preferred noise mitigation strategy (refer to Section 6 - Justification). This is consistent with the approach taken for the excavations of Parramatta and North Strathfield metro stations as stated in the EIS, which are primarily being excavated within standard construction hours.

An acoustic shed has been constructed at the Five Dock eastern construction site where excavations, supporting activities and spoil management are required to occur outside standard construction hours in line with the conditions of approval. This was considered an appropriate control in consideration of the construction program and additional activities to be undertaken (such as tunnelling of the cavern from the eastern site), and therefore extended periods of out of hours works are required.

Proposed change

The proposed change, subject of this Consistency Assessment, is to alter the proposed noise mitigation strategy to respond to the change in construction methodology. An acoustic shed at Five Dock western construction site is no longer proposed due to shaft excavations occurring during standard construction hours only. Alternate feasible and reasonable noise mitigation in accordance with condition of approval D39 to minimise exceedances of the noise management levels to nearby receivers during the standard construction hours is required. Table 2-1 provides a comparison between the Approved Project and proposed change.

Table 2-1 - Comparison of the proposal with relevant elements of the Approved Project

Relevant elements of the Approved Project	Proposed change
Hours of work The construction hours identified in Condition of Approval D35 for the Approved Project are: • 7:00am to 6:00pm Mondays to Fridays, inclusive; • 8:00am to 6:00pm Saturdays; and • at no time on Sundays or public holidays. Exceptions to this in accordance with Condition of Approval D37 generally include: • work required for safety reasons and emergencies • construction work that is deemed to meet 'Low Noise Impact Work' criteria are permitted out of standard construction hours • tunnelling (excluding cut and cover tunnelling and surface works) are permitted 24 hours a day, seven days a week • any changes to construction working hours approved by the NSW Environment Protection Authority (EPA) under an EPL.	No changes to the construction hours identified in Condition of Approval D35 and D37 for the Approved Project are required as a result of the proposed change. Details on the proposed working hours for shaft excavation and tunnelling at the Five Dock western construction site are included below.

Shaft excavation works at the Five Dock western construction site Section 9.5.8 of the EIS for the Approved Project discussed the activities for shaft excavation at the western site and identified the indicative location of the shaft within the construction site (Figure 9-28 of the EIS). The EIS for the approved project also identified that initial shaft excavation without an acoustic shed was required at Five Dock. The EIS identified that this excavation without an acoustic shed would be restricted to standard construction hours only. Section 11-3 of the EIS described that once acoustic sheds (or other acoustic measures) are in place, excavation works for shaft excavation would occur 24 hours per day, seven days a week. Condition of approval D37 specifies that work within an acoustic shed may be undertaken outside standard construction hours where there is no exceedance of noise levels under Low Noise Impact Work circumstances, unless otherwise agreed by the Planning Secretary.	This Consistency Assessment does not change the extent or location of shaft excavation at Five Dock. This Consistency Assessment does not change the methodology of the shaft excavation required, and the plant and equipment required would also remain unchanged. Given the change in construction sequencing, this Consistency Assessment proposes reduced working hours at Five Dock western site for shaft excavation and spoil management compared to the hours assessed in the EIS. Shaft excavation and spoil management at Five Dock western site will only be required to be undertaken during the standard construction hours listed in condition of approval D35. Highly noise intensive work would only be able to be undertaken during standard construction hours in accordance with condition of approval D36, which also requires respite periods during extended durations of noisy works. If shaft excavation work is deemed to meet the low noise impact criteria, this may be undertaken outside of standard construction hours in accordance with condition of approval D37.
Tunnelling and supporting activities Section 9.4 of the EIS for the Approved Project discussed the activities for the construction of the tunnels including the use of tunnel boring machines to excavate most of the twin tunnels, and roadheaders to excavate irregular shaped tunnels including the cavern required between the two shafts at Five Dock. Section 11-3 of the EIS described that tunnelling and activities that support tunnelling may need to occur 24 hours per day, up to seven days per week.	This Consistency Assessment does not change the scope of tunnelling or supporting activity for the Approved Project. The depth of the tunnel at Five Dock is approximately 30 metres to the invert below ground level, consistent with the assessment in the EIS for the Approved Project. Roadheaders for the cavern will now be launched from the eastern site within the existing acoustic shed and tunnelling can be undertaken 24 hours 7 days per week under the approved EPL and in accordance with condition of approval D37(d). Some tunnelling works including excavation of the western cavern are required from the western site once the cavern excavation breaks through the western shaft, and to facilitate the tunnel boring machine being passed through, however, these would only be required during standard construction hours unless they are deemed to be low noise impact work for airborne noise. Ventilation for tunnelling will also mostly be serviced from the eastern site. Feasible and reasonable mitigation measures will be implemented, as required, during the course of these activities. No change to the methodology of the tunnel boring machine work is required as a result of the proposed change.

Timing An indicative program for construction activities at Five Dock is shown in Figure 9-29 of the EIS for the Approved Project. The EIS and Technical Paper 2 – Noise and Vibration for the Approved Project identified that for both construction sites at Five Dock: • shaft excavation would be completed over a period of approximately 40 weeks • station cavern excavation would be completed over a period of approximately 30 weeks over an approximate 15 month period.	Shaft excavation without an acoustic shed was identified as being required for the approved project, and would be limited to being undertaken within standard construction hours only. As such, shaft excavation of the western site commenced in February 2023 and would be expected to continue until Q3 2023. Tunnelling for the Five Dock cavern is proposed to occur from around May 2023 and be expected to be completed over a period of approximately 6 months. The tunnel boring machine is expected to pass through Five Dock in approximately Q4 2023. Some excavation work may be required after the tunnel boring machine passes through to complete the cavern, and as noted earlier, this would be undertaken during standard construction hours unless it meets the low noise impact work criteria for airborne noise. Overall, this Consistency Assessment does not change the overall duration of the construction work of the Approved Project. Refer to Section 3 – Timeframe for more details.
Heavy vehicles In accordance with condition of approval D85 for the approved project, a Construction Traffic Management Plan (CTMP) has been prepared in accordance with the Sydney Metro Construction Traffic Management Framework (CTMF) to assess and manage impacts on the surrounding road network. The haul routes identified in the CTMP are consistent with Figure 10-44 of the EIS. The approved CTMP includes a peak daily traffic movement volume of 308 heavy vehicle movements per day from the western site, with up to 28 heavy vehicle movements per hour during the AM and PM peak periods. In accordance with condition of approval D37 of the approved project, no delivery of materials or spoil haulage would be undertaken from the Five Dock western construction site between the hours of 10pm and 7am unless required for safety reasons.	Construction traffic volumes are not expected to increase as a result of this proposal. No change to the peak daily traffic movement volumes or the hourly movement volumes during the peak period would be required as a result of this proposal. No change to the haul routes would be required. Construction traffic will be managed as per the approved Construction Traffic Management Plan (CTMP), prepared in accordance with condition of approval D85. In accordance with the conditions of approval, no delivery of materials or spoil haulage would occur from the Five Dock western construction site between the hours of 10pm and 7am unless required for safety reasons.
Noise and vibration mitigation measures During the preparation of the EIS, it was assumed that excavation work at the Five Dock eastern and western sites would be required to occur 24/7. The EIS for the approved project considered that excavation would be completed within acoustic sheds or below	An acoustic shed at Five Dock western construction site is no longer proposed due to shaft excavations occurring during standard construction hours only. Alternate feasible and reasonable noise mitigation in accordance with condition of approval D39 to minimise exceedances of the noise management levels to nearby receivers during the standard construction hours is required.

acoustic panels (or other acoustic measures) at sites where 24/7 excavation works are proposed including at the Five Dock construction sites. The EIS identified that at sites where no regular out of hours works were proposed and excavation works were proposed to be undertaken during the daytime only (such as North Strathfield), acoustic sheds or panels were not identified as a feasible or reasonable mitigation measure. Condition of approval D39 stipulates the need to implement feasible and reasonable mitigation measures with the aim of achieving construction noise management levels and vibration criteria in accordance with the relevant guidelines.	Noise mitigation measures have been determined by taking into account construction program, construction working hours and construction traffic management in accordance with the Sydney Metro Construction Noise and Vibration Standard (CNVS). The standard mitigation measures in the CNVS will be applied as well as the additional mitigation measures, as required. These measures are also included in the Noise and Vibration Management Plan prepared for the Approved Project. In accordance with condition of approval D44, a Detailed Noise and Vibration Impact Statement (DNVIS) must be prepared for each construction site and include specific mitigation measures identified through consultation with affected sensitive land users. Site specific noise mitigation measures to be implemented on the Five Dock western construction site as identified through the DNVIS include: - elimination of general out of hours work for shaft excavations and spoil management at the Five Dock western construction site - hoarding of around 3 metres would be installed around the perimeter of work area with chain-mesh gates provided for access. This would provide noise attenuation and provide visual screening by creating a solid barrier between the construction activities and sensitive receivers - surface miner would be trialled in western shaft excavation which is less intrusive than comparable excavations with hydraulic excavator - avoidance of high noise impact works when reasonably practicable, with respite provided as per condition of approval D36 - community notifications and consultation including community meetings and information sessions - verification of the noise model by undertaking noise monitoring. If noise monitoring is higher than predicted then the works will be reviewed and additional feasible and reasonable measures will be implemented. Further discussion of mitigation measures including alternatives considered is provided in Section 6 – Justification.

Community Consultation

Extensive community engagement has occurred since before construction commenced at Five Dock and will continue throughout construction. The concerns and sensitivities of the local community are well understood and have been considered in determining feasible and reasonable mitigation measures.

The local community will be provided with information about the change of approach at the western site and an opportunity to discuss the changes with members of the AFJV team. Key activities will include:

- Briefings for City of Canada Bay Council
- Notification distributed to all residents and businesses within 500m of the construction site and sent to email distribution list
- Construction update briefings for relevant local organisations such as Five Dock Chamber of Commerce
- Doorknock residents and businesses adjacent to the western site
- Community information sessions in Fred Kelly Place
- Respond to stakeholder enquiries as they are received
- Community meetings specifically arranged for nearby residential receivers

3. Timeframe

An indicative construction program for the major civil construction work between Westmead and The Bays is shown in Figure 9-29 of the EIS. Section 9.3 of the EIS notes that the actual program and commencement of the civil work at each construction site may vary and is subject to the final delivery strategy and actual construction program to be agreed with the successful contractor for each work package.

Surface work at Five Dock western construction site commenced in 2022. Shaft excavation and rock anchoring at Five Dock western site is scheduled to continue until approximately August 2023. Mined excavation is scheduled from May to October 2023. From November 2023 shaft excavation plant will be demobilised.

Three metre hoarding will be installed around the perimeter of the site in Q3 2023. Hoarding along East Street, Great North Road and St Alban's church will be handed over to the Sydney Metro West station contractor at the completion of AFJV's scope of work.

An overview of the surface works schedule is provided in Table 3-1. This table does not include the tunnel boring machine or works that follow the tunnel boring machine. These dates are indicative and may change depending on ground conditions, weather and other factors.

Table 3-1: Five Dock Station construction site indicative construction program for surface works

	2022				2023				2024
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Site Establishment									
Shaft excavation									
Cavern excavation									

Demobilisation									

Cavern excavations (tunnelling) are planned to commence from the eastern site in May 2023 and be completed in October 2023. Tunnelling with the Tunnel Boring Machine (TBM) is scheduled to breakthrough Five Dock cavern in Q4 2023, and some final excavation may be required to complete the cavern after this date.

Final site handover for Five Dock eastern and western construction sites is scheduled to occur in January 2025. Prior to this date the sites will need to be fully demobilised.

The program presented in Table 3-1 is generally consistent with the indicative program in the EIS.

4. Site description

Five Dock Station is located towards the middle of the Five Dock local commercial centre at Great North Road, with a future station entrance on Fred Kelly Place. As described in the EIS[1], Five Dock Station will be constructed from two surface construction sites, a western construction site and an eastern construction site as described below:

- The Five Dock Station western construction site covers approximately 4,150 square metres and is located between Great North Road and East Street, to the north of Fred Kelly Place and south of St Albans Anglican Church. Pre-construction this site contained commercial buildings. The proposal relates the western construction site only.
- The Five Dock Station eastern construction site covers approximately 2,150 square metres and occupies the former Second Avenue council car park and a number of residential properties located on Waterview Street. This proposal does not relate to the eastern construction site.

Five Dock Station western construction site, the subject of this proposal, is located on the following land parcels: Lot 1 DP166975, Lot 1 DP868504, Lot 2,4 and 5 DP219715, Lot A DP333934, Lot X DP 414325 and Lots A&B DP373732. The site is located in Canada Bay LGA. The land is owned by Transport for NSW.

Refer to Figure 4-1 for Five Dock western site layout.

[1] EIS Section 9.5.8 *Five Dock Station construction site*

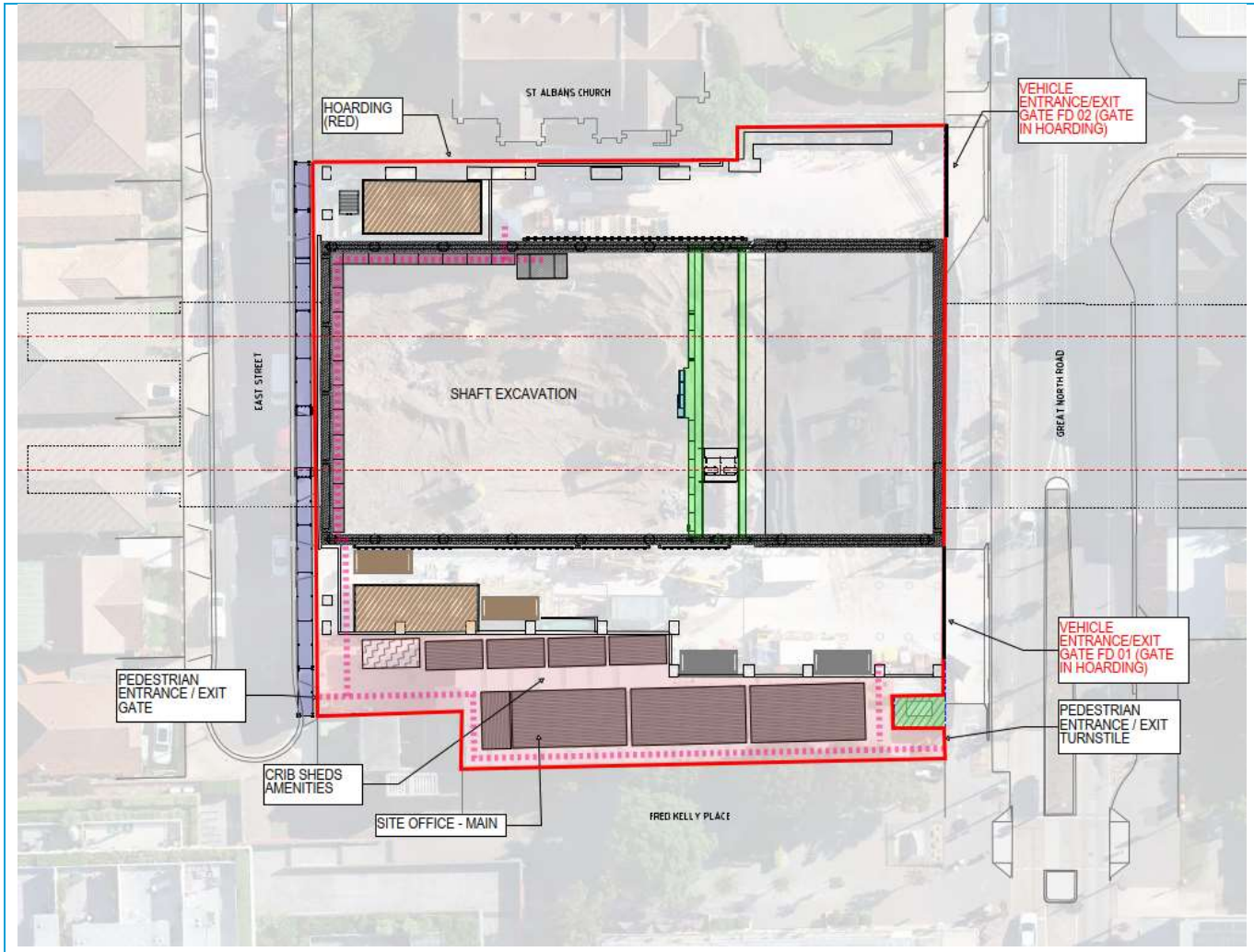


Figure 4-1 Five Dock Station western site layout

5. Site Environmental Characteristics

The Five Dock Station western construction site is located within the Five Dock commercial area, being an existing built-up area of mixed land use including commercial and residential areas. The site has been heavily disturbed as part of previous development. The site is bordered by Great North Road, East Street, St Alban's Anglican church and Fred Kelly Place.

The site does not contain any sensitive environmental features and the nearest waterway is Iron Cove Creek / Dobroyd Canal which is a concrete-lined disturbed waterway located approximately 650 metres to the south.

6. Justification for the proposed change

Acoustic sheds at the Five Dock western construction site were contemplated in the EIS for the approved project on the basis that shaft excavation would be required to be undertaken 24/7. Due to the change in construction methodology, shaft excavation is now only required to be undertaken during standard construction hours. An acoustic shed at Five Dock western construction site is therefore no longer proposed due to shaft excavations occurring during standard construction hours only. Using acoustic sheds in these circumstances would prolong the excavation process and would result in noise impacts associated with constructing the acoustic shed. Alternate feasible and reasonable noise mitigation in accordance with condition of approval D39 to minimise exceedance of the noise management levels to nearby receivers during the standard construction hours is required. Appropriate mitigations are able to be implemented (including a 3 metre noise hoarding) with much less impact and which will appropriately resolve any impacts associated with there being no acoustic shed. This section provides a justification of the proposed change including:

- Justification of feasible and reasonable mitigation appropriate for excavation work and tunnelling of the cavern from the western shaft being primarily undertaken during standard construction hours including:
    - An assessment of different physical acoustic barriers against a number of criteria including noise mitigation effectiveness, constructability and design

Shaft excavation at the site has commenced without an acoustic shed in place and the excavation works have been restricted to standard construction hours only, which is consistent with the scenario identified in the EIS for the approved project. This section provides a justification for the proposed change including a discussion of the construction implications of installing an acoustic shed at the western site and the project benefits associated with alternate feasible and reasonable noise mitigation.

Mitigation measures

Condition D39 states that all feasible and reasonable mitigation measures must be implemented with the aim of achieving the construction noise management levels and vibration criteria listed in various standards and guidelines.

Chapter 11 Noise and Vibration of the EIS for the Approved Project states:

> *Acoustic shed(s) (or other acoustic measures) would be constructed over excavation and spoil handling areas as early as possible for sites where excavation and tunnelling works are proposed 24 hours per day seven days a week.*

At sites without acoustic sheds (or other acoustic measures), excavation works would be restricted to standard construction hours. Once acoustic sheds (or other acoustic measures) are in place, excavation works would occur 24 hours per day, seven days a week.

Where 24 hours per day, seven day a week tunnelling or excavation works are required near sensitive receivers, an acoustic shed (or other acoustic measures) would be erected to mitigate the noise emissions.

Additionally, section 11.3.4 of the EIS for the approved project states:

Acoustic sheds (or other acoustic measures) would be constructed prior to commencing evening and night time works at all sites where works outside of standard construction hours could have the potential to impact nearby receivers.

These statements from the EIS for the approved project suggest that an acoustic shed (or other acoustic measures) was considered an appropriate measure to mitigate airborne noise impacts during 24 hour excavation and tunnelling work.

Given the change in construction sequencing as identified in Section 2 above, the need for shaft excavations and surface works at Five Dock would now be limited to standard construction hours only and 24/7 excavation is no longer required. Therefore, reassessment of the need for an acoustic shed as the feasible and reasonable mitigation to manage day time noise impacts is justified. It is acknowledged that an acoustic shed may have benefits for managing noise during standard construction hours, however these impacts can be managed through feasible and reasonable mitigation measures as required by condition of approval D39.

Detailed Noise and Vibration Impact Statements (DNVIS) for tunnelling (SMWSTCTP-AFJ-1NL-NV-RPT-000001 Rev4) and for Five Dock (SMWSTCTP-AFJ-FDK-EN-RPT-000015 Rev 8) have been prepared in accordance with conditions of approval D43 and D44. These DNVIS's include mitigation measures identified through consultation and refer to compliance with the standards listed in condition of approval D39. All work at the Five Dock western construction site must be carried out in accordance with the endorsed DNVIS. The impact assessment in the DNVIS (revision 8) included in Appendix A of this Consistency Assessment has been used to inform the noise and vibration impact assessment and the justification of feasible and reasonable noise mitigation for the purposes of this Consistency Assessment. The DNVIS would be subject to endorsement by the Acoustics Advisor as per the conditions of approval. The proposed feasible and reasonable mitigation which includes site specific acoustic measures have been provided in Section 2 – Description Table 2-1 of this Consistency Assessment.

Proposed hoarding and alternatives considered

Throughout demolition and other phases of construction various hoardings have been installed to provide noise attenuation and a visual barrier around the western construction site. The proposed hoarding arrangement during shaft excavation is 3 metre high A Class hoarding installed around the boundary of the western site with openings for access. The section of hoarding along Great North Road will have a concrete traffic barrier as a base with plywood panels fixed with steel posts and timber walers. Other sections will be constructed with plywood panels fixed with steel posts and timber walers. Justification of why this is considered the most feasible and reasonable approach is provided in Table 6-1 below.

The hoarding installed at the site must meet the temporary design standards for a 10-year design life and be acceptable as a handover item at the completion of the tunnelling contractor's work to the station contractor. Previous hoarding installed at the site has included B Class hoarding which did not meet this 10-year design life.

Offices, crib sheds and amenities have been stacked, and positioned along the southern boundary which provides noise attenuation for Fred Kelly Place and other properties to the south of the site. This is demonstrated through the acoustic modelling shown in Figure 6-1 to Figure 6-6 below.

Installation of an acoustic shed, approximately 23 metres high, is no longer considered feasible or reasonable as it would have visual and shading impacts, extend the overall duration of surface construction works and have impacts associated with footpath and road closures. Installation of a 6 metre high bottom portion of acoustic shed was considered but it was not feasible to repurpose the shed from a design and program perspective. Acoustic panels are not feasible or reasonable because the structure would restrict access to the shaft from the surface which is necessary for spoil load-out during construction within the standard construction hours. Hoarding is considered the most

feasible and reasonable acoustic measure. The height of the hoarding was determined by considering noise attenuation, duration, feasibility of design, construction methodology and other impacts. Hoarding heights of 3 metre, 4 metre and 6 metre were considered and a 3 metre high hoarding was determined to be the most feasible and reasonable measure.

A comparison of noise attenuation for different hoarding heights was undertaken and a summary is provided in Table 6-1 and models provided in Figures 6-1 to 6-6. For the purpose of comparison, a scenario of rippable excavation at 6 metre depth was chosen and the intent of the models is to compare attenuation, not impact to receivers. A six metre hoarding height was chosen as a conservative assumption of excavation depth for determining feasible and reasonable mitigation. The actual excavation depth is currently approximately 10 metres below footpath level as of May 2023 and this has been undertaken in accordance with the initial excavation required for the site.

Assessment of a six metre excavation depth provides a conservative assessment and allows a comparison of the attenuation that is provided as the depth of the excavation increases. As the shaft becomes deeper the predicted noise levels decrease at nearby receivers. For example, the reduction in predicted noise levels with 4 metre hoarding at the nearest residential receiver is approximately 2.5 dB from 6 metre to 9 metre excavation depths. Section 10 – Noise and vibration includes an assessment of receiver impact.

A summary of the considerations for the three heights is provided in Table 6-1.

Table 6-1 Feasible and reasonable considerations for 3m, 4m and 6m hoarding

Consideration	Hoarding Height			Conclusion
	3m	**4m**	**6m**	
Noise attenuation Day-time standard construction hours rating background level (RBL) and noise management level (NML) for noise catchment area 14 (NCA 14) (west of Great North Road) is 42 dBA and 52 dBA respectively. RBL and NML for NCA 15 (east of Great North Road) is 43 dBA and 53 dBA respectively.	Hoarding will have some noise attenuation and reduce line of sight to ground level properties and attenuation will also be provided by the shaft wall as the excavation deepens. With 3m hoarding, for activity with a sound power level (SWL) of 115 dBA at 6m depth of excavation, the modelled noise impact at greatest impacted receiver is 62.5-65 dB on first floor (Figure 6-1) and 67.5-70 dB on second floor (Figure 6-2). This predicted impact is around 14.5-17 dB over the noise	With 4m hoarding, for activity with SWL of 115 dBA at 6m depth, the modelled noise impact at the greatest impacted receiver is 60-62.5 dB on first floor (Figure 6-3) and 65-67.5 dB on second floor (Figure 6-4). This is a 2.5 dB benefit compared to 3m hoarding. This predicted impact is around 12-14.5 dB over the noise management level on the second floor during day time work. Noise benefits decrease as excavation goes down ie. 4m hoarding at 6m deep excavation would have similar noise	With 6m hoarding, for activity with SWL of 115 dBA at 6m depth, the modelled noise impact at the greatest impacted receiver is 60-62.5 dB on first floor (Figure 6-5) and 60-62.5 dB on second floor (Figure 6-6). This is a 2.5 dB benefit on the first floor and 7.5 dB benefit on the second floor compared to 3m hoarding and 5 dB benefit on the second floor compared to 4m hoarding. This predicted impact is around 7-9.5 dB over the noise management level on the second floor during day time work.	• 6m high hoarding will have more acoustic benefit than 3m or 4m hoarding • 4m hoarding has a 2.5 dB noise benefit compared to 3m hoarding, however, noise benefits decrease comparatively as the depth of excavation increases. • In May 2023 shaft excavation is approximately 10m below the footpath level. The benefits of 6m hoarding at this depth have decreased compared to 6m depth and will continue to decrease as the shaft deepens.

Note: In this scenario the most affected residential and commercial receiver located on Great North Road (NCA15) was considered for each option. SWL of 115 dB represents rippable excavations at a depth of 3-10m.	management level on the second floor during day time work.	attenuation as 3m hoarding at 7m excavation.	Noise benefits decrease as excavation goes down ie. 6m hoarding at 6m deep excavation would have similar noise attenuation as 3m hoarding at 9m excavation.	
Design and construction	Construction of 3m hoarding could commence with little notice and provide benefits upon installation due to the availability of materials and resources and simplicity of design. Temporary works design has been approved for construction and is considered feasible from a design perspective. The structure requires minimal incursion into the footpath and uses the traffic barrier for support which is a required hand-over item. Hoarding posts are ~50 kg and can be hand-lifted into position without impacting the nearby footpaths or roads.	Design, procurement and installation would take approximately 2 months more than for 3m high hoarding. This would delay benefits of installing hoarding. The extra height from 3 to 4m significantly increases the loading (close to double) which requires additional design and structural support including approximately double the number of posts. The posts need to be drilled into the traffic barrier. It would be very difficult to drill this many posts without hitting the structural steel within the barrier making the design unfeasible. Posts are ~80kg and would need crane lift which would require closure of footpath and road for crane lifts. The design would increase the resources, risk and duration of construction associated with the hoarding installation.	Design, procurement and installation would take approximately 2 months more than for 3m high hoarding. This would delay benefits of installing hoarding. The design challenges of 6m hoarding would be greater than those of 3m and 4m high hoarding. The feasibility of design using the concrete traffic barrier, as discussed for 4m hoarding, is further compromised for a 6m high structure. Alternative structures not using the traffic barrier as a footing would infringe on pedestrian footpaths, require additional excavations and materials. Additionally, posts would need crane lifts which would require closure of footpath and road for crane lifts and may include night works. The impacts would be greater than for 3m or 4m hoarding.	3m hoarding construction would commence earlier and be installed faster than 4m or 6m hoarding and minimise the delay of benefits from the completed hoarding. Temporary works design has been approved for 3m high hoarding and is considered feasible. 4m and 6m high hoarding would require significant additional structural support compared to 3m hoarding which makes the designs unfeasible. The construction method for installing 3m hoarding is more simple and less intrusive than 4m and 6m hoarding.

		Alternative structures such as B-class hoarding would increase interface with pedestrian footpaths and the previously installed B-class hoarding did not meet the 10-year design life requirements.		
Other considerations	Height and style are similar to other hoarding on the Sydney Metro West Project such as North Strathfield and Sydney Olympic Park. The 3m hoarding would provide a visual screen between receivers and the construction site while minimising shading.	Additional consultation would likely be required with City of Canada Bay Council due to impact to footpath and road. The 4m hoarding would provide visual screening and will result in more shading than 3m hoarding.	Additional consultation would likely be required with City of Canada Bay Council due to impact to footpath and road. 6m hoarding is likely to be more visually imposing to pedestrians and local businesses. This height will also introduce additional shading.	3m hoarding is consistent with hoarding on other construction sites. All hoarding heights will provide a visual screen between receivers and the construction site. 4m and 6m hoarding is expected to be more visually imposing for pedestrians and local businesses and introduce additional shading.

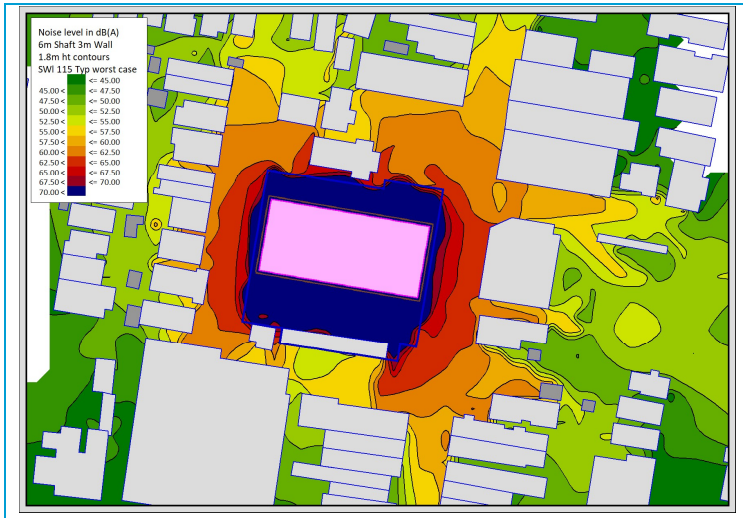


Figure 6-1 Noise contours for first storey with 3m hoarding at 6m shaft depth

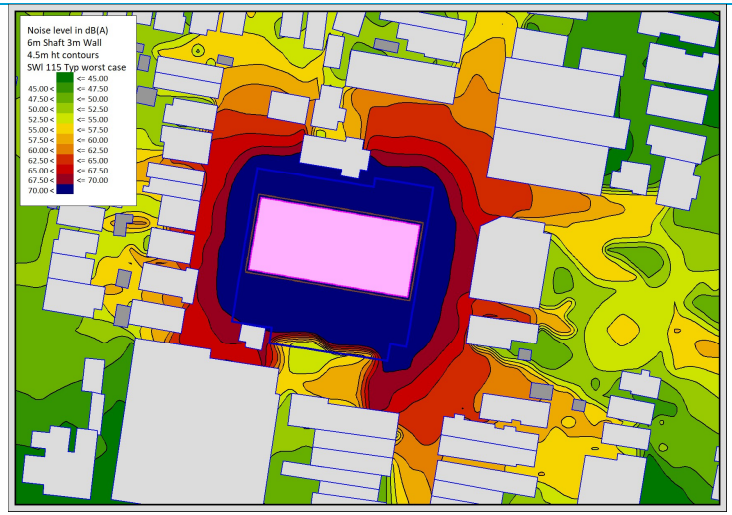


Figure 6-2 Noise contours for second storey with 3m hoarding at 6m shaft depth

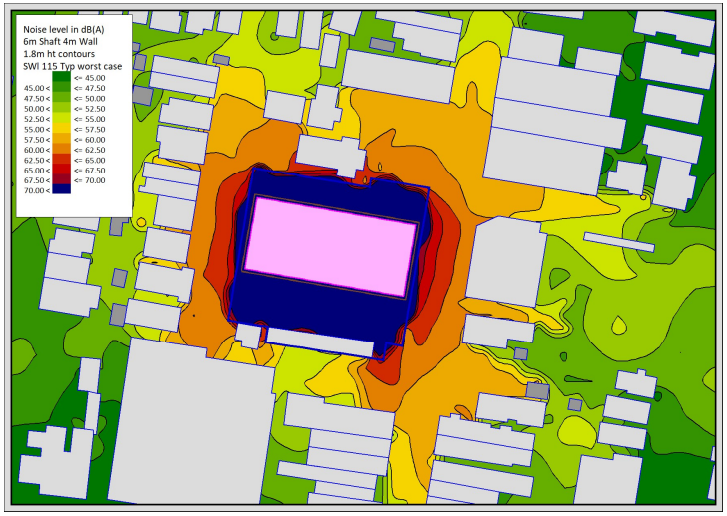


Figure 6-3 Noise contours for first storey with 4m hoarding at 6m shaft depth

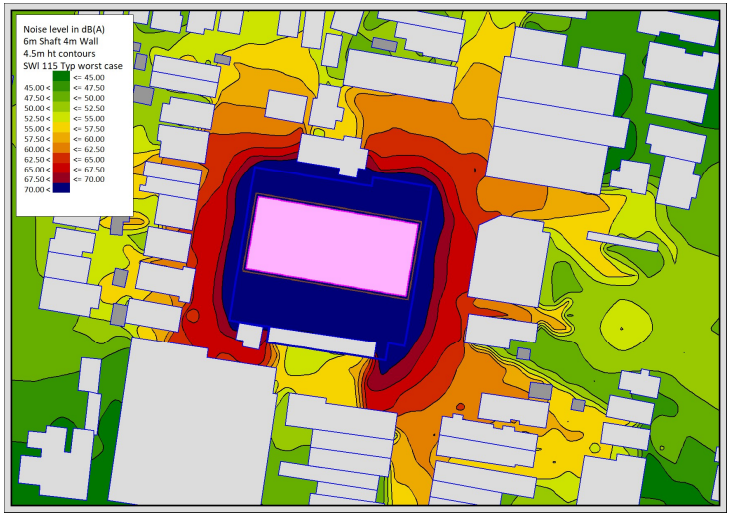


Figure 6-4 Noise contours for second storey with 4m hoarding at 6m shaft depth

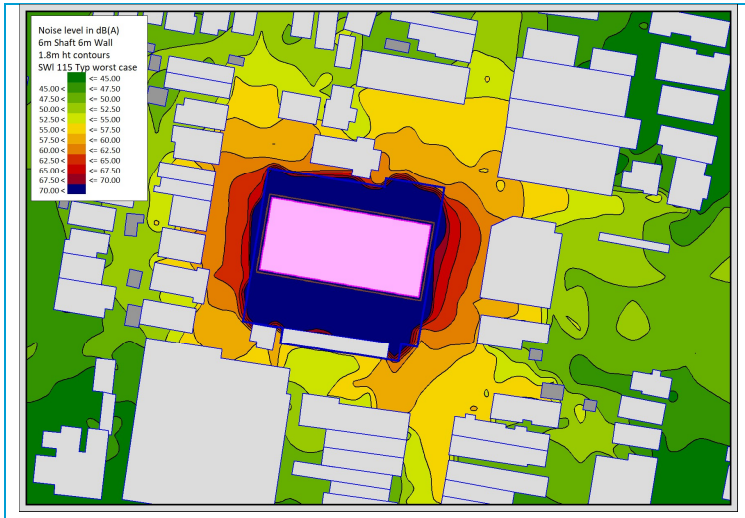


Figure 6-5 Noise contours for first storey with 6m hoarding at 6m shaft depth

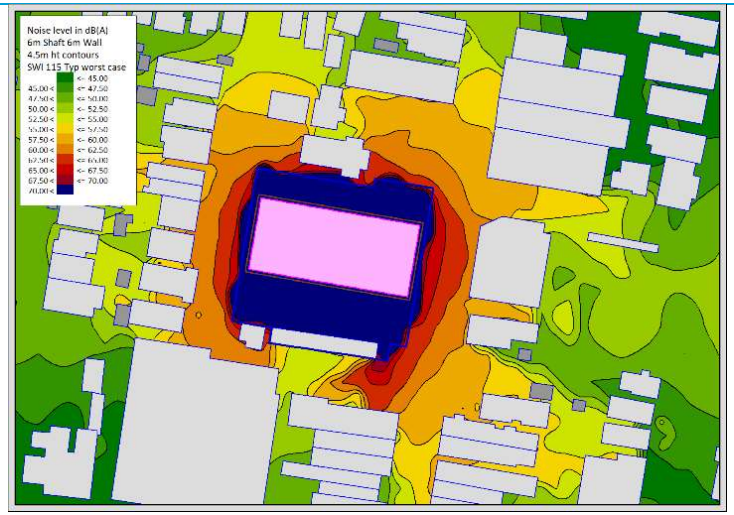


Figure 6-6 Noise contours for second storey with 6m hoarding at 6m shaft depth

In summary, the 3 metre high hoarding is considered the most feasible and reasonable mitigation measure for Five Dock western site due to reduced noise benefits of higher hoarding as the shaft deepens, timeliness of installation, the feasibility of design, simplified construction method and minimal visual impact.

Access gate options

Two construction vehicle access points are required on Great North Road, one on either side of the western shaft. These access points require openings in the perimeter hoarding (i.e. access gates). Acoustic and visual treatment at the access points have been compared to determine the most feasible and reasonable option. The four options reviewed were:

1. no additional gate or treatment (i.e. small security gates only): gates only required for safety and security with no noise attenuation. This option enables easy vehicle access as the gates would remain open during standard construction hours but does not provide any additional noise or visual attenuation
2. a fenced barrier with acoustic blankets along top of shaft with length equal to the width of the open gate: this option provides additional noise attenuation closer to the noise source (i.e. the shaft excavation) and can remain in place while vehicle access gates are required to be open. This option is easy to install and can be reused when required. This option also provides some visual screening of the shaft excavation but does not provide full visual screening of the construction site.
3. gate with mesh visual screening: this option does not provide any additional acoustic treatment however it does provide an additional visual barrier when the gates would be closed. However, given the vehicle movements required at the site, there would be a large portion of the day where the gates are required to be

opened (which would limit these benefits). The gradient of both access points would make the movement of gates difficult and a potential safety concern, and may require additional traffic control. The mesh would reduce risks associated with wind loading.

4. gate with acoustic treatment: this option does provide additional acoustic treatment and additional visual barrier when the gates would be closed. However, given the vehicle movements required at the site, there would be a large portion of the day where the gates are required to be opened (which would limit these benefits). The gradient of both access points would make the movement of gates difficult and a potential safety concern, and may require additional traffic control. The risks associated with wind loading would have to be factored into the design with additional steel footings required.

Option 2 is the most feasible and reasonable mitigation measure for noise and visual amenity. This is due to it providing the most consistent attenuation; simple and safe design, construction and operation requirements; and efficiency of traffic movements. Gates would be closed outside construction hours for security and visual screening.

The noise and vibration assessment in Table 10-1 assessed the site with 3 metre perimeter hoarding with openings at the access points. The noise blankets were not included in the noise models so the assessment can be assumed as worst-case scenario.

Implications of installing an acoustic shed

Installation and removal of an acoustic shed could increase surface works construction by up to 6 months at the western construction site. Any delay in shaft excavation to install the shed at the western site could have potential wider impacts to the tunnel boring machine programme. The extended duration of surface construction would prolong the communities' exposure to potential noise, vibration, dust and traffic impacts. It could also introduce additional night works for demobilisation of the shed and vibration impacts from compaction of crane pads. The following section outlines the potential impacts of installing an acoustic shed at Five Dock western site.

If the shed was installed, the on-site duration of shed construction is anticipated to be 4 months, given the restricted nature of the site, and the difficulties encountered with installing the large sections of panelling, which are highly sensitive to wind events. During the period of constructing the shed, shaft excavations would not be able to occur. Demobilisation of the shed after shaft excavation would take approximately 2 months.

The construction and demobilisation of the shed would involve cranes lifting steel components and personnel working from elevated work platforms (EWP's) with pneumatic rattle guns to tension the fasteners between structural members. These activities will occur in close proximity of the pedestrian footpaths and would require frequent closures for safety of the public. Closures would involve pedestrian diversions for multiple days.

Installation and demobilisation of an acoustic shed would require significant heavy vehicle movements for delivering and removing materials. Deliveries of shed materials, and also a significant portion of the construction of the shed would need to be undertaken at night, considering Great North Road closures for cranage, and oversized deliveries only permitted outside standard construction hours.

Construction of crane pads to create a level platform for cranes would require continual use of vibratory rollers for compaction and would last for an estimated 4 weeks, involving the delivery of material, placement, spreading, vibratory compaction in layers and testing. This would occur throughout the day. This activity is predicted to exceed human comfort vibration levels at around 106 properties (Table 6-3).

These crane pads would be removed after the shed is installed which would take approximately 4 weeks.

Crane pad construction and removal would require trucks to import and export material, thus increasing the number of movements beyond the numbers anticipated for shaft and cavern excavated material.

Several noise scenarios have been modelled using a project-specific noise prediction tool, KNOWnoise, and Table 6-3 provides indicative noise and vibration impacts associated with shed construction and demobilisation. These assessments for standard construction hours predict that up to 142 properties could be impacted by noise above

NML during crane pad construction for a duration of approximately 4 weeks and 74 properties impacted for approximately 3 months by shed installation. It is predicted that up to 159 properties would be impacted above NML for night work where road closures are required. Some of the properties identified as receivers contain multiple units so the actual number of receivers will be higher than shown in the noise model and Table 6-3. The full assessments are provided in Appendix B.

Table 6-3: Noise scenarios for acoustic shed installation and removal

				Impact (no. receivers)*							
Activity	**Indicative Duration**	**Time period**	**Maximum cumulative predicted LAeq, 15 minute noise level (dBA)**	**>75 dB**	**0-10 above NML**	**10-20 above NML**	**20-30 above NML**	**>30 above NML**	**Potential sleep disturbance**	**Human Comfort vibration**	**Cosmetic Damage vibration**
Crane pads construction with vibratory roller	4 weeks	Day	82	4	108	27	7	0	N/A	106	3
Crane pads removal	4 weeks	Day	81	4	99	27	5	0	N/A	0	0
Install/remove shed frame and cladding	3 months	Day	86	5	43	25	5	1	N/A	0	0
Night work using crane where road closure is required	Multiple nights	Night	70	0	117	35	7	0	96	0	0
Night deliveries of materials	Multiple nights	Night	69	0	100	28	8	0	94	0	0

*number of receivers may not accurately consider the number of units within a building

Installation of the shed would be for a limited period of time because it is a temporary works item and would need to be removed by the end of 2024. Given the site constraints, it cannot be handed over to the station contractor because it interferes with the station construction scope. Any benefits of the completed acoustic shed would therefore be short-medium term. In summary:

- construction and demobilisation of the shed would result in up to approximately six months of additional surface work.
- noise and vibration impacts would be experienced by around 100 receivers during the work associated with shed installation
- additional out of hours work and deliveries would be required for installation and demobilisation of the shed given the road closures required for crane access
- the shed would attenuate some noise and dust during certain stages of these activities, however, several activities would be difficult to mitigate, other than providing respite. For example, vibration from vibratory roller compaction and use of rattle guns to install and remove shed structure and panels above the hoarding height
- eliminating installation of an acoustic shed allows early commencement of the shaft excavation in the Five Dock western construction site and reduces approximately 6 months of surface work associated with this activity.

Overview of justification

In summary, given 24/7 excavation is no longer proposed at the western construction site, an acoustic shed is no longer considered the feasible and reasonable mitigation. An assessment of alternate noise mitigation options to reduce daytime noise impacts has been undertaken, considering acoustic mitigation, duration of acoustic mitigation

associated with an increasing shaft depth, and constructability. A three metre hoarding is considered the most feasible and reasonable mitigation for the site. In addition, the installation of an acoustic shed would result in additional noise and vibration impacts including an approximate six months of surface works required at the site with disruptions to the local community associated with footpath and road closures, and out of hours work required to install the large structure. Constructing an acoustic shed could therefore extend the period of excavation and exacerbate construction noise. As discussed in the impact assessment below, no additional visual or air quality impact are anticipated and any impacts can be managed through standard mitigation.

7. Environmental Benefit

Omission of the acoustic shed reduces the surface works required by approximately 6 months at Five Dock western site. This provides benefits to the community by reducing overall duration of exposure to potential noise, vibration, dust and traffic impacts.

Elimination of out of hours work at the western construction site for surface works will benefit the local community by reduced noise, vibration, construction vehicles and light spill impact at night and on Sundays.

Not constructing the acoustic shed results in less resource consumption and waste being generated during construction and demobilisation. This will also reduce truck movements during shed construction and demobilisation.

Elimination of the acoustic shed, which would have been up to 23m high, will have some visual benefits and eliminate risk of additional shading in neighbouring properties.

8. Control Measures

Will a project and site specific EMP be prepared?	☐ Yes ☒ No	Are appropriate control measures already identified in an existing EMP?	☒ Yes ☐ No

9. Conditions of approval

Will the proposal be consistent with the conditions of approval?	☒ Yes ☐ No

The most relevant conditions of approval to this proposed change are provided in the following table. No changes to the conditions of approval are required as a result of the proposed change.

Ref. no.	Condition description
D35	Work must only be undertaken during the following hours: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; (b) 8:00am to 6:00pm Saturdays; and (c) at no time on Sundays or public holidays.
D36	Except as permitted by an EPL, highly noise intensive work that results in an exceedance of the applicable NML at the same receiver must only be undertaken: (a) between the hours of 8:00 am to 6:00 pm Monday to Friday; (b) between the hours of 8:00 am to 1:00 pm Saturday; and (c) if continuously, then not exceeding three (3) hours, with a minimum cessation of work of not less than one (1) hour. For the purposes of this condition, 'continuously' includes any period during which there is less than one (1) hour between ceasing and recommencing any of the work.
D37	Notwithstanding Conditions D35 and D36 of this schedule work may be undertaken outside the hours specified in the following circumstances: (a) Safety and Emergencies, including: (i) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or (ii) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm. On becoming aware of the need for emergency work in accordance with (a)(ii) above, the AA, the ER, the Planning Secretary and the EPA must be notified of the reasons for such work. The Proponent must use best endeavours to notify as soon as practicable all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work. (b) Low Noise Impact Work, including: (i) construction that causes LAeq(15 minute) noise levels: · no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, and · no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); and (ii) construction that causes LAFmax(15 minute) noise levels no more than 15 dB(A) above the rating background level at any residence; or (iii) construction that causes: · continuous or impulsive vibration values, measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), or

	· intermittent vibration values measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006). (c) By Approval, including: (i) where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or (ii) works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol as required by Condition D38 of this schedule; or (iii) negotiated agreements with directly affected residents and sensitive land user(s). (d) By Prescribed Activity, including: (i) tunnelling (excluding cut and cover tunnelling and surface works) are permitted 24 hours a day, seven days a week; or (ii) concrete batching at the Clyde construction site is permitted 24 hours a day, seven days a week; or (iii) delivery of material that is required to be delivered outside of standard construction hours in Condition D35 of this schedule to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to / from the Five Dock and Westmead construction sites and to / from Burwood North construction site using any roads / streets other than directly from Parramatta Road; or (iv) haulage of spoil except between the hours of 10:00 pm and 7:00 am to / from the Five Dock and Westmead construction sites and to / from Burwood North construction site using any roads / streets other than directly from Parramatta Road; or (v) work within an acoustic shed where there is no exceedance of noise levels under Low Noise Impact Work, circumstances identified in (b) above, unless otherwise agreed by the Planning Secretary. Note: Tunnelling does not include station box excavation.
D39	All reasonable and feasible mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration criteria: (a) construction 'Noise affected' noise management levels established using the Interim Construction Noise Guideline (DECC, 2009); (b) vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure); (c) Australian Standard AS 2187.2 - 2006 "Explosives - Storage and Use - Use of Explosives" (for human exposure); (d) BS 7385 Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2" as they are "applicable to Australian conditions"; and (e) the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage for structurally unsound heritage items). Any work identified as exceeding the noise management levels and / or vibration criteria must be managed in accordance with the Noise and Vibration CEMP Sub-plan. Note: The ICNG identifies 'particularly annoying' activities that require the addition of 5 dB(A) to the predicted level before comparing to the construction Noise Management Level.

10. Impact Assessment – Construction

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Flora and fauna	No change from approved project	No additional measures	Y	Y	
Water	No change from approved project. Surface water runoff will be managed as per the progressive erosion and sediment control plan. Runoff will be pumped to the water treatment plant at the Five Dock eastern construction site.	No additional measures	Y	Y	
Soils and contamination	No change from approved project	No additional measures	Y	Y	
Air quality	Unmitigated dust impacts for Five Dock were assessed in Table 23-10 of EIS Chapter 23 Air Quality. The EIS determined that the large extent of excavation and earthworks combined with the close proximity of sensitive receivers results in the Five Dock Station construction site being assessed as having a 'high risk' rating (unmitigated) for earthworks and track-out activities. The EIS assessed that potential dust impact would be temporary in nature and would be substantially reduced with the implementation of standard mitigation measures identified in EIS Section 23.7. The measures identified in EIS Section 23.7 will be implemented at Five Dock for the duration of works. Omission of the acoustic shed is not expected to change the nature and extent of air	Dust impacts will be managed as per the Air Quality Management Plan including dust suppression such as sprinklers. No additional measures are required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	quality impact as assessed in the EIS when air quality mitigation measures are implemented. Potential additional dust impacts will be effectively managed through mitigation measures outlined in the EIS and Air Quality Management Plan. These measures are currently being implemented at Five Dock. For example, a water sprinkler/spray system used during excavations to suppress dust.				
Noise and vibration	**Sensitive receivers** Types of nearby sensitive receivers for noise and vibration include residential, childcare, commercial, public space and place of worship. The nearest receiver is 171 Great North Road (St Albans Church) which is within 3 metres of the site boundary and 12 metres from the edge of the western shaft. The nearest residential receivers are houses on East Street, approximately 17 metres from the site boundary. **Detailed noise and vibration impact statement** A detailed noise and vibration impact statement (DNVIS) has been prepared for Five Dock eastern and western sites as required by condition of approval D43 and D44 (Hutchison Weller, May 2023) (Appendix A). The DNVIS is prepared in accordance with Sydney Metro Construction Noise and Vibration Standard v4.3 (CNVS) and the Noise and Vibration Management Plan (NVMP). The DNVIS includes an assessment of the proposed activities at the Five Dock western site without an acoustic shed installed. **Working hours**	- Shaft excavations and spoil handling will not be undertaken out of the standard construction hours at Five Dock western construction site. - Tunnelling and support activities at Five Dock western construction site outside the hours in condition of approval D35 will be managed to be meet the low noise impact work criteria for airborne noise. - Monitoring will be undertaken to verify noise levels and additional mitigation measures may be implemented. - 3 metre hoarding will be installed to mitigate noise and visual impacts from construction activities.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	Shaft excavations and spoil handling will no longer be required to be undertaken out of hours at Five Dock western construction site. No work will be undertaken outside standard construction hours at the Five Dock western site unless it complies with the Project EPL 21610 and condition of approval D37. Examples of out of hours work that may be required include oversized deliveries (D37ai), emergency works (D37aii) and low noise impact works (D37bi). Tunnelling activities (D37di) including cavern excavation from the western shaft would generally be undertaken during standard construction hours only. No out of hours tunnelling including supporting activities would be undertaken from the western shaft unless the work meets the low noise impact work criteria for airborne noise. Impacts of any activities outside the standard construction hours would be assessed on a case-by-case basis as per the out of hours work process outlined in the NVMP. **Night work assessment in the EIS** The EIS for the approved project considered that excavation would be completed within acoustic sheds or below acoustic panels (or other acoustic measures) at sites where 24/7 excavation works are proposed including at the Five Dock construction sites. The EIS identified that at sites where no regular out of hours works were proposed and excavation works were proposed to be undertaken during the daytime only (such as North Strathfield), acoustic sheds or panels were not identified as a feasible or reasonable mitigation measure.				

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	Table 73 of EIS Technical Paper 2 – Noise and Vibration shows that at both Five Dock western and eastern sites, which were predicted to require 24/7 excavation, noise levels at night during excavation with acoustic sheds were predicted to impact up to: • 375 receivers 1-10 dBA above NML, • 88 receivers 11-20 dBA above NML; and • 17 receivers >20 dB NML. While these numbers are not split between east and west, EIS Technical Paper 2 Figure 67 shows impact to receivers at both sites. Therefore, for the EIS scenario an acoustic shed was considered an appropriate mitigation measure to manage noise impacts of work outside standard construction hours, however, noise impacts were still anticipated with an acoustic shed. Condition of approval D37 has placed restrictions on work within an acoustic shed and outside the standard construction hours to limit these to those that meet the low noise impact criteria for airborne noise. The proposed change includes that no shaft excavation would be undertaken outside of standard construction hours at the western shaft and no out of hours tunnelling including supporting activities would be undertaken from the western shaft unless the work meets the low noise impact work criteria for airborne noise. **Shaft excavations during standard construction hours** During the site establishment and initial excavation phases, the work undertaken at Five				

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	Dock western construction site was consistent with EIS and was only undertaken during standard construction hours. As discussed in Section 2 - Description, an opportunity has been identified to improve the sequence of work at the Five Dock western site to eliminate the requirement for general out of hours excavation of the western shaft. Excavating the shaft at Five Dock western site during standard construction hours will eliminate impact from this activity during the evening and night periods. As no regular out of hours excavation works are proposed, acoustic sheds or panels are no longer identified as a feasible and reasonable mitigation measure. Feasible and reasonable mitigation measures will be implemented for shaft excavations during standard construction hours (refer to Section 6). A detailed noise and vibration impact assessment has been prepared to assess the noise and vibration impacts using the preferred feasible and reasonable noise mitigation for the proposed change. This includes: • elimination of general out of hours work for shaft excavations and spoil management • installation of 3m hoarding around the site boundary • avoidance of high noise impact works when reasonably practicable, with respite provided as per condition of approval D36 • community notifications and consultation				

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	• verification of the noise model by undertaking noise monitoring This detailed noise and vibration technical assessment contains a more refined assessment of the predicted noise and vibration levels when compared to the more conservative assumptions in the EIS (refer to DNVIS in Appendix A for the assessment). The EIS for the approved project predicted the following daytime noise impacts for use of rockbreaker which considered the worst-case noise impact scenario (Technical Paper 2 Table 73). The DNVIS assessed the daytime noise impacts without an acoustic shed but with alternate feasible and reasonable mitigation during standard construction hours. An assessment of the worst-case noise impacts during the daytime has been completed, comparing the predicted impacts from the DNVIS to the EIS from the approved project. **Highly noise affected receivers** As identified in the DNVIS, approximately 31 receivers would be highly noise impacted (>75 dB(A)) during shaft excavation of non-rippable materials using a rockbreaker as a result of the proposed change. In comparison, the EIS predicted: ○ approximately 33 receivers would be highly noise affected during enabling works using a rockbreaker, and 26 receivers would be highly noise affected during initial excavations using a				

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	rockbreaker (both without an acoustic shed in place) ○ approximately 1 receiver would be highly noise affected during main excavation work using a rockbreaker which was modelled with an acoustic shed in place The number of highly noise impacted receivers is generally consistent with the EIS scenario for the use of rockbreakers at the site without an acoustic shed, however is greater than the scenario with an acoustic shed in place (refer to Table 10-1). Impacts associated with the use of rockbreakers without an acoustic shed would be experienced for a longer duration (i.e. an additional 3 months without an acoustic shed) than anticipated in the EIS for the approved project. **Exceedances of the noise management level (NMLs)** As identified in the DNVIS, approximately 252 receivers would experience an exceedance of the NML by 1-10dB, 91 receivers would experience an exceedance of the NML by 10-20dB, and 33 receivers would experience an exceedance of the NML by >20dB during shaft excavation of non-rippable materials using a rockbreaker without an acoustic shed. In comparison, the EIS predicted: • Approximately 543 receivers would experience an exceedance of the NML by 1-10dB, 115 receivers would experience an exceedance of the NML by 10-20dB, and 33 receivers would experience an exceedance of the NML by				

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	>20dB during initial excavations using a rockbreaker (without an acoustic shed in place) • Approximately 81 receivers would experience an exceedance of the NML by 1-10dB, 15 receivers would experience an exceedance of the NML by 10-20dB, and 2 receivers would experience an exceedance of the NML by >20dB during main excavations using a rockbreaker which was modelled with an acoustic shed in place The total number of impacted receivers is generally consistent with the EIS scenario for the use of rockbreakers at the site without an acoustic shed, however, is greater than the scenario with an acoustic shed in place (refer to Table 10-1). Impacts associated with the use of rockbreakers without an acoustic shed would be experienced for a longer duration (i.e. an additional 3 months without an acoustic shed) than anticipated in the EIS for the approved project. As the shaft deepens during excavation the predicted noise levels decrease at nearby sensitive receivers. For example, the comparative conservative assessment shown in Section 6 demonstrates that the reduction in predicted noise levels with 4m hoarding at the nearest residential receiver is approximately 2.5 dB from 6 metre to 9 metre excavation depths. In summary, the DNVIS assessment is generally consistent with predicted noise impacts for affected receivers associated with excavation works without an acoustic shed identified in the EIS. The number of impacted receivers during				

<table>
<tr><th>Aspect</th><th>Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project</th><th>Proposed Control Measures in addition to project CoA and REMMs</th><th>Minimal Impact Y/N</th><th colspan="2">Endorsed</th></tr>
<tr><th></th><th></th><th></th><th></th><th>Y/N</th><th>Comments</th></tr>
<tr><td></td><td>shaft excavations would decrease if the construction methodology was to progress with the installation of a shed. With the omission of the shed, sensitive receivers would be exposed to higher noise levels from non-rippable excavations for approximately 3 months, however, the installation and removal of a shed would prolong other surface work noise impacts by up to approximately 6 months as discussed in Section 6. The shed would have noise benefits for activities besides non-rippable excavations but the noise levels are lower for those activities. Given the extended duration of worst-case day time noise impacts, additional feasible and reasonable mitigation would be required to manage this impact (refer Section 6). These activities represent worst case scenario and appropriate respite, as per D36, will be implemented during these activities.
Table 10-1 Comparison of noise impact during non-rippable excavations
<table>
<tr><td rowspan="3">Standard Daytime NML exceedance (dB)</td><td colspan="3">Activity: excavation non-rippable with rock breaker (worst case scenario)</td></tr>
<tr><td colspan="3">Number of receivers</td></tr>
<tr><td>EIS East + West no shed</td><td>EIS East + West with shed</td><td>DNVIS West no shed</td></tr>
<tr><td>>75 dB*</td><td>26</td><td>1</td><td>31</td></tr>
</table>
</td><td></td><td></td><td></td><td></td></tr>
</table>

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments

0-10	543	81	252
10-20	115	15	91
20+	33	2	33

**Highly noise affected*

Tunnelling including cavern excavation

This consistency assessment applies to tunnelling (including cavern excavation) from the western shaft. No out of hours tunnelling would be undertaken from the western shaft unless the work meets the low noise impact work criteria for airborne noise.

The DNVIS has predicted that cavern excavation at the western site is not predicted to result in any highly noise affected receivers without an acoustic shed in place during standard construction hours as a result of the proposed change. Cavern excavation during standard construction hours is not predicted to exceed the airborne NML at the western construction site as a result of the proposed change. The EIS predicted 3 receivers would be impacted with an acoustic shed with the doors closed, however this was anticipated to increase to 29 with the doors open. The predictions in the DNVIS for daytime noise impacts during cavern excavation are therefore consistent with those identified in the EIS for the approved project. By limiting the cavern excavation at the western site to standard construction hours only, up to 40 receivers would

<table>
<tr><th rowspan="2">Aspect</th><th rowspan="2">Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project</th><th rowspan="2">Proposed Control Measures in addition to project CoA and REMMs</th><th rowspan="2">Minimal Impact Y/N</th><th colspan="2">Endorsed</th></tr>
<tr><th>Y/N</th><th>Comments</th></tr>
<tr><td></td><td>no longer experience an exceedance of the airborne NML during night time work for this activity as identified in the EIS. Any out of hours cavern excavation and associated tunnel support activities must be undertaken from the eastern shaft with an acoustic shed in place, unless the work is determined to be low noise impact work for airborne noise. Refer to the following table for a comparison of noise impact from cavern excavations during standard construction hours.
Table 10-2 Comparison of noise impact during cavern excavations
<table>
<tr><td rowspan="2">Standard Daytime NML exceedance (dB)</td><td colspan="3">Activity: cavern excavation</td></tr>
<tr><td colspan="3">Number of receivers</td></tr>
<tr><td></td><td>EIS East + West shed doors open</td><td>EIS East + West shed doors closed</td><td>DNVIS West no shed</td></tr>
<tr><td>>75 dB*</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0-10</td><td>25</td><td>3</td><td>0</td></tr>
<tr><td>10-20</td><td>4</td><td>0</td><td>0</td></tr>
<tr><td>20+</td><td>0</td><td>0</td><td>0</td></tr>
</table>
Highly noise affected

In summary, the DNVIS assessment for cavern excavations without an acoustic shed at Five Dock</td><td></td><td></td><td></td><td></td></tr>
</table>

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	western site is generally consistent with predicted noise impacts identified in the EIS with an acoustic shed. Tunnelling and support activities at Five Dock western construction site outside the hours in condition of approval D35 must be managed to meet the low noise impact work criteria for airborne noise. **Vibration** The proposed change is not anticipated to result in any additional vibration impacts to those identified in the EIS for the approved project. The DNVIS identifies one property within the safe working distance for cosmetic damage during excavations at the western site. The same property was identified in the EIS (section 11.13.2) as exceeding the cosmetic damage screening criteria. This impact would be managed in accordance with the Noise and Vibration Management Plan. **Summary** Overall, reducing the requirement for out of hours work for shaft excavation would reduce noise and vibration impacts outside of standard hours. Whilst noise impacts during the day would be greater for a longer duration than if an acoustic shed was in place, noise impacts can be managed with the implementation of feasible and reasonable mitigation measures. Not installing a shed also reduces additional surface construction work required which is anticipated to take up to six months. As a result of the proposed change, shaft				

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	excavation would only be required to be undertaken during standard construction hours and excavation of the cavern would be limited to standard construction hours only unless the low noise impact work criteria for airborne noise are met.				
Aboriginal heritage	No change from approved project	No additional measures	Y	Y	
Non-Aboriginal heritage	No change from approved project	No additional measures	Y	Y	
Community and socio-economic	The following stakeholders may be temporarily impacted by the proposed change: • City of Canada Bay Council (impact on residents and businesses) • Residents along Great North Road, East Street and Pendium Apartments on Garfield Street • St Albans Church on the northern boundary of the site • Businesses on Great North Road and Fred Kelly Place • Sunshine Early Learning Centre • Five Dock Chamber of Commerce Local stakeholders may be concerned about potential increased noise and dust impacts without the acoustic shed in place. Refer to the noise and vibration and air quality aspects of this table for details. It should be noted there will be some benefits associated with the change of approach. These benefits include: no surface or shaft excavation	Management measures will include: • Briefings for City of Canada Bay Council • Notification distributed to all residents and businesses within 500m and sent to email distribution list • Construction update briefings for relevant local organisations such as Five Dock Chamber of Commerce • Doorknock residents and businesses adjacent to the western site • Community information sessions in Fred Kelly Place • Respond to stakeholder enquiries as they are received	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	work on the western site after 6pm; no truck haulage from the site after 6pm; reduced visual impacts without the 23 metre tall shed on site; and no construction impacts, including night works, associated with installation and removal of the shed which would extend surface works by approximately six months. The revised construction program, potential impacts and mitigation measures will be clearly communicated to local residents and businesses through written information and in person during briefings and information sessions. Potential impacts associated with noise and air quality will be addressed with feasible and reasonable mitigation measures as per the Noise and Vibration Management Plan and Air Quality Management Plan. Access to properties will not be altered. Overall, the impact to community and stakeholders is considered to be broadly consistent with that assessed in the Stage 1 EIS.				
Traffic and transport	No heavy vehicle movements are proposed outside standard construction hours for haulage at Five Dock western site. Traffic numbers will be as per the approved CTMP and are not expected to increase as a result of this proposal. The proposed haul routes are consistent with Figure 10-44 of the EIS Chapter 10. As per condition of approval D37 (d), delivery of materials and spoil haulage to / from Five Dock will not be undertaken between the hours of 10:00	No haulage would be undertaken outside standard construction hours at the western site	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	pm and 7:00 am. The exception is oversized deliveries permitted under D37 (a) for safety and security requirements. No changes to light vehicle volumes are proposed. No additional impacts are anticipated for the active transport network or public transport services.				
Waste and resource management	The proposed change would result in less waste being generated by eliminating the construction and demobilisation of an acoustic shed.	No additional measures	Y	Y	
Visual	Landscape character and visual amenity impacts were assessed in Chapter 15 of the Stage 1 EIS. Work at Five Dock was assessed as having minor to moderate adverse impacts to landscape character and visual amenity. A visual amenity assessment memo was prepared to assess potential impacts and provide recommendations for the construction sites. At the Five Dock western construction site the acoustic shed was identified as having a potential visual impact. Removal of the shed at the western site will reduce this risk and the hoarding or other measures can be installed to adopt the recommendations of the memo. An acoustic shed would introduce potential additional shading effects to directly adjacent properties. The following diagram is the potential shadowing impact of a 20m shed in June at 10am. Note, the shed, if constructed would be approximately 22m	3m hoarding will be installed around the perimeter of the site. No additional measures are required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	and cause more shading than predicted in the model.  Not installing the shed eliminates the potential shading impact on East Street residential properties, child care centre and Fred Kelly Place as predicted in the diagram. Overall, the landscape character and visual impacts (without the shed) are considered to be broadly consistent with that assessed in the EIS.				
Land use and property	No change from approved project	No additional measures	Y	Y	
Hazard and risk	No change from approved project	No additional measures	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Other	No change from approved project	No additional measures	Y	Y	

11. Impact Assessment – Operation

Stage 1 of the planning application for Sydney Metro West (subject of this Consistency Assessment) is for major civil construction work for Sydney Metro West between Westmead and The Bays. Measures to avoid or minimise impacts have been developed only for major civil construction work for Sydney Metro West between Westmead and The Bays– which involves construction only. Impacts applicable to the operational aspects of Sydney Metro West including operation stage environmental mitigation measures are subject to the Sydney Metro West - Rail infrastructure, stations, precincts and operations (Stage 3) planning approval. As the proposed change relates to a change in construction methodology only, operational impacts associated with the proposed change are not anticipated.

Aspect	Nature and extent of impacts (negative and positive) during operation (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Flora and fauna	No change from the approved project.	No additional measures	Y	Y	
Water	No change from the approved project.	No additional measures	Y	Y	
Soils and contamination	No change from the approved project.	No additional measures	Y	Y	
Air quality	No change from the approved project.	No additional measures	Y	Y	
Noise and vibration	No change from the approved project.	No additional measures	Y	Y	
Aboriginal heritage	No change from the approved project.	No additional measures	Y	Y	
Non-Aboriginal heritage	No change from the approved project.	No additional measures	Y	Y	
Community and socio-economic	No change from the approved project.	No additional measures	Y	Y	
Traffic and transport	No change from the approved project.	No additional measures	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during operation (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Waste and resource management	No change from the approved project.	No additional measures	Y	Y	
Visual and urban design	No change from the approved project.	No additional measures	Y	Y	
Land use and property	No change from the approved project.	No additional measures	Y	Y	
Hazard and risk	No change from the approved project.	No additional measures	Y	Y	
Other	No change from the approved project.	No additional measures	Y	Y	

12. Consistency with the Approved Project

Question	Consider the following:
Is the project (including the proposed changes) consistent with the conditions of approval?	Yes. The proposed works would be consistent with the conditions of approval.
Is the project (including the proposed changes) consistent with the objectives and functions of elements of the Approved Project?	Yes. The changes identified in this assessment are consistent with the objectives and functions of the elements of the approved project.
Are the environmental impacts of the proposed change consistent with the impacts of the approved project?	Yes. The proposed works would result in some minor changes to the impacts as assessed in the EIS and Submission Report for the Approved Project, however, the level of impact would remain consistent. Potential impacts to receivers would be adequately addressed through the application of the mitigation measures provided in the EIS, Submissions Report and conditions of approval. The proposed change includes that no shaft excavation would be undertaken outside of standard construction hours at the western shaft and no out of hours tunnelling including supporting activities would be undertaken from the western shaft unless the work meets the low noise impact work criteria for airborne noise. As such, alternate feasible and reasonable mitigation to an acoustic shed has been selected to mitigate the day time noise impacts.
Are there any new environmental impacts as a result of the proposed works/project changes?	The proposed works would not result in any new environmental impacts beyond those considered in the Approved Project. The proposed changes would be negligible or minor environmental impacts relative to the impact of the Approved Project. All impacts identified for the proposed change would be adequately mitigated through the application of the mitigation measures provided in the EIS, Submissions Report and conditions of approval.
Are the impacts of the proposed activity/works known and understood?	Yes. The impacts of the proposed works are understood and will be accounted for by implementing the control measures within the CEMP and sub-plans.
Are the impacts of the proposed activity/works able to be managed so as not to have an adverse impact?	Yes. The impacts of the proposed works can be managed so as to avoid an adverse impact. This includes routine monitoring and ongoing community consultation in accordance with the Sydney Metro Overarching Community Communications Strategy to manage any potential noise impacts.
Is the proposed change/s consistent with the approval (having regard to the above assessment)?	☒ Yes ☐ No

13. Other Environmental Approvals

Identify all other approvals required for the proposed works:	Nil. No additional environmental approvals are required.

14. Recommendation

Based on the above impact assessment, and with reference to the Sydney Metro West – Concept and Stage 1 (major civil construction between Westmead and The Bays) Environmental Impact Statement, including the conditions of approval, it is recommended that:

	Tick relevant box
The proposed change has negligible or more than negligible impacts on the environment or community however is consistent with the Approval , including the conditions of approval. The proposed impacts are consistent with those assessed for the Approved Project (i.e., does not trigger a change to the conditions of approval).	✓
The proposed change is not consistent with the Approved Project including the conditions of approval and would be subject to a separate modification application.	
The proposed change is not substantially the same as the Approved Project and is considered a radical transformation. A new planning pathway should be considered.	

Author certification

I certify that to the best of my knowledge this Consistency Checklist: • Examines and takes into account the fullest extent possible all matters affecting or likely to affect the environment as a result of activities associated with the proposed change; and • Examines the consistency of the proposed change with the Approved Project; is accurate in all material respects and does not omit any material information.			
Name:	Sarah Grobler	Signature:	
Title:	Environmental Manager		
Company:	AFJV	Date:	19/06/2023

Assessment Supporting Signature

Application supported and submitted by			
Name:	Yvette Buchli	Date:	20/06/2023
Title:	Director Planning Approvals	Comments:	
Signature:			

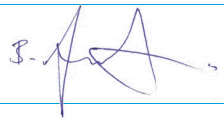
Assessment Endorsement

Based on the above assessment, are the impacts and scope of the proposed change consistent with the existing Approved Project?

Yes ☒ The proposed change is consistent with the Approved Project and no further assessment is required.

No ☐ The proposed change is not consistent with the Approved Project.

A modification or a new activity approval/ consent is required. Advise Senior Project Manager of appropriate alternative planning approvals pathway to be undertaken.

Endorsed by			
Name:	Ben Armstrong	Date:	20 June 2023
Title:	Director Environment, Sustainability & Planning, West	Comments:	
Signature:			

Appendix A – Five Dock Detailed Noise and Vibration Impact Statement

hutchison weller

Acciona Ferrovial Joint Venture
Sydney Metro West Central Tunnelling Package
Five Dock

Detailed noise and vibration impact statement
June 2023

Doc no. 21028-NV-RP-3-8

Detailed noise and vibration impact statement

Client	Acciona Ferrovial Joint Venture
Project	Sydney Metro West Central Tunnelling Package
Document no.	21028-NV-RP-3-8
Revision	Rev
Date	2 June 2023
Author	John Hutchison
Reviewer	Scott Hughes
Doc Number	21028-NV-RP-3-8 SMW CTP Five Dock DNVIS TRK.docx

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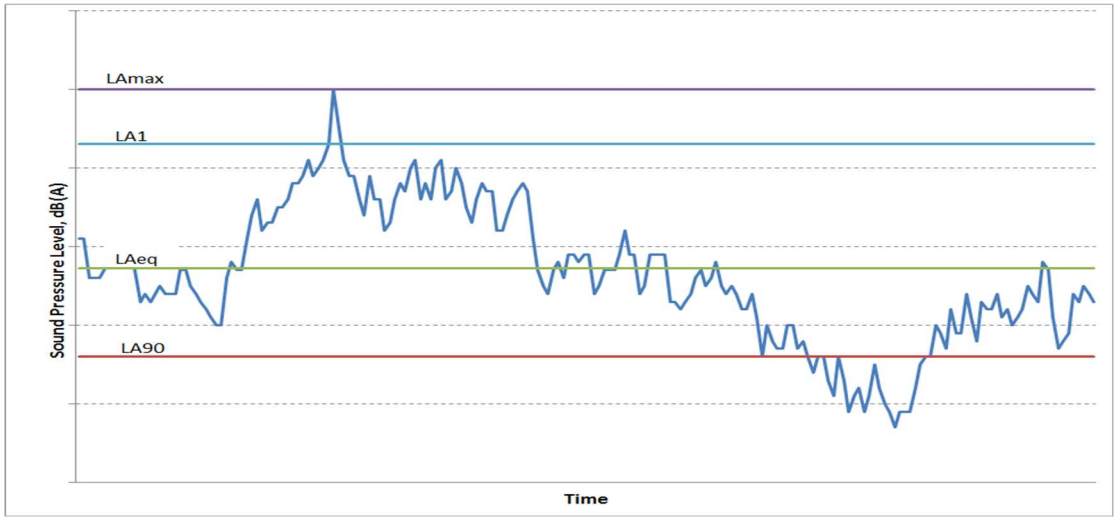
Revision history

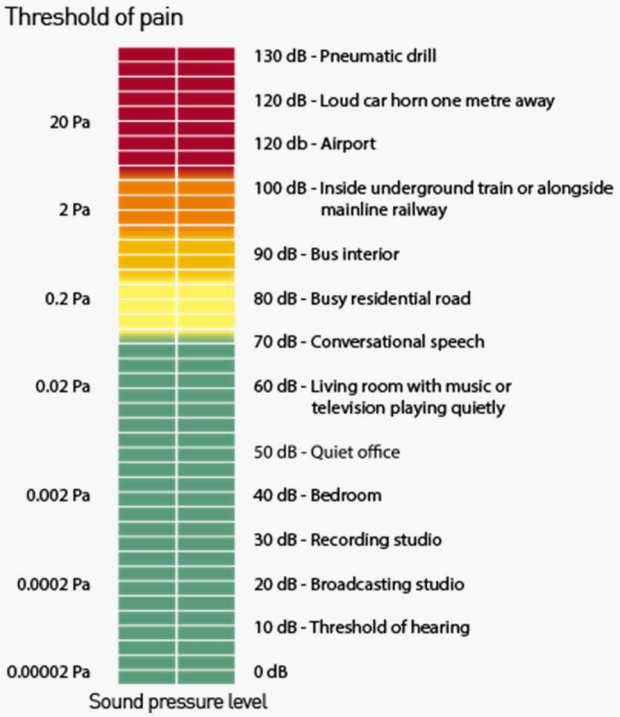
0	2 November 2021	Draft report to client
1	5 November 2021	Revised report following client review
2	7 December 2021	Revised report following AA review
3	3 March 2022	Revised report minor edits
4	21 April 2022	Additional AA and ER comments
5	28 June 2022	Hoarding updated to reflect plan during shed construction
6	23 March 2023	Report updated to include changes to FDK west acoustic shed and hoarding plan
7	11 May 2023	Updated with AA/ER and client comments
8	2 June 2023	Updated with AA/ER comments

Contents

Definition of acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
Approved hours	Construction hours approved in the Project Conditions of Approval D35. These differ from "standard" hours defined in the ICNG. Work outside the approved hours does not imply the works have not been otherwise approved through the procedures outlined in the NVMP.
Assessment period	The period in a day over which assessments are made.
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation.
CSSI	Critical State Significant Infrastructure
Decibel (dB)	A measure of sound equivalent to 20 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure, and 10 times the logarithm (to base 10) of the ratio of a given sound power to a reference power.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
dB(C)	Unit used to measure 'C-weighted' sound pressure levels, an adjustment made to sound level to approximate low frequency noise between 10 Hz and 200 Hz.
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
Extraneous noise	Noise resulting from activities that are not typical of the area such as construction, and traffic generated by holiday periods or special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Highly affected receivers	Residential receivers are considered to be highly noise affected where construction activities are determined to have an LAeq, 15 minute noise level of 75 dB(A) or higher.
Highly noise intensive works	Construction activities which are defined as annoying under the ICNG. See Section 2.1.2.
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
Noise assessment criteria	A standard rule or test by which the acceptability of the nature and characteristics of noise may be judged or evaluated. Criteria are generally based on guidelines or standards developed by Government agencies (eg EPA) to protect the majority of people for the majority of the time from adverse impacts.
NCA	Noise Catchment Area

Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period. 
NML	Noise Management Level
NVMP	Noise and Vibration Management Plan
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
Sound Power Level (SWL)	The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.

Sound Pressure Level (SPL)	This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB). Examples of typical sound pressure levels are shown below.  Source: https://www.osha.gov/dts/osta/otm/noise/health_effects/soundpropagation.html
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1. Introduction

1.1 Project overview

Sydney Metro is Australia's biggest public transport program comprising four main packages of work including Metro North West Line, Sydney Metro City and Southwest, Sydney Metro West and Sydney Metro Greater West. The Sydney Metro West component involves the construction and operation of a metro rail line, around 24km in length, between Westmead and the Sydney CBD.

The planning approvals and environmental impact assessment for Sydney Metro West has been split into several stages recognising the size of the project. This includes:

- Stage 1 – Concept and all major civil construction works including station excavation and tunnelling between Westmead and The Bays. Planning approval for this stage was granted in March 2021. ·
- Stage 2 – All major civil construction works including station excavation and tunnelling from The Bays to Sydney CBD ·
- Stage 3 – Tunnel fit-out, construction of stations, ancillary facilities and station precincts, and operation and maintenance of the Sydney Metro West line.

Acciona Ferrovial Joint Venture (ACJV) was commissioned to deliver the Central Tunnel Package of Stage 1, comprising excavation of five shafts and around 11.5 kilometres of twin-bore tunnel between The Bays and Sydney Olympic Park (the Project). An overview of the Project is presented in Figure 1-1, which includes the tunnel alignment and location of the future stations at:

- The Bays
- Five Dock
- Strathfield
- Burwood North
- Sydney Olympic Park

This report covers activities for construction of Five Dock east and west shafts located in the heart of the Five dock village. This DNVIS comprises several phases including:

- Site establishment
- Excavation of the shaft
- Tunnelling
- Demobilisation

An overview of the site layout of Five Dock is presented in Figure 1-2.

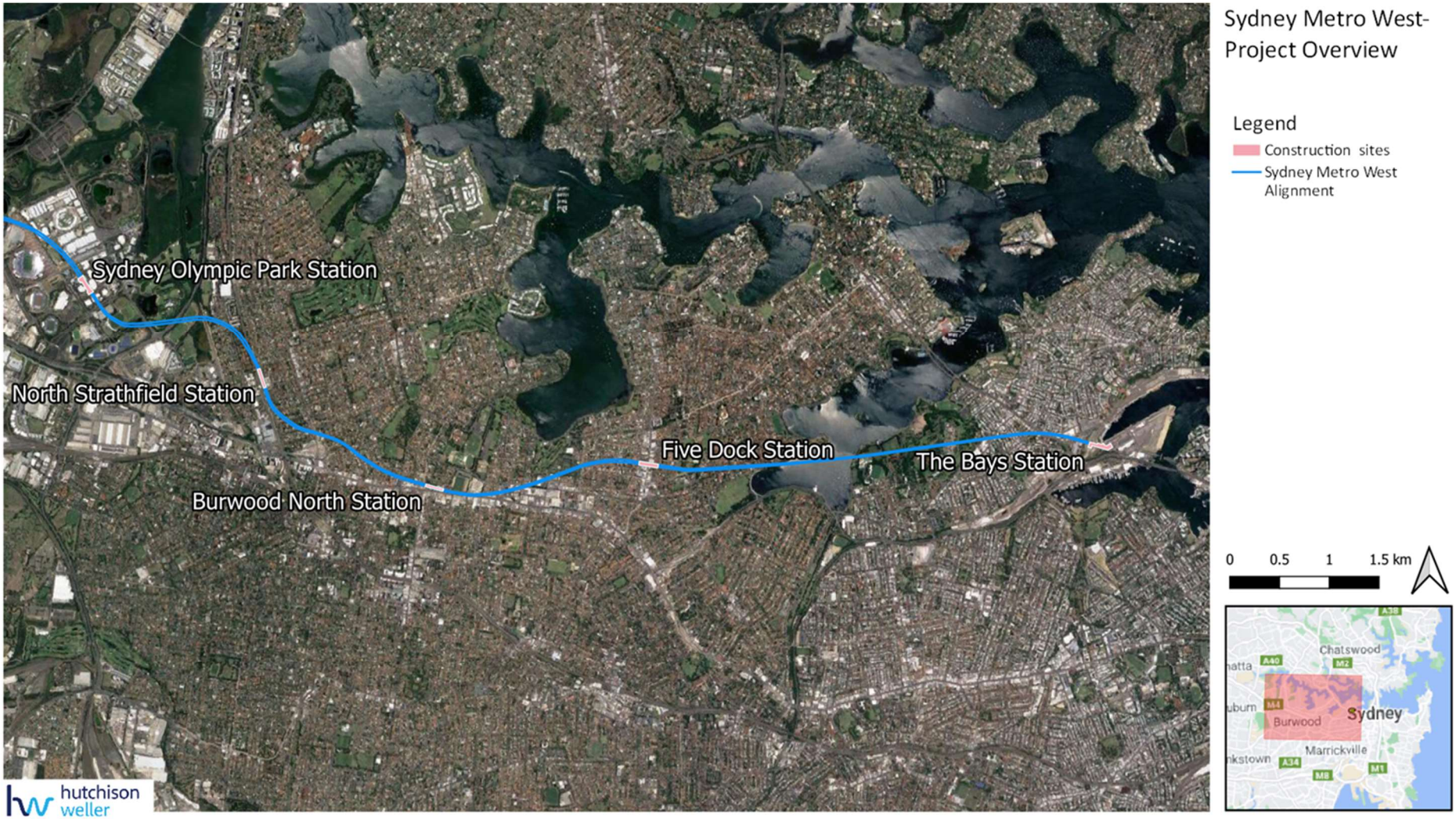


Figure 1-1 Overview of the CTP of Stage 1 of the Sydney Metro West Project.

Figure 1-2 Five Dock construction site

1.2 Detailed noise and vibration impact statement

Considering the risk of noise and vibration impact is necessary to ensure appropriate mitigation and management measures can be applied. This Detailed Noise and Vibration Impact Assessment (DNVIS) has been prepared in accordance with the Sydney Metro (2020) Construction Noise and Vibration Standard, v 4.3 (CNVS) and supplements the Project's Construction Noise and Vibration Management Plan (CNVMP) as required in the Project's Condition of Approval (CoA) D43.

The objective of the DNVIS is to establish the location, nature and scale of proposed works, assess the level of impact on the community's amenity and include mitigation measures identified through consultation with affected sensitive land users.

The structure of this DNVIS meets the requirements of the Condition of Approval D43 and the CNVS and includes:

- Section 2 – Construction works and hours
- Section 3 – Identification of noise and vibration sensitive receivers and existing noise levels
- Section 4 – Construction noise and vibration objectives
- Section 5 – Description of planned works, equipment and sound power levels
- Section 6 – Construction noise assessment – predicted noise levels and exceedances of objectives, including sleep disturbance
- Section 7 – Construction vibration assessment
- Section 8 – Traffic noise assessment
- Section 9 – Mitigation and management, including consultation

2. Construction works and hours

2.1.1 Planned works

Activities associated with Five Dock east and west sites are summarised in Table 2-1 and Table 2-2, which will be completed in 4 main phases for each site generally following establishment, excavation, tunnelling support and demobilisation.

Low impact works mainly comprising of geotechnical and utilities investigations in and around the Five Dock sites commenced in October 2021. Site establishment works commenced in early January 2022 and shaft construction activity at these sites will continue until late 2023. The anticipated program to completion of construction activities is illustrated in Table 2-3 and shows the duration of each work phase.

The current program has the shaft construction and station cavern excavation works being finalised in about October 2023. After this time, only tunnelling activities and demobilisation will occur at the Five Dock east and west sites and there would be no major spoil haulage required from these locations.

Five Dock east

Piling activities and construction of an acoustic shed at Five Dock east are complete and shaft excavation has commenced with works lasting until around October 2023.

Once the shaft at Five Dock east has been excavated to the operational level at about 28 metres below the surface, excavation of the underground station cavern joining the east and west shafts would continue. For the purpose of this DNVIS, this activity represents the horizontal excavation or tunnelling phase of the work.

At the eastern site operation within the acoustic shed would be on a 24 hour basis with stockpiling of spoil inside the acoustic shed during the night.

Ancillary facilities are located at 21 Waterview Street next to the acoustic shed. These facilities will be accessible 24 hours by construction personnel. The facility and turnstile have not been assessed in this DNVIS due to use being infrequent and cannot be accurately modelled. The operation of the turnstile will be maintained to ensure it does not cause noise impacts. Noise mitigation will be reviewed on-site during use of these facilities and reasonable and feasible measures will be implemented as required.

Five Dock west

At Five Dock west, the acoustic shed will not be constructed, as shaft excavation activities outside approved hours are not contemplated from this location. Alternate reasonable and feasible noise mitigation in accordance with condition of approval D39 to minimise exceedances of the noise management levels to nearby receivers during the standard construction hours is required. Three metre hoarding is considered a reasonable and feasible acoustic measure on the site boundary and this will be installed in May 2023 to minimise noise impacts at the closest receiver during approved hours of operation. Three metre hoarding has been modelled in this DNVIS.

Where noisy work is planned, these works must comply with the requirements of CoA D36, scheduled during approved hours only, and in accordance with the project NVMP.

While noisy construction activities at Five Dock west are not proposed outside of approved hours, some low impact OOHW would still be undertaken in accordance with CoA D37 where noise at the most affected residences meets the project NML. Other out of hours work may be undertaken where they comply with CoA D37 and EPL 21610. Examples of out of hours work that may be required include oversized deliveries (D37ai), emergency

works (D37aii), low noise impact works (D37bi) and tunnelling activities (D37di). Impacts of these activities would be assessed on a case-by-case basis as per the out of hours work process outlined in the NVMP.

To complete the western excavation during approved hours, the shaft excavation will progress in three distinct stages.

The first stage will include removing spoil that is accessible using an excavator and bucket and/or ripping attachments. When the rock classification is around class 4 or lower, heavy ripping using a D9 Dozer will be the primary excavation method. This method is expected to continue to a depth of around 10 metres below the surface.

From around 10-20 metres below the surface, the harder rock would be excavated using rock hammers or a surface miner where this option is available and a trial is successful. While the hammering has an overall higher noise level, at this depth the shielding from the excavation itself reduces direct noise impacts at the nearest residences. The SWL of the surface miner would be slightly lower than rock hammers by around 3 dB(A).

From around 20 metres depth, excavation would continue to the bottom of the shaft using various equipment that could include roadheaders, surface miners and hydraulic excavators. At the base of the shaft, works would be around 30 metres below the natural surface.

Once work within the western shaft has reached operational levels cavern mining at the western portal would commence. The western cavern is a short section of around 16 metres which would be completed prior to the arrival of the TBM.

Tunnelling and support activities at Five Dock western construction site outside the hours in D35 will be managed to be below airborne NML. Monitoring will be undertaken to verify noise levels and additional mitigation measures may be implemented to achieve NML compliance.

At the western shaft spoil haulage would follow the approved construction hours and there would be no off site transport of spoil during OOH periods.

The underground station cavern will connect the east and west shafts below ground. Once breakthrough is complete ventilation for the short western cavern excavation will be located underground in the eastern cavern and piped across the underground station cavern to the western cavern work face. The audible components of the ventilation will be located within the eastern cavern and the ventilation pipe at the western cavern is not predicted to be audible. During this time some OOHW at the east shaft would be undertaken where the activity is demonstrated to comply with D37(d) and west shaft where the activity meets the definition of Low Noise Impact Work as per D37(b) (NML compliant for airborne noise).

Once the underground station cavern heading and bench excavations are complete, these sites would become the local bases for TBM tunnelling activities including concrete lining and other tunnelling support as required and no further excavation or spoil haulage would be necessary from the surface. Tunnelling support activities and ventilation of caverns and drives would be undertaken as necessary, to support tunnelling activities.

This DNVIS addresses the work phases from 1 to 4 for Five Dock West and phases 5 to 8 for Five Dock East. Tunnelling and demobilisation will be addressed in an update to this DNVIS once more detailed information on future methodologies has been developed.

Table 2-1 Summary of proposed activities at Five Dock – West

Construction phase	Activity		Outside approved hours?
	1a	Routine activities	No

Construction phase	Activity			Outside approved hours?
1. Site Establishment	1b	Construction utilities and facilities		No
	1c	Temporary fencing/ hoardings		No
	1d	Utilities disconnection/relocation		No
	1e	Demolition and clearing site		No
	1f	Site Concrete Works		No
2. Shaft Excavation	2a	Piling		No
	2b	Site structures		No
	2c	Capping beams	Detailed excavation, break back & capping beam	No
	2d	Active anchors	Ground stabilisation	No
	2e	Excavation & Retention	Other Than Rock (OTR) - Dozer (No ripping)	No
	2f		Rippable - Dozer (ripping)	No
	2g		Non-rippable - Excavators with hammers or eccentric rippers	No
	2h		Road header/Surface miner	No
	2i		Retention - Ground Anchors, Shotcrete	No
3 Mucking out	3a/3b	Spoil handling	Clearing during OTR – Excavator surface	No
			Shaft clearing – Gantry, kibble & excavator	No
4. Station cavern excavation	4a	Excavations	Cavern excavation (within cavern)	Evening and night*
	4b	Tunnel Lining	Concrete lining	Evening and night*

*subject to being below airborne NML

Table 2-2 Summary of proposed activities at Five Dock –East

Construction phase	Activity			Outside approved hours?
5. Site Establishment	5a	Temporary fencing/ hoardings		No
	5b	Utilities disconnection/relocation		No
	5c	Demolition and clearing site		No
	5d	Site Concrete Works		No
6. Tunnel Support Excavation	6a	Piling		No
	6b	Site structures including acoustic shed		No
	6c	Capping beams	No	No
	6d	Active anchors	No	No
	6e	Excavation & Retention	Other Than Rock (OTR) - Dozer (No ripping)	Evening
	6f		Rippable - Dozer (Ripping)	Evening
	6g		Non-rippable - Excavators with hammers or eccentric rippers	Evening
	6h		Retention - Ground Anchors	Evening
7 Mucking out	7a	Spoil handling	Clearing during OTR – No Kibble	Evening
	7b		Spoil Handling all shaft clearing with kibble	Evening
8. Station cavern excavation	8a	Excavations	Cavern excavation (within cavern)	Evening and night
	8b	Tunnel Lining	Concrete lining	Evening and night

Table 2-3 Current shaft and cavern construction program for Five Dock

		2023											
Phase	Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Overall	Site establishment												
	Shaft excavation												
	Demobilisation												
Site establishment	Site establishment												
Excavation	Shaft excavation												
	Demobilisation												
	Piling												
	Acoustic shed												
	Capping beam												
	Active anchors												
	Excavation OTR												
	Excavation rippable												
	Active/Passive anchors												
	Excavation non-rippable												
	Station cavern excavation												
Demobilisation	Site demobilisation												

2.1.2 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2-4. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2-4 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under out-of-hours work protocol or EPL)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under out-of-hours work protocol or EPL)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.1.3 Variations to work hours

In some circumstances, the planned construction activities would be undertaken outside the hours described in CoA D35 and D36. As specified in the Conditions of Approval, these activities include those which are:

- Low impact as described in CoA D37b), including:
  - i. construction that causes L_{Aeq} (15 minute) noise levels:
    - no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, and
    - no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); and
  - ii. construction that causes L_{AFmax} (15 minute) noise levels no more than 15 dB(A) above the rating background level at any residence; or
  - iii. construction that causes:
    - continuous or impulsive vibration values, measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), or
    - intermittent vibration values measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006).

- By Prescribed Activity, as described in CoA D37d) and applying to Five Dock construction scenarios:
  - i. tunnelling (excluding cut and cover tunnelling and surface works) which is permitted 24 hours a day, seven days a week; or
  - iii. delivery of material that is required to be delivered outside of standard construction hours in Condition D35 of this schedule to directly support tunnelling activities
  - v. work within an acoustic shed where there is no exceedance of noise levels under Low impact circumstances identified in (b) above, unless otherwise agreed by the Planning Secretary.

Where out-of-hours work is necessary, appropriate respite would be identified in consultation with the affected community, in line with the NVMP. As per CoA D51, consultation would include providing:

a) a progressive schedule for periods no less than three (3) months, of likely out-of-hours work;
b) a description of the potential work, location and duration of the out-of-hours work;
c) the noise characteristics and likely noise levels of the work; and
d) likely mitigation and management measures which aim to achieve the relevant NMLs (See Section 4) including circumstances of when respite or relocation offers would be available and details about how the affected community can access these offers.

3. Existing environment

3.1 Existing environment

The Five Dock construction zones cover two separate locations within the Five Dock village precinct, namely Five Dock East (FDE) and Five Dock West (FDW) as illustrated in Figure 1-2.

The FDW site is located west of the Great North Road near the intersection of Second Avenue and covers an area of around 3600m^2. Adjacent land uses to this site, fronting the Great North Road, are mostly commercial businesses with some mixed-use commercial/ residential buildings.

West of FDW, the closest residences are located on East Street with the Sunshine childcare facility at the end of the row of residences. To the north of the site is St Albans Church, which is heritage listed, whilst to the south is a Coles supermarket complex which also has some multi storey residences on the upper floors.

The FDE site is located to the east of Great North Road, bounded by Second Avenue and Waterview Street and has a footprint of around 1900m^2. This site has residences on all four facades with a three-storey mixed use occupancy to the west having commercial premises on the ground floor and residences on the upper two floors.

The acoustic environment in all areas is described in the EIS as dominated by road traffic noise on the major transport corridors such as Great North Road, Ramsey Road and First Avenue. Contributions from aircraft are also noted.

3.2 Sensitive receivers

To assess and manage construction noise and vibration impacts, a detailed land use survey was prepared for the Project in line with CoA D34, with results of the survey are provided graphically in the Construction Noise and Vibration Management Plan (CNVMP) and relevant land uses to Five Dock are presented in Appendix A of this DNVIS.

In summary, a number of residential and non residential receivers have been identified and include:

- Residential receivers immediately adjacent to FDE in Waterview Street including directly abutting
- Residential receivers on Great North Road including 110 Great North Road which is between FDE and FDW
- Residential receivers in East Street and over looking FDW from apartments above Coles
- Non-residential receivers including:
    - St Albans Church directly abutting FDW (heritage site)
    - Five Dock public school to the west of FDW
    - GGC Church in Great North Road
    - Commercial office space on great North Road including medical and dental rooms
    - Cafes and restaurants adjacent to FDE on Great North Road
    - Childcare centres in East Street, Garfield Street and Henry Street
    - Police Station at Corner West and Garfield Streets.

Consultation with sensitive receivers is underway and feedback to date is summarised in Section 7.1.5.

3.3 Heritage items

There are several items of heritage value area were identified in the EIS, which include the following. These items have been considered for impacts of vibration-intensive activities in Section 6.3.

- St Albans Church and associated buildings
- Canada Bay Police Station

3.4 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Five Docks sites have been divided into Noise Catchment Areas (NCAs).

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs were established as part of the EIS, are summarised in Table 3-1 and illustrated in Figure 1-1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA (see Section 4.2).

Table 3-1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description	Ambient noise influences
14	West of Great Northern Road	High component of commercial and mixed-use receivers at the eastern boundary of the NCA, adjacent to the Great North Road. Mainly residential one block west from the main road. 'Other sensitive' receivers include the St Albans Anglican Church, Sunshine Early Learning Centres x 2, Garfield Street Child Centre, Five Dock Police station, Five Dock Public School, and several local practices.	Road traffic on the Great North Road, Barnstaple Road and Ramsay Road.
15	East of Great Northern Road.	Commercial and mixed-use receivers at the western boundary of the NCA, adjacent to the Great North Road. Mainly residential one block to the east from the main road. 'Other sensitive' receivers include the St Albans Anglican Church, Kiddies on First Early Learning Centre, Domremy Catholic College, and a local medical practice.	Road traffic on the Great North Road, Barnstaple Road and Ramsay Road.

3.5 Background noise survey

Background noise monitoring was undertaken as part of the wider Sydney Metro West Project EIS (Section 2, Technical Paper 2) through unattended background noise monitoring at representative locations. Monitoring was completed in March and July 2019 for each of the NCAs listed in Table 3-1.

The Five dock Area is heavily influenced by traffic flows that generate lower noise levels during the night-time than the daytime and evening periods. This pattern of reduced noise levels in the evening and night time is characteristic of urban and suburban areas, where there is no industrial or infrastructure noise influences.

The baseline information was used to establish the Rating Background Level (RBL), which represents the average minimum background sound level for each measurement period, averaged over the measurement days. The RBL at each NCA is provided in Table 3-2.

Table 3-2 Background noise levels

	Noise level (dBA)[1]		
NCA	Day[2]	Evening[2]	Night[2]
NCA14	42	41	33
NCA15	43	43	38

Notes:

1. The RBL values have been extracted from the EIS; refer to Table 4 in the EIS Technical Paper 2.
2. Daytime is 7:00am to 6:00pm, evening is 6:00pm to 10:00pm and night-time is 10:00pm to 7:00am.
3. During the EIS noise assessment, the monitoring level was found to be higher than the daytime. In this situation, the NPfl requires that the evening level be reduced to match the daytime

4. Noise and vibration assessment criteria

4.1 Overview

Project CoA D43 requires planned works to be assessed within this DNVIS where any planned works may exceed the NMLs, vibration criteria and/or ground-borne noise levels specified in CoA D39 and D40 at any residence outside construction hours identified in CoA D35, or where receivers will be highly noise affected.

This DNVIS includes specific mitigation measures identified through consultation with affected sensitive land user(s) and these mitigation measures will be implemented for the duration of site establishment and shaft construction activities.

This DNVIS has been provided to the AA and ER before the commencement of the planned works at the establishment phase. Subsequent revisions of this DNVIS are provided for review and approval as appropriate.

CoA D39 requires noise and vibration from construction activity to be managed with guidance from:

- Noise: the Interim Construction Noise Guideline (ICNG, DECC 2009)
- Vibration for human exposure: Assessing Vibration: A Technical Guideline (DEC, 2006)
- Vibration for building damage: BS 7385 Part 2-1993 – Evaluation and measurement for vibration in buildings Part 2, and
- Vibration for damage of unsound heritage items: DIN 4150-3 Structural Vibration – effects of vibration on structures.

The over-arching document for assessment and management of noise and vibration impacts on this Sydney Metro project is the Sydney Metro *Construction Noise and Vibration Standard* (CNVS, vers. 4.3, Transport for NSW 2020). The following sections outline the framework of these guidelines and the way this DNVIS will assist to assess and manage impacts.

4.2 Noise

4.2.1 ICNG

The CNVS refers to the *Interim Construction Noise Guideline* (ICNG) (DECC 2009), which provides guidance on management of construction noise. The ICNG notes noise that exceeds background noise levels may result in adverse impacts and an increased likelihood of complaints.

During approved hours, where construction noise is within 10 dB(A) of the RBL, impacts are considered acceptable. Where construction noise is more than 10 dB(A) above the RBL, a residential receiver is taken to be noise affected and the proponent should undertake all reasonable and feasible steps to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a residential receiver is considered to be highly noise affected, requiring respite to be given in consultation with the regulatory authority and the community.

Outside approved construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected.

In addition, noise from activities/equipment such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs and a 3 hours on, 1 hour off respite schedule applies.

A noise level above $L_{Aeq\ 15min}$ 70 dB(A) at a commercial property is considered to warrant noise mitigation. Similarly, an industrial facility would warrant noise mitigation at $L_{Aeq\ 15\ minute}$ noise levels above 75 dB(A).

Table 4-1 presents management levels for noise at other relevant sensitive land uses based on the principle that the characteristic activities for each of these land uses should not be unduly disturbed.

Internal noise levels are assessed at the centre of the occupied room. Where internal noise levels cannot be measured, external noise levels may be used. A conservative estimate of the difference between internal and external noise levels is 10 dB for buildings other than residences.

Table 4-1 NMLs for non-residential sensitive receivers

Sensitive receiver type	NML applicable when in use, LAeq, 15 min
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Childcare centres - sleeping areas - play areas	 Internal noise level 45 dB(A) External noise level 65 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)
Community centres	Refer to the recommended 'maximum' internal levels in AS2107 for specific uses.

4.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

4.2.3 Ground-borne noise

CoA D40 requires all reasonable and feasible mitigation measures to be applied when the following residential ground-borne noise levels are exceeded. These levels are only applicable when ground-borne noise levels are higher than airborne noise levels at residential receivers during the evening and night periods.

a) evening (6:00 pm to 10:00 pm) — internal LAeq(15 minute): 40 dB(A); and
b) night (10:00 pm to 7:00 am) — internal LAeq(15 minute): 35 dB(A).

4.2.4 Construction traffic

While operating within the construction site, construction vehicles are assessed as part of the construction activity of which they are a part. However, once these vehicles leave the construction site and enter public roads, they are assessed as road traffic.

The Road Noise Policy (RNP) is generally adopted to assess the impact of construction traffic on public roads. A screening test is first applied to establish whether existing road traffic noise levels will increase by more than 2 dB due to construction traffic. Where any noise increase is less than 2 dB, the objectives of the Road Noise Policy have been met.

The CNVS recommends, where the road traffic noise levels are predicted to increase by more than 2 dB as a result of construction traffic, consideration should be given to feasible and reasonable noise mitigation measures to reduce the potential noise impacts and preserve acoustic amenity.

In considering feasible and reasonable mitigation measures, the actual noise levels associated with construction traffic and whether these levels comply with the road traffic noise criteria in the RNP would be reviewed.

- 60 dB L_{Aeq} (15hour) day and 55 dB L_{Aeq} (9hour) night for existing freeway/ arterial/ sub-arterial roads.
- 55 dB L_{Aeq} (1hour) day and 50 dB L_{Aeq} (1hour) night for existing local roads.

4.2.5 Additional mitigation measures

The CNVS builds on the guidance provided by the ICNG and recommended further mitigation measures where all reasonable and feasible mitigation measures to minimise noise at the nearest receivers have been implemented and construction noise is still predicted to exceed the noise or vibration objectives. The Additional Mitigation Measures Matrix (AMMM) for airborne and ground-borne noise taken from the CNVS are presented in Table 4-2 and Table 4-3.

Table 4-2 Additional Mitigation Measures Matrix for airborne noise (CNVS)

Construction hours	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	0 to 10	-
	10 to 20	LB
	20 to 30	LB, M, SN
	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	0 to 10	LB
	10 to 20	LB, M
	20 to 30	LB, M, SN, RO
	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	0 to 10	LB
	10 to 20	LB, M, SN, RO
	20 to 30	LB, M, SN, IB, PC, RO, AA
	> 30	LB, M, SN, IB, PC, RO, AA

Notes:
PC = Phone Calls and emails
M = Monitoring
IB = Individual briefings
AA = Alternative accommodation
SN = Specific notification
LB = Letterbox drops
RO = Project specific respite offer

Table 4-3 Additional Mitigation Measures Matrix for ground-borne noise (CNVS)

Construction hours	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	No NML for ground-borne noise during standard hours (refer to Table 4-7)	
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	0 to 10	LB
	10 to 20	LB, M, SN
	> 20	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	0 to 10	LB, M, SN
	10 to 20	LB, M, SN, IB, PC, RO, AA
	> 20	LB, M, SN, IB, PC, RO, AA

Notes: PN = Project notification; SN = Specific notification; M = monitoring; LB = Letterbox drops; IB = Individual briefings; DR = Duration reduction; AA = Alternative accommodation; RO = Project specific respite offer

4.3 Project-specific construction noise management levels

Based on the measured RBLs for each NCA and requirements of the ICNG and CNVS, project-specific NMLs are summarised in Table 4-4. NMLs for non-residential receivers are described in Table 4-1.

Table 4-4 Noise management levels

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
14	52	75	47	46	38	40	52
15	53	75	48	48	43	43	53

4.4 Vibration management

4.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 4-5 for sensitive receivers.

Table 4-5 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

4.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 4-6 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 4-6 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

4.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound

(following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 4-6 would be applicable.

4.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 4-7. Acronyms are defined at Table 4-2.

Table 4-7 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

5. Impact assessment

5.1 Plant and equipment

A summary of proposed activities at Five Dock was provided in Table 2-1. Nominal equipment and estimated sound power levels of each item and activity are presented in Appendix B.

At Five Dock east equipment types and numbers will vary over the day, evening and night periods, with less equipment proposed outside standard hours and activities such as excavation of the shafts not proposed at night. Noise from within the acoustic shed is expected to comply with NML criteria during these times.

At Five Dock west construction during standard hours would require the adoption of respite mitigation during extended periods of noisy works.

During site establishment it is likely that several activities would be undertaken concurrently so cumulative impacts have been assessed as part of this DNVIS. Similarly, concurrent excavation of the east and west shafts has been considered (see Section 6).

Sound power levels (SWLs) and predicted noise levels depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. The SWLs include item quantities and nominal usage factors (proportion of a 15-minute assessment period the equipment would be operating at its maximum noise output).

5.2 Noise modelling

SoundPlan noise modelling software was used to calculate noise impacts in accordance with the ISO9613 prediction method at all identified noise-sensitive receivers. The model included:

- Topography – 1 metre DEM based on LPI Lidar data.
- Individual buildings for façade calculations and to account for shielding and reflections. Building heights are also taken from Lidar data.
- Individual sensitive receivers – One receiver location representing each residential dwelling and located 1.5 metres above most affected floor level (e.g. level 2) and most-affected façade at up to around 600 metres radius.
- Construction noise sources –Activities and equipment included in the noise model as area sources in locations specified by AFJV. SoundPlan takes the worst-case point within each area to perform its calculations, a conservative approach. Sound power levels in Appendix B. Source is modelled at 1.5 metres above ground.
- Shaft excavation depth was accounted for in the modelling, with calculation of shaft noise entering the shed from the ground then passing through the shed walls and roof (see acoustic shed design below).
- Each phase of work was modelled to account for the benefit from site hoarding during the establishment phase. Activities are enclosed early in the process by the acoustic shed, which demonstrates benefit from increasing depth of activity.
- Meteorology –worst-case conditions: gentle breeze (3-5 m/s) source to receiver and stable conditions (conducive of temperature inversion).

5.3 Mitigation measures included in the modelling

Mitigation measures would be implemented to ameliorate noise impacts as standard practice throughout the works. Mitigation measures, which may affect the predicted levels include the following, which have been incorporated in the assessment as base assumptions for noise predictions.

- Source noise control strategies:
  - Where the NML outside approved hours cannot be achieved, work is not proposed to be undertaken unless unavoidable and completed under the procedures contained in the CNVMP.
  - Equipment sound power levels will not exceed those described in Table 13 of the CNVS.
  - Residential grade mufflers fitted to all mobile plant, with equipment maintained and operated effectively.
  - 'Damped' rock hammers with reductions of around 10 dB in comparison to similar sized un-damped hammers
  - No shouting or swearing or playing of loud radios
  - Engine and exhaust brakes avoided
  - Stationary plant placed behind larger objects or as far from receivers as possible
  - Engines switched off when not in use for extended periods (15 minutes) and no idling trucks in front of residences
  - Dropping of heavy objects or metal-on-metal impacts avoided
  - Non-tonal reverse alarms installed on all mobile equipment regularly used on the project and all equipment outside approved hours.

- Noise barrier control strategies:
  - Hoarding of varying heights utilised as both visual and acoustic screens around the sites during the demolition (now complete) and construction phases.
  - For FDW this will include:
    - On the southern and northern boundaries the external building facades will be retained as long as practicable to provide to provide shielding during the demolition phase.
    - At the East Street boundary, including a small section bordering the church property, the hoarding will comprise of concrete barrier and panel to an approximate height of 3 metres. This type of barrier along East Steet will be necessary to facilitate access requirements during the demolition phase.
    - Class B hoarding along the Great North Road boundary of around 3 metres in height will be used for demolition phase of the works to minimise noise impacts at residential and commercial receivers opposite the site. After the demolition phase is complete the 3 metre hoarding will be modified to form the final configuration for this site. The hoarding will have two openings on Great North Road to allow access and egress for construction vehicles. Temporary hoarding measures are not feasible in these locations due to safety concerns and design requirements.

  - At FDE:
    - During demolition, both the eastern and western boundaries will be a concrete barrier and panel to an approximate height of 2.4 metres.
    - The common boundary at the southern facade will be chain wire fencing with screening material.
    - The building at 23 Waterview Street will be demolished prior to the installation of the A class hoarding. During this time, the building at 21 Waterview Street will carry a lease option for the JV effectively removing this receiver location.
    - On the northern boundary, chain wire fencing with screening material will be used to facilitate construction of the offices during the site establishment phase.

- An acoustic shed was completed in March 2023 and work will continue internally after that time. The model assumes acoustic shed doors are closed out of hours.

The final noise control option for the Five Dock East site will be an acoustic shed while at the western site, a 3 metre A class hoarding will be installed in May 2023. For the west site, this hoarding plan and the existing site offices will form the final noise barrier configuration during the site occupation.

The acoustic shed design is detailed in Section 0 and the planned hoarding arrangement for Five Dock west is presented in Figure 5-1.

Figure 5-2 presents an overview of the location and scale of the shed at Five Dock east.

Figure 5-1 Hoarding arrangement Five Dock west and acoustic shed east

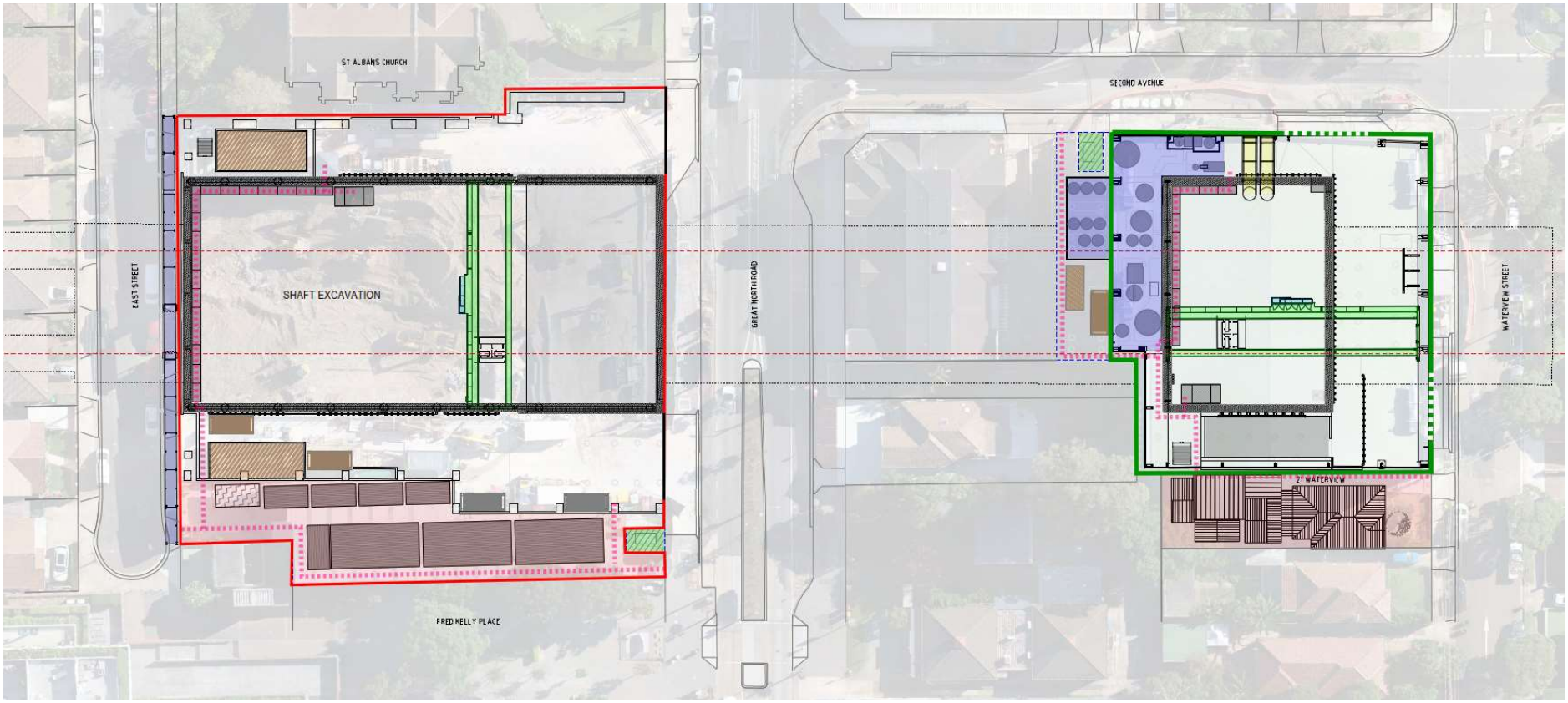


Figure 5-2 Five Dock west hoarding plan (red) and east acoustic shed (green).

In addition to the modelled mitigation measures other measures will be implemented as per D39. Examples include minimising use of plant such as sweeper truck where possible, installing temporary acoustic shields or positioning plant in locations to minimise potential noise impact.

5.4 Five Dock east acoustic shed design

An acoustic shed has been constructed at Five Dock east where excavations, supporting activities and spoil management are required to occur outside standard construction hours in line with the conditions of approval. This was considered an appropriate control in consideration of the construction program and additional activities to be undertaken (such as tunnelling of the cavern from the eastern site), and therefore extended periods of out of hours works are required.

The 22 metre tall acoustic shed over the Five Dock east shaft excavation site has been modelled with a weighted noise reduction, Rw, of 40, which is equivalent to:

- SpeedPanel 78mm (450 kg/m^3) with transmission loss equivalent or better than values in Table 5-1.

Table 5-1: Transmission loss at frequencies (Hz)

Frequency (Hz)	63	125	250	500	1000	2000	4000
Reduction (Rw)	16	22.8	28.7	35.9	42.3	44.9	42.5

Permastop HDP 75 absorption on walls and ceiling down to 4 m above floor with absorption equivalent or better than values in Table 5-2.

Table 5-2: Sound absorption coefficients at frequencies (Hz)

Frequency (Hz)	125	250	500	1000	2000	4000
Absorption (α)	0.35	0.8	1.00	1.00	0.95	0.95

Intake and exhaust noise from the Acoustic shed has been accounted for in the model based on the preliminary shed design with the vent openings in the roof. Intake and exhaust fans have silenced, ducted inlets and exhausts on the roof.

Aerial photographs of the east and west sites showing the Five Dock east shed are presented in Figure 5-3 and Figure 5-4 showing the scale of the building in situ.

Figure 5-3 Five Dock east acoustic shed and Five Dock west site showing hoarding and site buildings.

Figure 5-4 Five Dock east acoustic shed and surrounding buildings.

During detailed construction planning for the Five Dock west, taking into consideration the construction program, working hours and traffic management; it was determined that shaft excavation works and spoil haulage is now only required during standard construction hours. Shaft excavations at the western site will only be undertaken during the standard construction hours in condition of approval D35 of the Approved Project unless they are considered to be below airborne NML. As a result, an acoustic shed is no longer justified as the preferred noise mitigation strategy. This is consistent with the approach taken for the excavations of North Strathfield metro stations as stated in the EIS, which are primarily being excavated within standard construction hours.

Alternative measures were considered for the western site and 3 metre hoarding was considered the most reasonable and feasible acoustic measure due to reduced noise benefits of higher hoarding as the shaft deepens, timeliness of installation, the feasibility of design, simplified construction method and minimal visual impact. Three metre hoarding has been included in the noise model of this DNVIS.

6. Predicted noise levels

6.1.1 Overview

A summary of predicted noise levels for work during approved hours and outside approved hours is provided in the following sections for each construction phase. Detailed results for all sensitive receivers are provided in Appendix D.

Noise contours for key activities are presented in Appendix C. The contours demonstrate the extent of the worst-case cumulative impacts and illustrate buildings around the work sites generally providing good noise screening. Contours models included in Appendix C include impacts for the first floor which allows all buildings to be assessed at an equal height (not all buildings have 2 or more floors). Refer to Appendix D for highest impact for all floors which provides worst case for that property.

6.1.2 Site establishment works (Phases 1 & 5)

Site establishment has been completed during standard hours with exceedances in NML predicted for all impact classes during this time. These impacts represent a high risk of adverse impact on nearby residences during these times.

Up to 18 residential receivers are likely to be highly noise affected (>75 dBA) at some time during the establishment phase, with particular reference to demolition. The highest impact is expected during demolition for Five Dock West where 290 receivers may experience exceedances of the daytime NML of up to 10 dB, with 83 receivers experiencing impacts in the 10-20 dB range and 18 receivers in the greater than 20 dB range. Highly noise intensive work will be undertaken in accordance with COA D36.

At Five Dock west and east sites, work of the initial shaft construction will occur with only the post establishment phase hoarding mitigation in place. Works at this time will include the piling and break-back (by cropping where possible), pouring of capping beams and installation of active ground anchors.

Construction of the Five Dock east acoustic shed would commence towards the end of these works at which point shielding from the partially constructed shed would be apparent. It is recommended that acoustic shed construction begin on the boundary of the most affected receivers for this reason.

A summary of maximum predicted noise levels at residential and non-residential land uses and predicted exceedances of the NMLs are presented in Table 6-1.

6.1.3 Shaft works (Phases 2-4 & 6-8)

Some of the initial phases of work have been completed with excavation activities currently underway for both the east and west sites.

After the piling and capping work was completed, all active noise sources from Five Dock east have been located within a purpose built acoustic shed located over the tunnelling shaft.

The highest impacts for the Five Dock east site were expected to be generated during the soil nailing during the site establishment phase where around 70 receivers had noticeable noise impacts without any shielding from the acoustic shed. In this scenario, up to 11 receivers experienced clearly audible noise impacts and 4 residences were predicted to experience noise levels of >20 above NML.

Modelling of the acoustic shed assumes that roller doors are closed during noisy activities, but would remain open during other times as required for safety and access reasons. With the acoustic shed operational as modelled, work undertaken inside the shaft within the shed is not expected to generate an exceedance of the noise goals meeting the project NMLs for all periods.

Within the shed at Five Dock east, ripping and hammering would not take place during the night time. Where this is proposed at any later stage, additional assessment will be completed with a monitoring survey to verify OOHW noise levels would meet the night NML.

At Five Dock West the current hoarding layout will represent the final mitigation measures for the site. This site will be operational during approved hours and will implement appropriate respite periods as required in the NVMP.

The highest impacts for Five Dock west are expected to occur when hammering for non - rippable excavation work begins at around 10m below the surface. Predicted noise levels are based on the approximate level for the commencement of each new activity however, these impacts would gradually decrease as works progress deeper increasing the shielding to nearby receivers.

At this time around 252 receivers are predicted to experience noticeable noise impacts of up to 10 dB with 91 receivers in the 10-20 dB(A) range and up to 33 receiver locations experiencing impacts greater than 20 dB(A) above the NML. At the commencement of the rippable phase of work, around 31 receiver locations would be highly noise affected (>75dBA). These are daytime noise impacts and will be managed in accordance with the NVMP.

Once excavation work has reached the operational floor of the shaft at Five Dock west, excavation of the underground station cavern would continue to the west. Where cavern excavations exceed airborne NML's the work would be restricted to approved hours only. Once wholly inside the cavern the ground borne noise and vibration impacts are further considered in the tunnelling DNVIS.

For this DNVIS the airborne noise impacts from the cavern excavation would be audible at the tunnel portal 30 metres below the surface level. These impacts are assessed in the cavern excavation scenario (activity 4a) to determine compliance with the project NML.

Predicted noise impacts from the cavern excavation indicates that no receiver locations would experience noise levels above the NML for approved hours. During the evening, modelling indicates that the no additional receivers would be impacted. During the night the number of affected receiver locations above NML increases to about 40 without additional mitigation measures.

While cavern excavation would not meet the evening and night NML noise criteria without mitigation, additional mitigation measures may be considered to extend the working hours where monitoring indicates works would be NML compliant or otherwise compliant with the EPL.

A summary of noise level impacts for this phase of works is presented in Table 6-2.

Table 6-1 Summary of predicted NML exceedances for Phase 1 – Site establishment

Activity		Maximum level, dBA			Predicted no. receivers with exceedance of NML														
					Approved hours			Outside approved hours - Day				Outside approved hours - Evening				Outside approved hours - night			
		Res	Non-res	Rec. >75	0-10	10-20	20+	0-10	10-20	20-30	30+	0-10	10-20	20-30	30+	0-10	10-20	20-30	30+
1a	Routine site activities	78	83	2	62	13	1	Approved hours only				Approved hours only				Approved hours only			
1b	Construction facilities	79	84	2	76	15	1												
1c	Fencing & hoarding	78	86	2	45	10	4												
1d	Utilities disconnection	77	83	2	61	13	1												
1e	Demolition	89	95	18	290	83	18												
1f	Site Concreting	77	82	0	56	11	1												
5a	Routine site activities	82	82	3	87	16	3												
5b	Construction facilities	79	79	1	47	10	2												
5c	Fencing & hoarding	78	86	2	45	10	4												
5d	Utilities disconnection	82	82	3	87	16	3												
5e	Demolition	86	86	4	148	24	7												
5f	Site Concreting	81	81	0	73	14	3												

Table 6-2 Summary of predicted NML exceedances for Phase 2 to 8 –Excavation activities

Activity		Maximum level, dBA			Predicted no. receivers with exceedance of NML															
					Approved hours				Outside approved hours - Day				Outside approved hours - Evening				Outside approved hours - night			
		Res	Non-res	Rec. >75	0-10	10-20	20-30	30+	0-10	10-20	20-30	30+	0-10	10-20	20-30	30+	0-10	10-20	20-30	30+
2a	Piling	74	80	2	60	15	1	-	Approved hours only				Approved hours only				Approved hours only			
2c	Capping Beams	70	76	1	22	11	-	-												
2d	Active Anchors	78	85	3	140	24	-	-												
2e	Excavation OTR	70	78	1	28	12	-	-												
2f	Excavation Rippable	70	78	1	30	7	-	-												
2g	Excavation Non-Rippable	90	95	31	252	91	27	6												
2h	Excavation Road Header	75	80	1	41	14	1	-												
2i	Rock bolting	70	79	1	26	6	-	-												
3a	Mucking Out - Surface	44	44	-	-	-	-	-												
3b	Mucking out - Shaft	45	45	-	-	-	-	-												
4a	Cavern Excavation*	46	53	-	-	-	-	-												
4b	Concrete lining*	49	49	-	-	-	-	-												
6a	Piling	74	74	-	36	8	-	-												
6b	Acoustic Shed	68	68	-	10	2	-	-												
6c	Caping Beams	69	69	-	11	4	-	-												
6d	Active Anchors	78	78	2	72	11	4	-												
6e	Excavation OTR	38	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6f	Excavation Rippable	43	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6g	Excavation Non-Rippable	43	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7a	Mucking Out - Excavator	41	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7b	Mucking out - Shaft	38	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8a	Cavern Excavation	38	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8b	Concrete lining	43	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*activities may be undertaken outside approved hours where they are verified to be below airborne NML

6.1.4 Sleep disturbance

For activities outside approved hours any work within the east and west sites would be compliant with CoA D37 or the project the EPL. Activities external to these sites undertaken outside of approved hours is covered separately under the project OOHW protocol .

Activities to be completed outside standard hours for the Five Dock west site, would be NML compliant and therefore sleep disturbance impacts are not applicable.

At Five Dock east activities outside approved hours would be wholly within the acoustic shed, which is designed to ensure that all planned OOHW will be NML compliant whilst inside, therefore would not exceed the sleep disturbance criteria.

Other out of hours work such as utility relocations and oversized plant, may be undertaken where they comply with CoA D37 and EPL 21610 and these works would be assessed through the out of hours works process.

6.2 Ground-borne noise

The requirement to consider ground-borne noise is applicable to tunnelling or other subterranean works which have the potential to generate airborne noise impacts at the same receiver. During excavation of the tunnel support shafts, vibration-intensive equipment such as rock hammers and rock bolters would be used. Road headers would also be employed to excavate the station cavern.

A range of ground-borne noise monitoring has been completed over the last few years in Sydney, which provides an indication of the level of ground-borne noise to be experienced by sensitive receivers for work at various 3-dimensional slant distances from the vibration sources. A sample of measured ground-borne noise data for road headers, rock breaking and rock bolting is provided in Figure 6-1 to Figure 6-3.

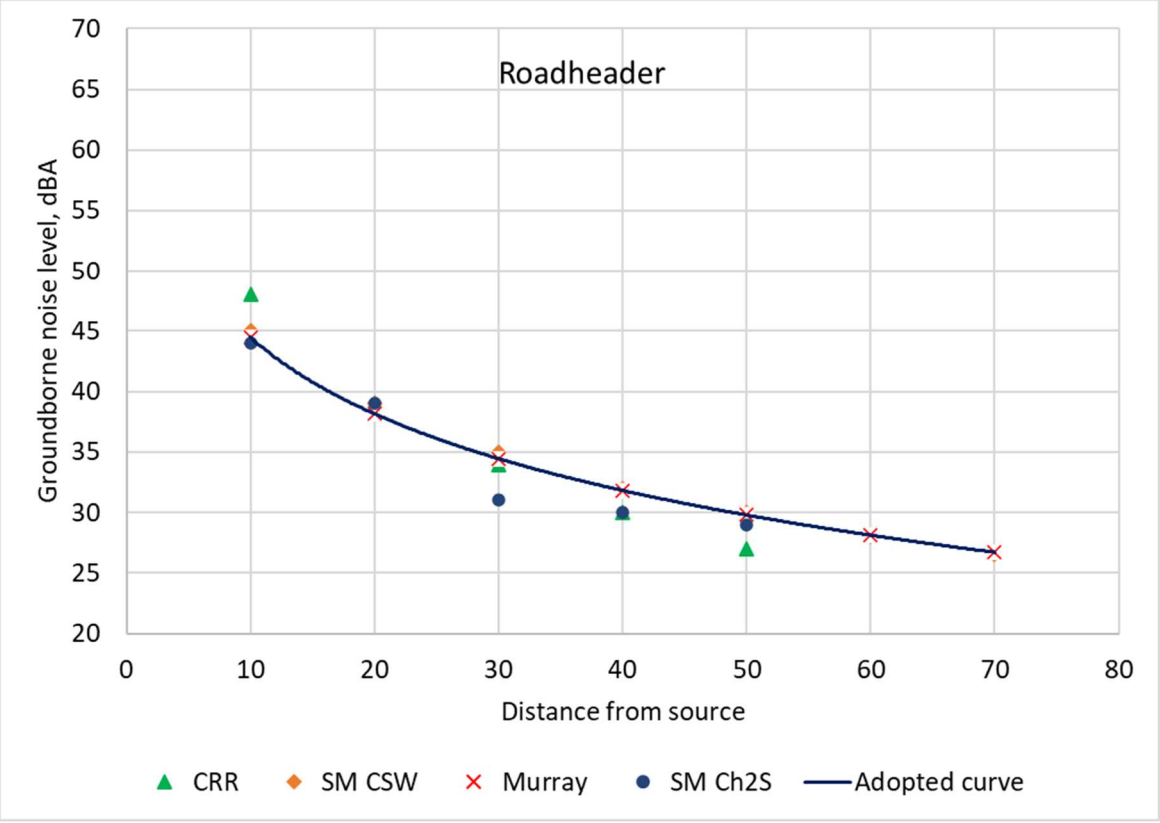
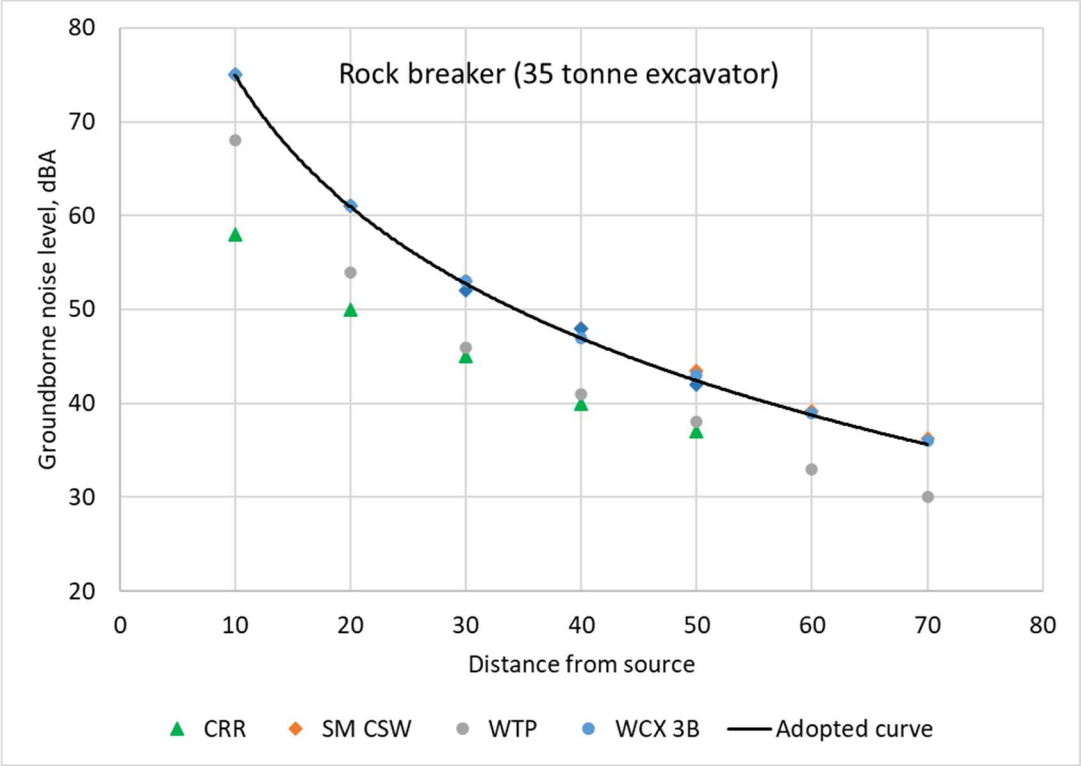


Figure 6-1 Ground-borne noise for road header at various slant distances[1]



[1] CRR (2011) Cross River Rail EIS Construction noise and vibration, SM CSW (2019) Sydney Metro City and Southwest EIS construction noise and vibration, Murray (2003) Tunnelling noise and vibration management, Technical Review, SM Ch2S (2016) Sydney Metro Chatswood to Sydenham Technical Paper.

Figure 6-2 Ground-borne noise for 32 tonne excavator with rock breaker at various slant distances[2]

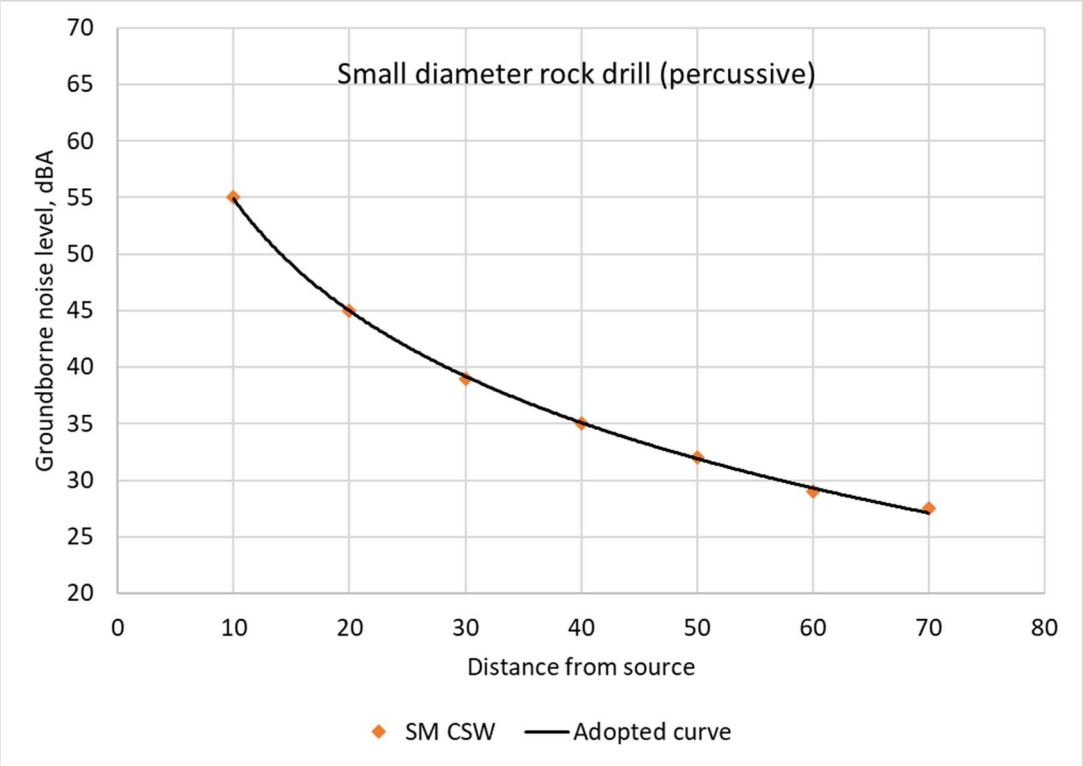


Figure 6-3 Ground-borne noise for road bolter at various slant distances

Ground-borne noise criteria are not applicable while airborne noise remains the dominant influence on amenity at a sensitive receiver. Predicted noise levels for excavation activities demonstrate the acoustic shed will provide good attenuation of noise. Therefore, ground-borne noise should be assessed for all phases of rock breaking and rock bolting when occurring inside the shed.

As described in Section 4.2.3, ground-borne noise criteria apply only to residential receivers during the evening and night periods. Therefore, where excavation and rock bolting continue outside approved construction hours, ground-borne noise would be considered. For the revised program at Five Dock west, there are no works outside of approved hours unless compliant with D37 and EPL.

The graphs shown above indicate residential receivers may experience ground-borne noise levels above the evening criterion within a slant distance of around 16 metres for road heading, 60 metres for rock breaking and 30 metres for rock bolting.

Since ground-borne noise predictions are based on the slant distance from the works, the predicted level will vary as the shaft depth at Five Dock east increases. Therefore, predictions have been completed for works at depths of 10m, 20m and 30m below ground level to capture the variation in noise at the nearest receivers.

A summary of the likely number of exceedances of the evening criteria for the east shaft at each assessed depth is presented in Table 6-3.

[2] WTP(2020) Sydney Metro West Stage 1 EIS Technical Paper on Noise and Vibration, WCX 3B (2020) M4-M5 Link Rozelle Interchange Construction Noise and Vibration Impact Statement

Results show a small number of exceedances is expected when rock breaking and bolting continue into the evening, with the number reducing as the depth of the shaft increases. The number of exceedances increases where rock breaking and rock bolting occur at night.

Table 6-3 Summary of exceedances of the evening ground-borne noise criterion

Shaft and excavation depth		Number of exceedances of the evening ground-borne noise criterion for construction period		
		10 m excavation	20 m excavation	30 m excavation
East	Rock breaking	16	15	12
	Rock bolting	3	1	0
	Road header	N/A	N/A	0

Predictions are based on measurements from other projects so would be verified in site-specific conditions at commencement of each activity. A Summary of predicted ground borne vibration impacts is presented in Appendix D.

6.3 Vibration impact assessment

6.3.1 Assessment method and reference data

Vibration-intensive surface works will form part of the site establishment and ongoing excavation works for the duration of the Project. Potential items of plant that can generate vibration impacts are:

- Rock Hammers
- Percussive drills such as an Air track
- Vibratory rollers

To assess the likelihood of impacts on human comfort and structures, reference vibration levels are summarised in Table 6-4 and curves of vibration with distance are presented in Figure 6-4. Reference vibration levels are based on previously measured levels.

Table 6-4 Summary of vibration-intensive activities

Activity	Typical equipment	Typical PPV vibration emission levels	Source
Demolition/Rock breaking	35 t Excavator with hammer	1.3 mm/s at 10 m	Site measurement
Site compaction	Vibratory roller	4.5 mm/s at 10 m	Site measurement
Soil nailing/ Anchor bolts	Percussive drill rig	5 mm/s at 5 m	Site measurement

Based on the estimated vibration emission levels of each activity and the following equation for geometric damping (conservatively ignoring material damping), predicted levels of vibration with distance can be established.

$$PPV_2 = PPV_1 \left(\frac{R_1}{R_2}\right)^n$$

Where:
PPV – Peak Particle Velocity at the source (PPV_1) and Receiver (PPV_2)
R – distance from source of reference level (R_1) and distance from source of receiver (R_2)
n – ground factor assumed as 1.7 for body waves near the ground surface

Predicted levels of vibration over distance are summarised in Table 6-5.

Table 6-5 Predicted level of vibration with distance from the source

Typical equipment	Distance from source, m				
	PPV, mm/s				
	5	10	15	20	25
32 t Excavator with hammer	9.6	2.9	1.5	0.9	0.6
20t Vibratory roller	14.6	4.5	2.3	1.4	0.9
Drill rig	4.9	1.5	0.8	0.5	0.3

6.3.2 Risk of cosmetic damage

Predicted levels of vibration over distance are illustrated in Figure 6-4. Considering the vibration guideline values prescribed in the CNVS, with residential dwellings at 7.5 mm/s, the risk of cosmetic damage is low for equipment outside 8-10 metres from the source. Where unsound heritage items are present, with a guideline value of 2.5 mm, the risk of damage increases below about 15 metres.

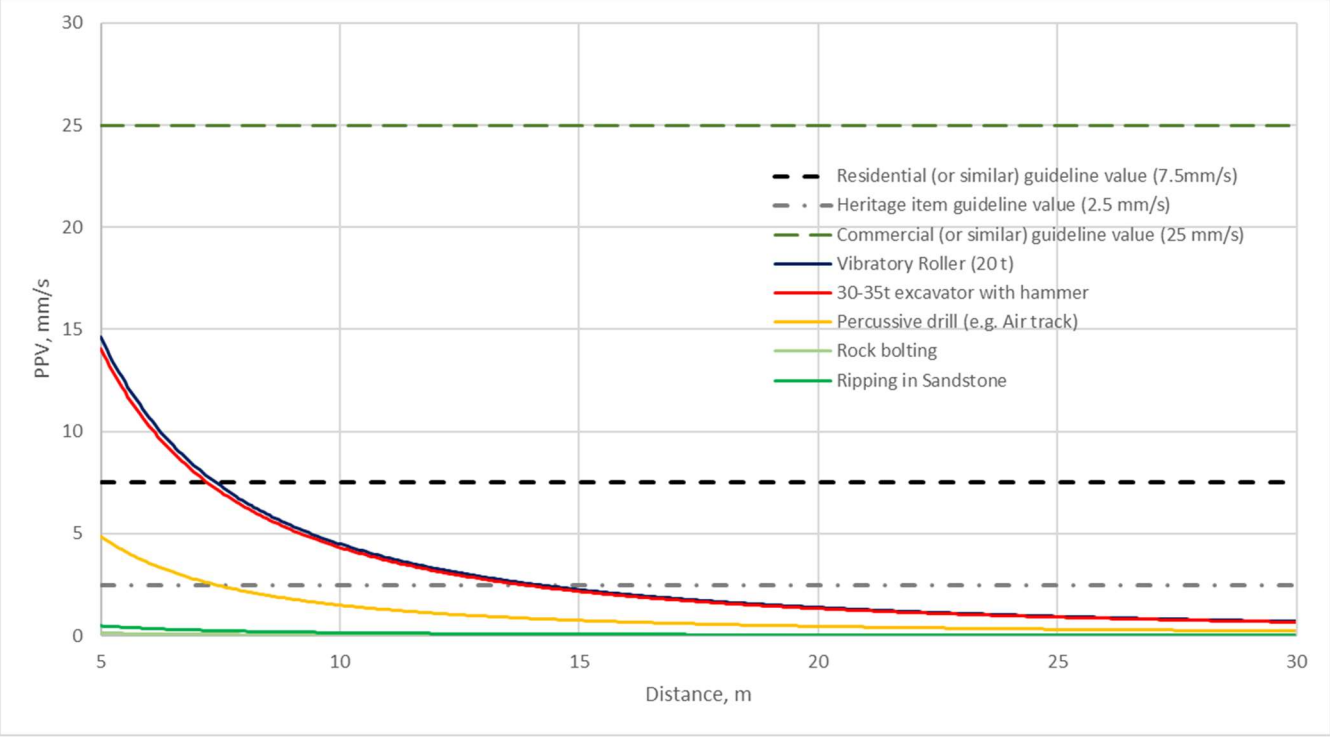


Figure 6-4 Curves of vibration with distance from the source

Contours representing the distance at which the vibration guideline values for each item are predicted to be achieved are presented in Appendix C. Where sensitive structures are within the buffer distance, trial monitoring should be undertaken prior to any works commencing to determine actual vibration levels.

St Albans Church was assessed to be structurally sound by an appropriately qualified person during the initial stages of the project, therefore a criterion of 7.5mm/s would be applicable for construction activity in the vicinity of the Five Dock west shaft.

The number of sensitive receivers within the minimum distance to meet the applicable vibration guidelines can be inferred from the maps in Appendix C and are listed in Table 6-6. Monitoring for sensitive receivers is outlined in (Section 7.1.4) and consultation (Section 7.1.5) provides information on addressing impacts at these locations.

Table 6-6 Properties identified within safe working distance cosmetic damage

Activity	Activity Location	Address	Distance to works (m)
Demolition	East Shaft	110 Great North Rd, Five Dock	6
	East Shaft	21 Waterview St, Five Dock	6
	West Shaft	171 Great North Rd, Five Dock - St Albans Church	3
Excavation	East Shaft	21 Waterview St, Five Dock	15
	West Shaft	171 Great North Rd, Five Dock - St Albans Church	15

Consideration of vibration generating activities should include alternative methods where possible to minimise vibration risk, such as:

- Employ non-vibratory (static) rolling methods for compaction on the where practicable.
- Use a ripper and bucket in place of a hammer where possible.
- Use smallest available excavator and hammer combination when breaking concrete or rock.

Compaction is not anticipated for shaft excavation and tunnelling activities.

The location of sensitive receivers surrounding each site means that the potential for adverse comment is high and the perceived impact to property will be elevated given the presence of construction activities adjacent to residences.

To minimise the potential for recourse of vibration type impacts including ground settling, a thorough investigation and survey of all adjacent properties will be necessary. Vibration monitoring for the most affected buildings including the heritage listed St Albans Church will be required to confirm actual vibration levels against cosmetic damage criteria (see Section 7.1.4).

6.3.3 Human exposure

Excavation rock hammering activities would generate high levels of vibration and over short periods of time. Based on the distance to the nearest residences, It is unlikely the vibration level and duration of operation would result in vibration dose values exceeding the criteria.

To estimate the vibration dose value of hammering, the estimated VDV (eVDV) equation from DEC 2006 has been used:

$$eVDV = 1.4 \times a \times t^{0.25}$$

where *a* represents the root mean square (rms) vibration acceleration in m/s^2 and t is the duration of the activity in seconds. Since we only have velocity values for vibration, acceleration is substituted for velocity by the following equation:

$$a_{rms} = 2 \times \pi \times f \times v_{rms} /1000$$

where f is the dominant frequency of the vibration and v is the root mean square (rms) velocity.

The rms velocity was derived from the peak particle velocity assuming a crest factor (the ratio of the peak value to its rms value) of 4. The dominant frequency of compacting is taken as 80 Hz.

eVDVs for durations of hammering of between 1 hour and 8 hours, are presented in Figure 6-5 and show the VDV at various distances from the source for a range of exposure durations. From the graph, hammering in the daytime would result in possible adverse comment within about 13-15 metres from the source for a total of up to 2 hours of work. For durations over 2 hours, the human comfort impact zone would extend to around 20 metres.

Human exposure to vibration applies when a sensitive receiver is impacted in a habitable room, where no receiver is present, human comfort criteria would not apply. In addition, where the work moves further from the impacted building a reduced impact would be predicted and duration of exposure would increase proportionally.

Human comfort should be assessed inside the residence at the centre of a habitable room. Therefore, the building's construction, how many floors, how the building is coupled to the ground and the distance to the nearest habitable room would influence the actual levels measured during compaction and would likely be lower than predicted.

Vibration contours are presented in Appendix C and illustrate the homes that may fall within the 15 metre contours for possible adverse comment during daytime hours.

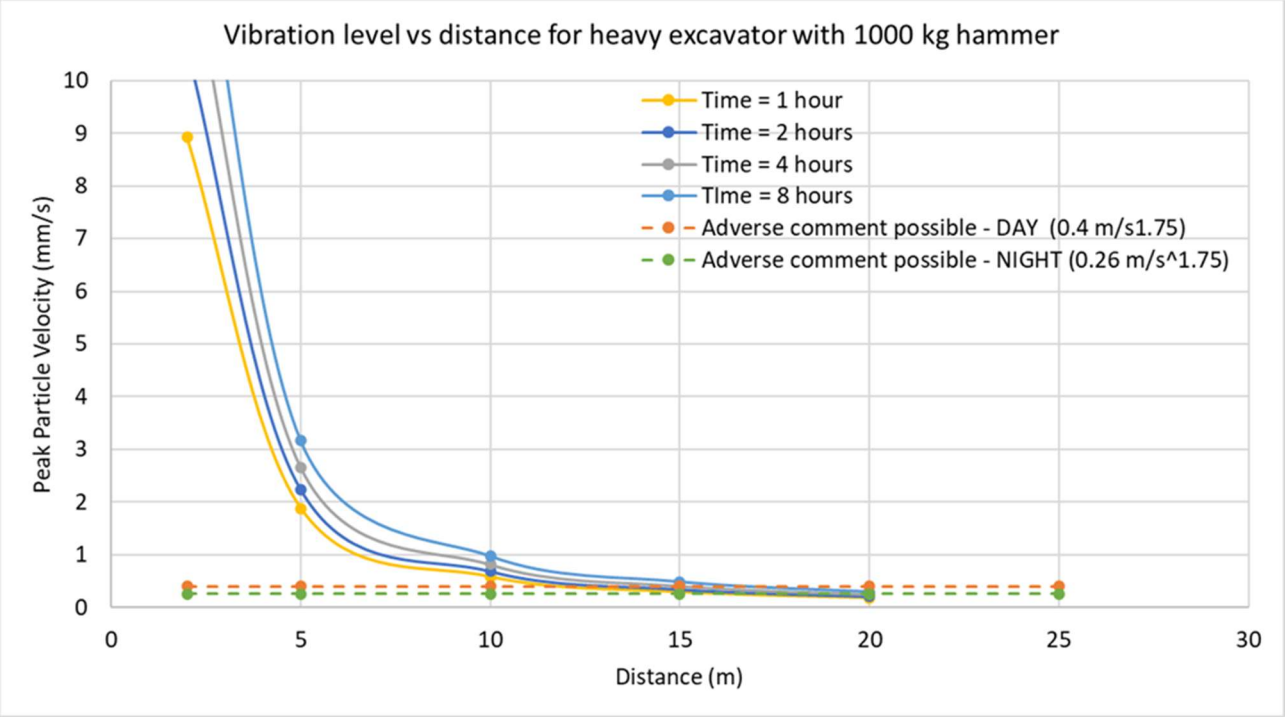


Figure 6-5 VDV curves for excavator and hammer

There are two scenarios assessed for human comfort vibration level: surface vibration works that would occur during site establishment and rock hammering within the tunnel support shaft.

Vibratory works such as rock hammering undertaken during site establishment will generally be of short duration and can be managed using recommendations in Section 6.3.2 combined with respite periods.

When hammering activities move to the tunnel shafts, longer duration impacts are likely and residences within about 20 metres of the work could experience vibration impacts. Prior to the beginning of hammering, a trial run to measure actual vibration impacts at each shaft will be conducted at representative receiver locations where access is available.

Receivers to be monitored for human comfort vibration impacts from surface and tunnel shaft works are shown in Appendix C.

6.4 Construction traffic

Heavy vehicle movements related to the Five Dock construction activities will comprise of deliveries of materials and equipment as well as spoil haulage during excavation.

Predicted truck movements during excavation are presented for each site in Table 6-7 and Table 6-8, indicating average and peak vehicle movements for daily and hourly periods. Other than delivery of materials and equipment, truck movements for the Five Dock sites would only occur during the $L_{Aeq\ 15\ hour}$ (TfNSW NCG daytime period) hours of operation.

During this period the Five Dock West site would have around 18 trucks accessing and 18 leaving per hour over the peak operating period (outside traffic peak-hour). The Five Dock East site is expected to have around 14 trucks entering and leaving the site during the peak of activities, providing the scenario for the worst case 1 hour L_{Aeq} noise level.

Trucks would enter the Five Dock West site from the north bound lane of Great North Road (FD Gate 1) and exit into the same lane (FD Gate 2). At the Five Dock East site, vehicles enter from Waterview Street (FD Gate 4) and exit west bound on the Second Avenue (FD Gate 3), as shown in Figure 6-6.

Public roads around the site, including Waterview Street and Second Avenue are expected to have lower volumes of existing traffic and the EIS indicated a 2 dB increase above existing traffic noise on these roads was likely.

Considering this, an assessment against the RNP criteria for arterial and local roads has been undertaken using the *Calculation of Road Traffic Noise* (CoRTN) methodology.

Five Dock West has the existing traffic profile of an arterial road and with a RNP criteria for daytime road traffic of 60 dB L_{Aeq} 15hr. Five Dock East is classified as a local road with a 55 dB L_{Aeq} 1 hr traffic noise criteria.

Based on a speed limit of 40-50km/h for vehicles entering and exiting the east and west site, predicted noise levels at 7 metres for the peak number of construction-related heavy vehicles would be 64 dB L_{Aeq} 1hr and 63 L_{Aeq}15hr respectively, indicating an exceedance of the RNP traffic noise criteria for both sites at the closest residences.

The project noise and vibration sub plan provides for the management of construction traffic related noise impacts as follows:

Where road traffic noise levels increase by more than 2 dBA because of construction traffic, consideration will be given to applying feasible and reasonable noise mitigation measures to reduce the potential noise impacts and preserve acoustic amenity. Consideration will also be given to the actual noise levels associated with construction traffic and whether these levels comply with the following road traffic noise criteria in the RNP:

A review of the predicted impacts from construction traffic for these receivers indicates that there were no viable options for traffic noise mitigation detailed in the EIS. Due to the limited duration of spoil removal from

the east and west sites, and given that these impacts are further restricted by the CoA D37(d) to daytime traffic spoil movements, a monitoring survey will be initiated to assess actual noise levels for impacted roads in accordance with the management sub plan. This survey will also include street sweeper movements. Following the noise survey, a review of feasible and reasonable mitigation in accordance with the project Revised Environmental Management Measure (REMM) NV14 will be provided in a traffic noise monitoring report.

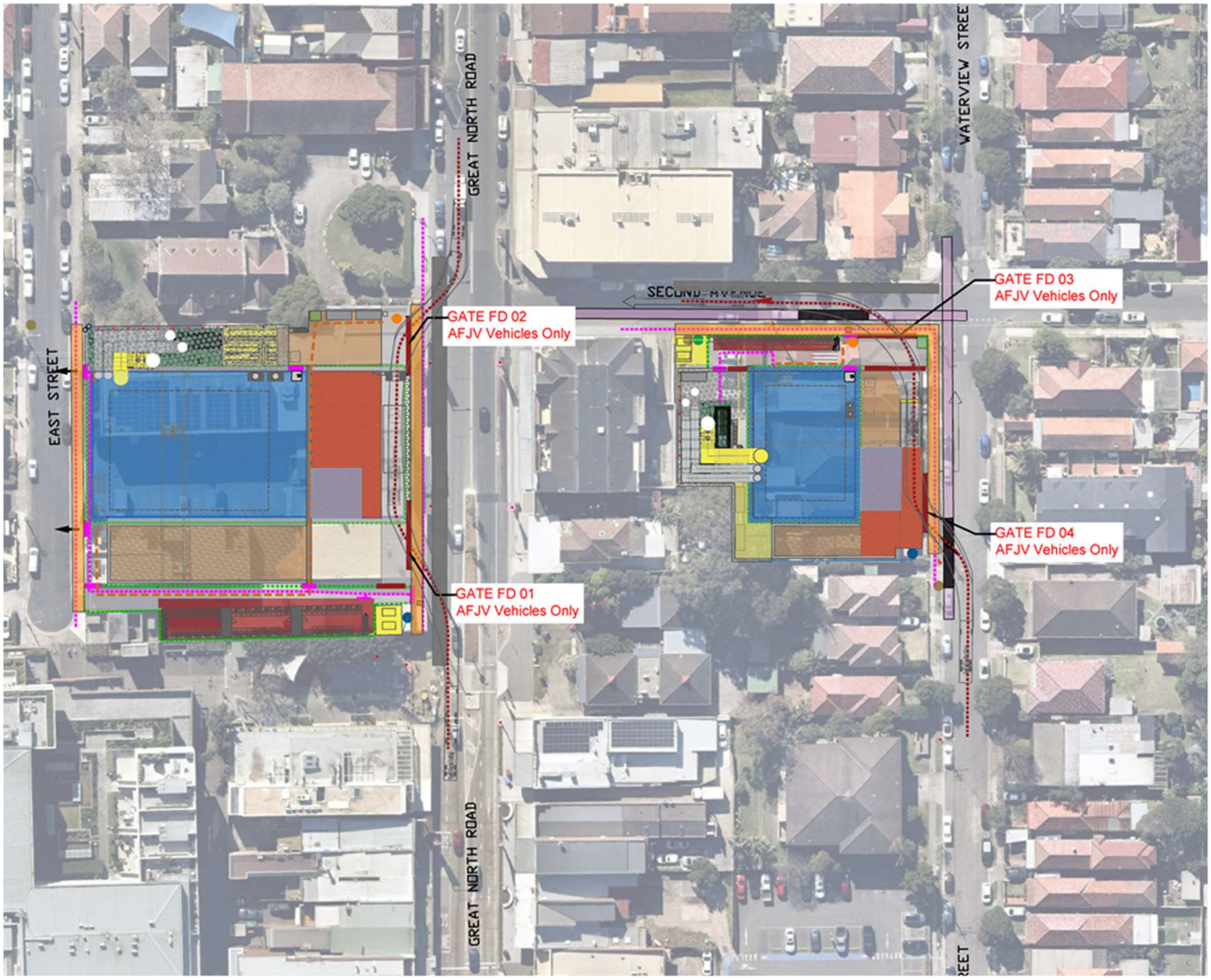


Figure 6-6 Five Dock construction traffic movements

Table 6-7 Construction traffic Five Dock West – Heavy Vehicles

		Five Dock West Shaft							
		Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23
AVG	Number of Trucks per day	36	54	88	115	115	115	115	115
	Number of Trucks per hour	4	8	8	13	13	13	13	13
PEAK	Number of Trucks per day	35	60	115	154	154	154	154	154
	Number of Trucks per hour	4	3	12	18	18	18	18	18

Table 6-8 Construction traffic Five Dock East – Heavy Vehicles

		Five Dock East Shaft							
		Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23
AVG	Number of 10 wheelers per day	81	55	55	90	90	90	90	90
	Number of 10 wheelers per hour	8	6	6	10	10	10	10	10
PEAK	Number of 10 wheelers per day	87	87	96	120	120	120	120	120
	Number of 10 wheelers per hour	9	9	12	14	14	14	14	14

7. Summary and recommendations

7.1.1 Impact summary

This DNVIS established that during some early construction activities, noise and vibration would result in adverse impacts on the local community, with residents directly adjacent to the works experiencing the greatest level of impact.

In NCA 14 and 15,the NMLs at night reduce to very low levels increasing the risk of impacts during this time. Based on predicted noise levels, proposed construction program during approved hours and sensitivity of the community to noise and vibration, this site is classed as a moderate risk and mitigation measures in line with this classification are proposed.

To minimise the risk of impacts for the Five Dock community, only works during approved hours are planned for construction activities up to the time of completion of the acoustic shed at Five Dock east. The acoustic shed has been designed to mitigate noise from most activities during the daytime and evening hours. Construction works during the night would continue where activities within the shed are NML compliant at the nearest receiver locations.

At Five Dock west shaft construction activities would remain as approved operating hours only for the duration of the site construction activities expected to be completed in November 2023.

Noisy activities such as rock hammering are not planned for night-time at the eastern site however, other works are expected to be undertaken inside the acoustic shed. Spoil stockpiling and other activities within the acoustic shed are not predicted to generate an exceedance of the NML during these times.

As there are no noisy works programmed during the evening or night, there are no sleep disturbance impacts expected for the duration of the Project.

Out of hours work will be required for works outside the scope of this DNVIS such as out of hours utility relocations and oversized plant deliveries and this will be assessed through the out of hours work process. These activities may cause impacts above NML and sleep disturbance levels and mitigation measures such as offering alternative accommodation will be implemented as required.

Construction traffic for the Five Dock sites is managed in accordance with the requirements of the project approval limiting vehicle movements to the 7am to 10 pm daytime period as detailed in the Road Noise Policy. Traffic noise impacts on local roads are considered against the requirements of the Revised Environmental Management Measures for these sites.

During establishment vibration impacts from surface works including hammering or vibratory rolling were managed in accordance with the Project NVMP. Noise and vibration monitoring has been implemented at key locations close to the shaft sites to identify any exceedances of the project goals during that time.

With respite, the level of human comfort impact on residents is not likely to exceed any vibration management levels outside of the 15 metre buffer zone around these activities. With the implementation of vibration reducing construction methods, cosmetic damage to property outside of this distance is also less likely.

7.1.2 Standard mitigation

Standard noise mitigation measures described in Table 7-1 should be implemented at all phases of the project in addition to those described in the project Construction Noise and Vibration Management Plan (CNVMP).

In line with CoA D42 best practice construction methods will be implemented where reasonable and feasible to ensure noise is maintained at a practical minimum. Practices will include:

- use of regularly serviced low sound power equipment;
- temporary noise barriers (including the arrangement of plant and equipment) around noisy equipment and activities; and
- use of specific alternative construction techniques such as:
  - Minimising use of rock hammers during demolition phase of the work by using shear and jaw attachments for excavators
  - Avoid hammering foundations during demolition where practicable by saw cutting and lifting slabs with the excavator bucket
  - Minimising use of rock hammers using rippers and road headers for spoil removal where practicable
  - Completing pile cap breaking using non percussive equipment such as pile croppers

The acoustic shed will be designed and constructed with the aim of meeting the NMLs for evening and night periods for the activities proposed during these times. Shed walls will be erected as early as possible, with walls protecting the nearest residential receivers to be scheduled as a priority.

Where external noise sources are identified outside of this DNVIS, use of noise mats and timber hoarding will provide both an acoustic benefit and a visual indicator to the public that all reasonable and feasible measures are being undertaken.

Equipment should be selected with consideration of noise emissions and the quietest equipment that can do the job should be chosen.

As required by CoA D37(a), any emergency works predicted to exceed the NML would be undertaken in accordance with Section 6.6 of the out-of-hours works protocol (SMWSTCTP-AFJ-1NL-PE-PLN-000005 Revision 02). Consultation will be critical in ensuring the community's expectations are managed, with impacts and durations clearly conveyed, resident's concerns heard, appropriate respite and other mitigation is offered and/or implemented and works outside of hours are not unexpected.

Table 7-1 Standard mitigation measures

Measure	Description
Administrative	
Construction hours	• As much work as possible will be programmed during approved hours. Where work outside approved hours is proposed, this will be completed in line with the CNVMP and Out of hours works protocol.
	• When working outside schools, medical facilities and child care centres, excessively noisy activities will be completed outside normal working hours where practicable.
	• When working outside churches, particularly noisy activities will be undertaken outside scheduled service times where reasonable and feasible.
	• Noisy activities as defined in the ICNG, such as concrete cutting, will be undertaken on a 3 hours on, 1 hour off basis to provide respite to the community, unless otherwise approved.

Measure	Description
Implementation	• Where mitigation measures include physical controls such as noise barriers and enclosures, long-term monitoring locations, specific mitigation measures for receivers, these will be included in an Environmental Control Map (ECM) for easy reference.
Community consultation	• In line with the CNVMP, nearby receivers should be notified of the upcoming works, including the duration and predicted level of impact.
	• In line with the CNVS, community consultation will be undertaken regarding the DNVIS and proposed mitigation such as respite offers
Site induction	• Site Environmental Induction should be delivered to the team and should include consideration and awareness of noise impacts.
Cumulative impacts	• Programming for works undertaken outside approved hours will also consider works being undertaken by third parties
Behaviour	• Avoid yelling and swearing near sensitive receivers.
Noise control	
Equipment selection	• Priority will be given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable.
	• All equipment shall be well maintained, including mufflers and any noise suppression
	• All equipment will meet the maximum sound power requirements of Table 13 of the CNVS.
	• Trucks approaching construction sites will avoid the use of compression braking, especially in the night period
	• Traffic management signage vehicles shall be padded to reduce rattling as much as possible.
Noise barriers	• Use temporary noise screens and enclosures as much as possible to reduce noise emissions from equipment when stationary or operating in one location for a reasonable duration. Screens (such as Echobarrier) should be placed between source and receivers, be continuous (without gaps) and installed according to manufacturer directions.
Use and siting of plant	• Plant used intermittently to be throttled down or shut down. Switch engines off when not in use for a short time (e.g. 15 minutes) • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Avoid compression breaking on approach to the site.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or equivalent) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Monitoring	
Noise monitoring	• Noise monitoring shall be completed to: - verify assumptions of this DNVIS regarding estimated equipment noise emissions, - ensure noise levels remain within the NMLs, - as required by the AMM for each assessed activity and - as required by the NVMP and associated monitoring program.
Vibration monitoring	• Attended vibration measurements would be undertaken at the commencement of vibration generating activities within safe working distances shown in Appendix B. Where there is potential for exceedances of criteria vibration, site law investigations would be undertaken to determine site-specific safe working.

7.1.3 Additional mitigation measures

Additional noise mitigation measures described in the CNVS AMMM should also be implemented as indicated in Appendix D for each receiver. AMM for each receiver is indicated by colour-coding as per the AMMM in Table 4-2.

AMMM would be largely limited to notifications and monitoring. Where works are undertaken outside approved hours, additional notification would likely be required as well as ensuring appropriate respite is

provided. Alternative Accommodation is not likely to be needed for works assessed in this DNVIS; however this will be reviewed on a case-by-case basis. Alternative accommodation is likely to be offered for work outside the scope of this DNVIS such as out of hours utility relocations and this will be assessed through the out of hours work process.

For vibration, AMM should be applied for sensitive receivers where measurement indicates it is applicable. In this case, measurement means either at a single location, which also indicates the likely level (and relevant AMM) at other similarly exposed locations or as established by site law measurements to indicate which receivers would be within the site-specific safe working distances.

7.1.4 Monitoring

Several assumptions have been made in this assessment to provide representative predictions, such as work location, equipment types, numbers, intensity of operation and noise screening options and these will be verified once works commence and regularly throughout the program.

Noise and vibration monitoring is undertaken in line with the Noise and Vibration Monitoring Program and out-of-hours protocol as appropriate, with the following monitoring to be completed as a minimum.

Noise

- Sound power level verification (on-site) to ensure equipment meets the requirements of the CNVS
- Monitoring at representative nearby sensitive receivers to verify predictions at various phases of construction.
- Evaluation of the acoustic shed to establish they meet the design requirements described in this DNVIS.
- Ground-borne noise monitoring would be conducted within the centre of habitable rooms at locations identified to exceed the ground-borne noise NMLs or in the event of a complaint if monitoring is identified as an appropriate response.

Vibration

- To verify predicted levels and assist in meeting objectives. This will be done as new vibration intensive activities commence such as ground compaction, percussive drilling, non-rippable excavation with hammers. Monitoring locations have been established at the nearest sensitive receivers or at the closest boundary if private property access was unavailable.
- Vibration monitoring was completed at heritage items while any vibratory work was underway within the nominated safe working distances. This includes the St Albans Church. In line with CoA D47, where vibration sensors were mounted directly onto the fabric of the church after a heritage specialist had been consulted.

Continuous monitoring

- To meet the requirements of CoA D63, fixed monitoring locations have been identified for this site and are detailed in the CNVMP. Long-term noise and vibration monitoring data at these locations will be readily available as required in the CNVMP and Monitoring Program.

7.1.5 Consultation

Condition of Approval D43 requires mitigation measures presented in this DNVIS to be identified through consultation with the affected community. This applies to standard hours and works outside standard hours. All mitigation measures developed as part of this DNVIS have been formed around community needs and concerns established through the community consultation process, as required by CoA D43.
In reviewing sensitive land uses near the Five Dock sites, specific receivers requiring consultation include:

- Childcare centre(s) – Sunshine Early Learning Centre on East Street
  - Place manager has had multiple conversations with centre manager and other staff to understand their needs, notify upcoming work, with one key outcome being identification of sleep times and in order to avoid them where possible.
  - Some recent work near the centre has been scheduled on Saturdays to avoid weekday disturbance.
  - Sydney Metro has installed some acoustic treatment measures at the property.
- Church – St Alban's Anglican Church (between East Street and Great North Road)
  - Place manager has frequent ongoing contact with property manager and Pastor over a range of topics.
  - Pre-construction property condition surveys offered, accepted and completed on church complex buildings
  - AFJV has installed a noise and vibration monitor on the southern side of the church building.
  - AFJV has assisted the Church with their driveways resurfacing work
  - AFJV partnered with the Church to deliver the 2022 Jazz on the Lawn Festival (printed promotional signage, volunteers helped to set up on the day, provided and staffed the BBQ stand and donating proceeds to charity)
- Public School – Five Dock Public School on West Street
  - AFJV staff have conducted online project briefing meetings with the school Principal and the president of the P&C in late 2021, and then with a broader P&C group in February 2022. Key concerns are around safety, noise, parking and traffic.
- Most sensitive residential receivers - residents of the unit block at 110 Great North Road between the two construction sites:
  - AFJV held an online residents' meeting specifically for this building in November 2021 to outline the construction program of work, understand the owners/residents' concerns and answer questions.
  - AFJV has had ongoing regular engagement with the residents and their key concerns are construction noise, truck movements, traffic safety and tunnelling impact.
  - Provided customised OOHW updates including detail of progress and specific locations as the work progresses
  - AFJV has also stopped work for up to an hour on two occasions for a resident of 110 Great North Road to attend important online meetings.
  - AFJV has installed a noise and vibration monitor on the eastern side of 110 Great North Road to provide ongoing data
  - AFJV has conducted additional attended noise and vibration monitoring in common areas and in residences.
  - Provided noise cancelling headphones to mitigate daytime noise impacts as well as good will gestures such as cinema vouchers and prepaid giftcards for special circumstances
  - Offered Bluetooth eye masks to trial which was declined.
  - Provided sleep ear plugs for trial to one household for whom alternative accommodation was not suitable
  - Pre-construction property condition surveys offered, accepted and completed for 14 of 15 properties in the complex.
  - Alternate accommodation offered to residents in this building for a range of nightwork events, with low acceptance rate to date. Adjusted these offers for residents with specific special circumstances to address their needs relating to location of accommodation, amenities within accommodation and duration of relocation.
  - Scheduled night work near the building to coincide with a period when some residents were away in December 2022 to minimise overall disturbance

AFJV is leasing the only directly adjacent property to the eastern construction site (southern side on Waterview Street) which provides a further noise buffer to nearest receivers.

In addition, AFJV place manager's presence on site since October 2021 has seen many impromptu outdoor conversations with residents and businesses around the construction sites. Face-to-face interaction has increased with the easing of Covid-19 restrictions in 2022.

Drop In Sessions:
AFJV staff were in attendance at a Sydney Metro EIS drop in session on 31 March 2022 in Five Dock Library as well as the Ferragosto festival on 21 August 2022. AFJV held a community drop in session on 7 April 2022 in Five Dock Library and community drop in sessions within Fred Kelly Place on 28 July, 6 August and 13 August 2022. Further sessions are planned for May 2023.

Presentations:
AFJV has made presentations with Q&A sessions to:

- Five Dock Rotary Club
- Abbotsford Chiswick Probus Club
- Five Dock Chamber of Commerce (noted above)
- Five Dock Public School P&C Committee

Ongoing Consultation:
Extensive community consultation has occurred since before construction commenced at Five Dock and community engagement will continue throughout construction. The concerns and sensitivities of the local community is well understood and has been considered in determining reasonable and feasible mitigation measures.

AFJV continues to consult with the community about planned work by providing regular updates about upcoming activities, associated noise and vibration impacts and mitigation measures being implemented as well as seeking ongoing feedback to be provided via email, 24-hour phone line or in person meetings. The email distribution list has grown to nearly 3000 recipients and they receive weekly email updates, monthly construction updates, specific OOHW work notifications, newsletters and event invitations via email. Impromptu project updates occur regularly with residents, shoppers and businesses when the Place Manager is approached on the streets around the construction sites

Further engagement is planned to occur in May 2023 to discuss the changes to construction sequencing and methodology at the Five Dock sites which has come about after AFJV carried out a detailed review of the work at both sites and determined that it would be less impactful to the community (from a construction duration point of view) to carry out station cavern excavation from the eastern site where the acoustic shed is already in place.

An out of hours work lookahead of no less than 3 months is provided to the community on a quarterly basis while site-based email and Sydney Metro Connect App messages provide regular updates on progress of current out of hours work as well as upcoming work. Information obtained from the ongoing engagement will be considered as the out of hours scope of work evolves and where appropriate, further targeted mitigation measures will be implemented.

The local community will be provided with information about the change of approach at the western site with regards to not installing an acoustic shed, and an opportunity to discuss the changes with members of the AFJV team. Key activities will include:

- Briefings for City of Canada Bay Council
- Notification distributed to all residents and businesses within 500m and sent to email distribution list
- Construction update briefings for relevant local organisations such as Five Dock Chamber of Commerce
- Doorknock residents and businesses adjacent to the western site
- Community information sessions in Fred Kelly Place
- Respond to stakeholder enquiries as they are received
- Community meetings specifically arranged for receivers in 110 Great North Road apartments

Appendix A. Land use survey and NCA maps


Barnstaple Road
Great North Road
First Avenue
Great North Road
Ramsey Road
Sydney Metro West
Central Tunneling Package
Land Use Survey
Five Dock east
Five Dock west
Receiver Type
Childcare
Commercial/Business
Commercial/Residential
Community Use
Community/Residential
Education
Hotel
Industrial/Utilities
Recreational/Open Space
Residential
Medical
Place of Worship
Recreational Passive
Aged Care
Transport/Infrastructure
0
50
100 m
Cabarita Park
Birkenhead Point
Burwood
M4
A22

Appendix B. Proposed equipment and sound power levels

B.1 Site establishment

Phase		Activity/ Work Area	Aspect		Plant/Equipment	Day	Evening	Night	SWL, dBA	Usage	Temp. barrier reduction, dB	Penalty, dB	SWL	Adj equipment SWL, LAeq,15 minute			Activity LAeq, 15 min SWL		
						7am - 6pm	6pm - 10pm	10pm - 7am					Lmax	Day	Evening	Night	Day	Evening	Night
1	Site Establishment- West shaft	**Construction Compound**	1a	Routine site activities	Power Generator	1			107	0.6		0	112	105	0	0	110	0	0
					Road truck (deliveries per 15 minutes)	2			107	0.6		0	112	108	0	0			
					Light vehicle / 15 min	4			93	0.3		0	98	94	0	0			
					Compressor	1			101	0.3		0	106	96	0	0			
					Hand tools	1			94	0.2		0	99	87	0	0			
					Water cart/ Street Sweeper	1			103	0.4		0	108	99	0	0			
					Franna Crane	1			101	0.3		0	106	96	0	0			
		Construction facilities	1b	Construction facilities	Excavator w bucket	2			107	0.6		0	112	108	0	0	111	0	0
					Franna Crane	1			98	0.6		0	103	96	0	0			
					Small Truck / 15 min	1			93	0.3		0	98	88	0	0			
					Concrete Agi / 15 min	2			103	0.3		0	108	101	0	0			
					Pneumatic vibrator	1			95	1		0	100	95	0	0			
					Compressor trailer mounted diesel	1			94	0.4		0	99	90	0	0			
					Concrete pump	1			108	0.3		0	113	103	0	0			
					Mobile crane	1			104	1.4		0	109	105	0	0			
					Hand tools	2			94	0.2		0	99	90	0	0			
					Elevated work platform	2			89	2.4		0	94	96	0	0			
		Temporary fencing/ hoardings	1c	Fencing & hoarding	Bobcat	1			107	0.3		0	112	102	0	0	107	0	0
					Tracked excavator w bucket	1			107	0.4		0	112	103	0	0			
					Flat bed truck	1			93	0.3		0	98	88	0	0			
					Hiab	1			101	0.3		0	106	96	0	0			
					Hand tools	1			94	0.2		0	99	87	0	0			
					Concrete agitator trucks	1			103	0.3		0	108	98	0	0			
		Utilities Disconnection	1d	Utilities disconnection	15t tracked excavator + bucket	1			107	0.4		0	112	103	0	0	110	0	0
					EWP	1			89	0.3		0	94	84	0	0			
					Bogie trucks	1			93	1		0	98	93	0	0			
					Compressor	1			93	0.5		0	98	90	0	0			
					Jackhammer*	1			111	0.2		5	119	109	0	0			
		Demolition	1e	Demolition	40t excavator	2			112	0.4		0	117	111	0	0	122	0	0
					30t excavator (with hammer)	1			122	0.3		5	130	122	0	0			
					Erkat	1			100	1		0	105	100	0	0			
					20t Franna Crane	1			98	0.4		0	103	94	0	0			
					EWP	1			89	0.3		0	94	84	0	0			
					Bobcat	1			107	0.3		0	112	102	0	0			
		Site Concrete Works	1f	Site Concreting	15t tracked excavator + bucket	1			107	0.4		0	112	103	0	0	109	0	0
					Franna	1			98	0.4		0	103	94	0	0			
					Concrete agi	1			103	0.3		0	108	98	0	0			
					Compressor, trailer mounted	1			94	0.5		0	99	91	0	0			
					Generator	1			106	1		0	107	106	0	0			
					Concrete Pump	1			108	0.3		0	113	103	0	0			
	Site Establishment- East Shaft	**Construction Compound**	5a	Routine site activities	Power Generator	1			107	0.6		0	112	105	0	0	110	0	0
					Road truck (deliveries per 15 minutes)	2			107	0.6		0	112	108	0	0			
					Light vehicle / 15 min	4			93	0.3		0	98	94	0	0			
					Compressor	1			101	0.3		0	106	96	0	0			
					Hand tools	1			94	0.2		0	99	87	0	0			
					Water cart/ Street Sweeper	1			103	0.4		0	108	99	0	0			
					Franna Crane	1			101	0.3		0	106	96	0	0			
			5b	Construction facilities	Excavator w bucket	2			107	0.6		0	112	108	0	0	111	0	0

Phase		Activity/ Work Area	Aspect		Plant/Equipment	Day	Evening	Night	SWL, dBA	Usage	Temp. barrier reduction, dB	Penalty, dB	SWL	Adj equipment SWL, LAeq,15 minute			Activity LAeq, 15 min SWL		
						7am - 6pm	6pm - 10pm	10pm - 7am					Lmax	Day	Evening	Night	Day	Evening	Night
					Franna Crane	1			98	0.6		0	103	96	0	0			
					Small Truck / 15 min	1			93	0.3		0	98	88	0	0			
					Concrete Agi / 15 min	2			103	0.3		0	108	101	0	0			
					Pneumatic vibrator	1			95	1		0	100	95	0	0			
					Compressor trailer mounted diesel	1			94	0.4		0	99	90	0	0			
					Concrete pump	1			108	0.3		0	113	103	0	0			
					Mobile crane	1			104	1.4		0	109	105	0	0			
					Hand tools	2			94	0.2		0	99	90	0	0			
					Elevated work platform	2			89	2.4		0	94	96	0	0			
		Temporary fencing/ hoardings	5c	Fencing & hoarding	Bobcat	1			107	0.3		0	112	102	0	0	107	0	0
					15t Tracked excavator w bucket	1			107	0.4		0	112	103	0	0			
					Flat bed truck	1			93	0.3		0	98	88	0	0			
					Hiab	1			101	0.3		0	106	96	0	0			
					Hand tools	1			94	0.2		0	99	87	0	0			
					Concrete agitator trucks	1			103	0.3		0	108	98	0	0			
		Utilities Disconnection	5d	Utilities disconnection	15t tracked excavator + bucket	1			107	0.4		0	112	103	0	0	110	0	0
					EWP	1			89	0.3		0	94	84	0	0			
					Bogie trucks	1			105	0.2		0	110	98	0	0			
					Compressor	1			93	0.5		0	98	90	0	0			
					Jackhammer*	1			111	0.2		5	119	109	0	0			
		Demolition	5e	Demolition	1 x 30T Excavator	1			109	0.4		0	114	105	0	0	114	0	0
					1 x 20T Excavator	1			105	0.4		0	110	101	0	0			
					Bobcat	1			107	0.3		0	112	102	0	0			
					Pad foot roller	1			109	0.6		0	117	107	0	0			
					Smooth drum roller	1			109	0.4		5	117	110	0	0			
					Franna	1			110	0.4		0	115	106	0	0			
					250T Mobile Crane	1			98	0.4		0	103	94	0	0			
		Temporary construction and concrete slabs	5f	Temporary drainage construction Temporary deck / piles / slab (inc. curing) Construction Slab (inc. curing)	15t excavator + Bucket	1			107	0.4		0	112	103	0	0	109	0	0
					Franna	1			98	0.4		0	103	94	0	0			
					Concrete Agi	1			103	0.3		0	108	98	0	0			
					Compressor (Diesel)	1			93	0.5		0	98	90	0	0			
					Concrete Pump	1			108	0.3		0	113	103	0	0			
					Generator	1			106	1		0	107	106	0	0			

B.2 Shaft excavation (West)\ Shaft excavation (East)

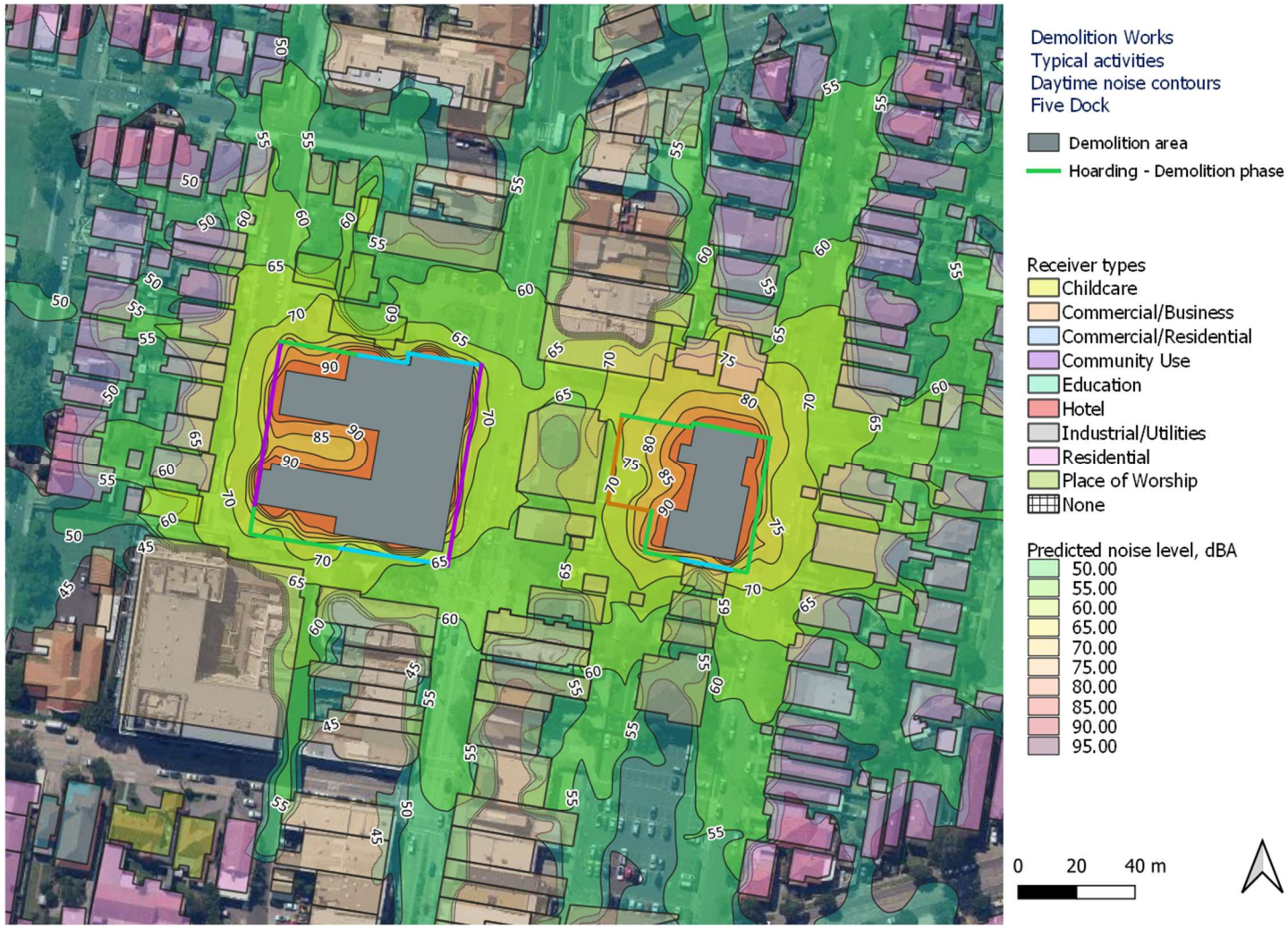
Phase		Activity/Work Area	Aspect		Plant/Equipment	Day	Evening	Night	SWL, dBA	Usage	Temp. barrier reduction, dB	Penalty, dB	Adj equipment SWL, LAeq,15 minute				Activity LAeq, 15 min SWL		
						7am - 6pm	6pm - 10pm	10pm - 7am					Lmax	Day	Evening	Nigh	Day	Evening	Night
2	West Shaft Surface Works	Piling	2a	Piling	Piling Rig (Bauer BG50)	1			113	0.4		0	118	109	0	0	111	0	0
					Franna x2	1			98	0.4		0	103	94	0	0			
					Concrete Pump	1			108	0.3		0	113	103	0	0			
					15t tracked excavator + bucket	1			107	0.4		0	112	103	0	0			
		Hoarding	2b	Hoarding (final layout)	100t mobile crane	1			98	0.4		0	103	94	0	0	103	0	0
					EWP	1			89	0.3		0	94	84	0	0			
					Delivery truck	1			93	1		0	98	93	0	0			
					Table saw*	1			100	0.2		5	108	98	0	0			
					Rattle gun*	1			105	0.2		0	110	98	0	0			
					5" grinder *	1			93	0.2		5	101	91	0	0			
					25T Mobile pick and carry crane (franna)	1			98	0.4		0	103	94	0	0			
		Capping Beams	2c	Capping Beams	Franna	1			98	0.4		0	103	94	0	0	106	0	0
					5t excavator + cropper	1			94	0.4		0	99	90	0	0			
					20t excavator x1	1			105	0.4		0	110	101	0	0			
					Concrete pump	1			108	0.3		0	113	103	0	0			

Phase	Activity/Work Area	Aspect		Plant/Equipment	Day	Evening	Night	SWL, dBA	Usage	Temp. barrier reduction, dB	Penalty, dB	Adj equipment SWL, LAeq,15 minute				Activity LAeq, 15 min SWL		
					7am - 6pm	6pm - 10pm	10pm - 7am					Lmax	Day	Evening	Nigh	Day	Evening	Night
				Vibrator	2			100	0.4		0	105	99	0	0			
	Active Anchors	2d	Active Anchors	Drill rig	1			114	0.4		5	119	115	0	0	115	0	0
				Shotcrete rig	1			106	0.4		0	111	102	0	0			
				Franna	1			98	0.4		0	103	94	0	0			
West shaft Excavation	Excavation - OTR	2e	OTR 0m-3m	2x 70T Excavator + Bucket (Bulk)	2			112	0.6		0	117	113	0	0	114	0	0
				1x 50T Excavator + Bucket (Bulk)	1			108	0.8		0	113	107	0	0			
				1x 30T Excavator + Bucket (Trim)	1			109	0.4		0	114	105	0	0			
	Excavation - Rippable	2f	Rip 3m-10m	1x D9 Dozer + ripper	1			117	0.4		0	122	113	0	0	115	0	0
				1x 50T Excavator + Bucket (Bulk)	1			108	0.8		0	113	107	0	0			
				1x 30T Excavator + Bucket + Ripper (Trim Walls)	1			109	0.4		0	114	105	0	0			
	Excavation - Non-Rippable	2g	Non_Rip 10m-20m	2x 60T Excavator + Bucket + Hammer (Bulk)	1			122	0.3		5	130	122	0	0	125	0	0
				1x 50T Excavator + Bucket	1			122	0.3		5	130	122	0	0			
				1x 30T Excavator + Bucket + Ripper (Trim Walls)	1			112	0.4		0	117	108	0	0			
	Excavation - Road Header	2h	Road header 20m-30m	300kW Roadheader Machines (Sandvik MT720)	2			100	1		5	108	108	0	0	110	0	0
				20T Excavators	1			109	0.4		0	114	105	0	0			
	Retention - Rockbolts	2i	Rock Bolting Row 03 - 22m below surface	Drill Rig (ECM 660IV)	1			114	0.4		5	119	115	0	0	115	0	0
				Shotcrete rig	1			106	0.4		0	111	102	0	0			
				telehandler	1			89	0.3		0	94	84	0	0			
				EWP x 2	1			100	0.4		0	105	96	0	0			
				Franna	1			98	0.4		0	103	94	0	0			
3	Mucking out-station	Mucking Out - Excavator	3a	Load out (only during OTR)	30t excavator +bucket	1			109	0.4		0	114	105	0	0	107	0	0
				Truck (25t)	1			107	0.3		0	112	102	0	0			
		Mucking Out- Gantry & excavator	3b	Shaft and Station cavern excavation	100t gantry crane	1			99	0.2		0	100	92	0	0	108	0	0
				2 x Truck (25t)	2			107	0.3		0	112	105	0	0			
				30t excavator +bucket	1			109	0.4		0	114	105	0	0			
4	Station Caverns (West)	Tunnelling	4a	Station Cavern Excavation (work within tunnel portal)	2 x 300kW Road header	2			100	1		5	108	111	0	0	127	0	0
				2 x 30T ADT Dump Trucks	2			108	0.2		0	113	104	0	0			
				40T Volvo Loader	1			110	0.4		0	115	106	0	0			
				E.W.Ps	1			89	0.3		0	94	84	0	0			
				2 x 20T Excavators	2			105	0.4		0	110	101	0	0			
				Twin boom robo drill	1			120	0.4		5	128	127	0	0			
				Shotcrete Rig	1			106	0.4		0	111	105	0	0			
		Concrete Lining	4b	Concrete Lining	3 x 6m3 agi truck	3			103	0.3		0	108	103	0	0	110	0	0
				Concrete Line Pumps	1			108	0.3		0	113	103	0	0			
				Telehandlers	2			100	0.4		0	105	99	0	0			
				4 x E.W.Ps	4			89	0.3		0	94	90	0	0			
				Scissor Lift	2			93	0.4		0	98	92	0	0			
				40T Volvo Loader	1			110	0.4		0	115	106	0	0			
				Bobcat	1			107	0.3		0	112	102	0	0			
6	East Shaft Surface works	Piling	6a	Piling	750 dia piling rig	1			113	0.4		0	118	109	0	0	111	0	0
				40t crawler crane	1			109	0.4		0	114	105	0	0			
				15t excavator + Bucket	1			107	0.4		0	112	103	0	0			
		Acoustic Shed	6b	Acoustic Shed	400T Mobile Crane	1			98	0.4		0	103	94	0	0	96	0	0
				1x E.W.P	1			89	0.3		0	94	84	0	0			
				1x Scissor Lift	1			93	0.4		0	98	89	0	0			
				Flatbed Truck Delivery	1			93	0.3		0	98	88	0	0			
		Caping Beams	6c	Caping Beams	Franna	1			98	0.4		0	103	94	0	0	105	0	0
				5T Excavator + Pile Cropper	1			94	0.4		0	99	90	0	0			
				Concrete Pump	1			108	0.3		0	113	103	0	0			
				20T excavator	1			105	0.4		0	110	101	0	0			
		Active Anchors	6d	Active Anchors	Drill Rig	1			114	0.4		5	119	115	0	0	115	0	0

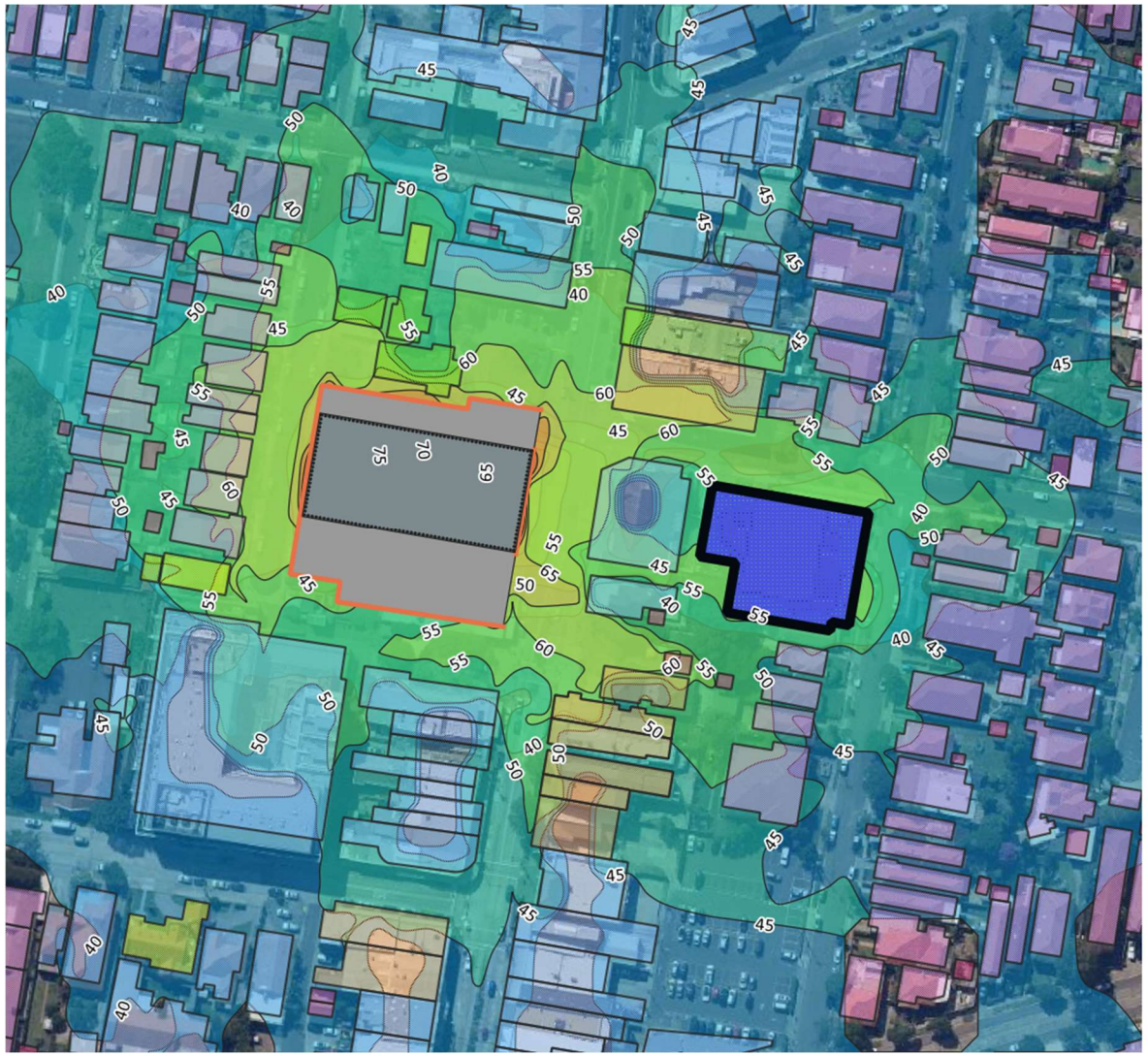
Phase		Activity/Work Area	Aspect		Plant/Equipment	Day	Evening	Night	SWL, dBA	Usage	Temp. barrier reduction, dB	Penalty, dB	Adj equipment SWL, LAeq,15 minute				Activity LAeq, 15 min SWL		
						7am - 6pm	6pm - 10pm	10pm - 7am					Lmax	Day	Evening	Nigh	Day	Evening	Night
					Shotcrete Rig	1			106	0.4		0	111	102	0	0			
					Franna	1			98	0.4		0	103	94	0	0			
	East Shaft Excavation & Retention	Excavation OTR	6e	Excavation OTR	2x 50T Excavator + Bucket (Bulk)	2			112	0.4		0	117	111	0	0	112	0	0
					1x 30T Excavator + Bucket (Trim)	1			109	0.4		0	114	105	0	0			
		Excavation Rippable	6f	Excavation Rippable	2x 50T Excavator + Bucket + Ripper + Hammer (Bulk)	2	1	1	122	0.3		5	130	125	122	122	125	122	122
					1x 50T Excavator + Bucket (Load out)	1	1	1	108	0.8		0	113	107	107	107			
					1x 30T Excavator + Bucket + Ripper (Trim Walls)	1	1	1	109	0.4		0	114	105	105	105			
					1x 30T Excavator + Bucket + Ripper (Saw Cutting/ Trimming))	1	1	1	110	0.4		5	118	111	111	111			
		Excavation Non-Rippable	6g	Excavation Non-Rippable	1x 70T Excavator + Bucket + Hammer (Bulk)	1	1	1	122	0.3		5	130	122	122	122	122	122	122
					1x 50T Excavator + Bucket (Load out)	1	1	1	108	0.8		0	113	107	107	107			
					1x 50T Excavator + Bucket (Load out)	1	1	1	108	0.8		0	113	107	107	107			
					1x 30T Excavator + Bucket + Ripper (Trim Walls)	1	1	1	109	0.4		0	114	105	105	105			
					1x 30T Excavator + Bucket + Ripper (Saw Cutting/ Trimming))	1	1	1	110	0.4		5	118	111	111	111			
		Retention- Rockbolts	6h	Rockbolting	Drill Rig (ECM 660IV)	1	1	1	114	0.4		5	119	115	115	115	115	115	115
					Shotcrete rig	1	1	1	106	0.4		0	111	102	102	102			
					telehandler	1	1	1	89	0.3		0	94	84	84	84			
					EWP x 2	1	1	1	100	0.4		0	105	96	96	96			
					Franna	1	1	1	98	0.4		0	103	94	94	94			
7	Mucking out- East Shaft	Mucking Out - Excavator	7a	Mucking Out - Excavator	1x 50T Excavator + Bucket	1	1	1	112	0.4		0	117	108	108	108	108	108	108
		Mucking Out - Crane and Kibble or telescopic excavator	7b	Mucking out - Shaft	20T Gantry Crane	1	1	1	99	0.2		0	100	92	92	92	106	106	106
					7m3 Bottom Dumping Kibble	1	1	1	98	0.4		0	103	94	94	94			
					15T Loader	1	1	1	110	0.4		0	115	106	106	106			
8	Mined Caverns East	Excavation	8a	Cavern Excavation from 25m-32m	300kW Roadheader Machines (Sandvik MT720)	2	1	1	100	1		5	108	108	105	105	125	122	122
					Bolting Rig (Percusion Drilling)	2	1	1	120	0.5		5	128	125	122	121.9897			
					Shotcrete Rig	1			106	0.4		0	111	102	0	0			
					30T ADT Dump Trucks (Moxy?)	2			108	0.2		0	113	104	0	0			
					40T Volvo Loader	1	1	1	110	0.4		0	115	106	106	106			
					E.W.Ps	4			89	0.3		0	94	90	0	0			
					20T Excavators	2			105	0.4		0	110	104	0	0			
					Bobcat	1			107	0.3		0	112	102	0	0			
		Concrete Lining	8b	Concrete Lining	6m3 agi truck	3	3	3	103	0.3		0	108	103	103	103	110	110	110
					Concrete Line Pumps	1	1	1	108	0.3		0	113	103	103	103			
					Telehandlers	2	2	2	100	0.4		0	105	99	99	99			
					E.W.Ps	4	4	4	89	0.3		0	94	90	90	90			
					Sciccosor Lift	2	2	2	93	0.4		0	98	92	92	92			
					40T Volvo Loader	1	1	1	110	0.4		0	115	106	106	106			
					Bobcat	1	1	1	107	0.3		0	112	102	102	102			

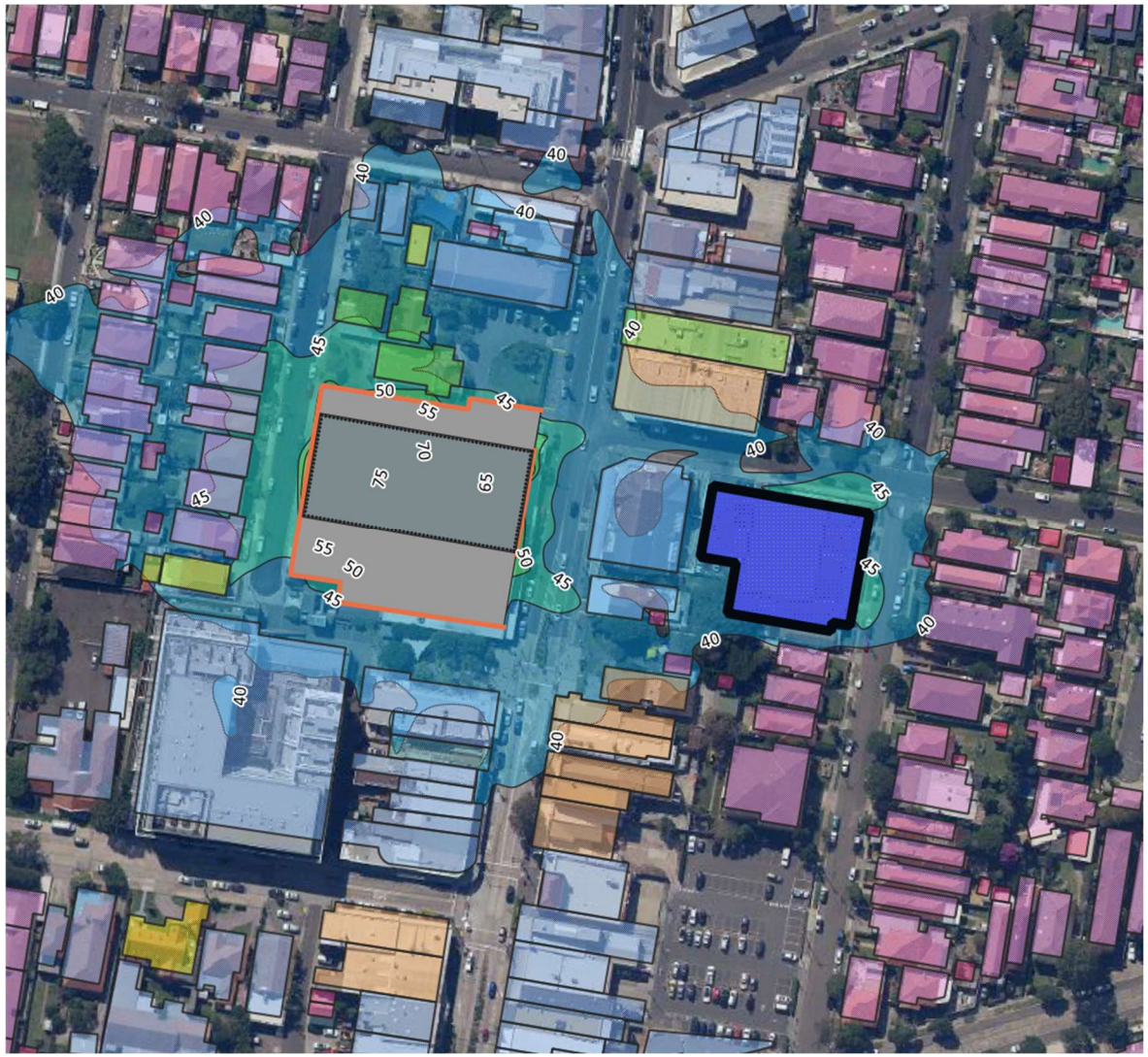
Appendix C. Construction noise and vibration contours

C.1 Construction noise contours




Demolition Works
Rock hammering
Daytime noise contours
Five Dock
Demolition area
Hoarding - Demolition phase
Receiver types
Childcare
Commercial/Business
Commercial/Residential
Community Use
Education
Hotel
Industrial/Utilities
Residential
Place of Worship
None
Predicted noise level, dBA
45.00
50.00
55.00
60.00
65.00
70.00
75.00
80.00
85.00
90.00
95.00
0
20
40 m


Station Box Excavation
West shaft Non- Rippable
Day noise contours
Five Dock
East Acoustic Shed
West Hoarding (3.0m)
Receiver types
Childcare
Commercial/Business
Commercial/Residential
Community Use
Community/Residential
Education
Industrial/Utilities
Residential
Medical
Place of Worship
Predicted noise level, dBA
40.00
45.00
50.00
55.00
60.00
65.00
70.00
0
20
40 m



Cavern mining
30 metres depth
Day noise contours
Five Dock

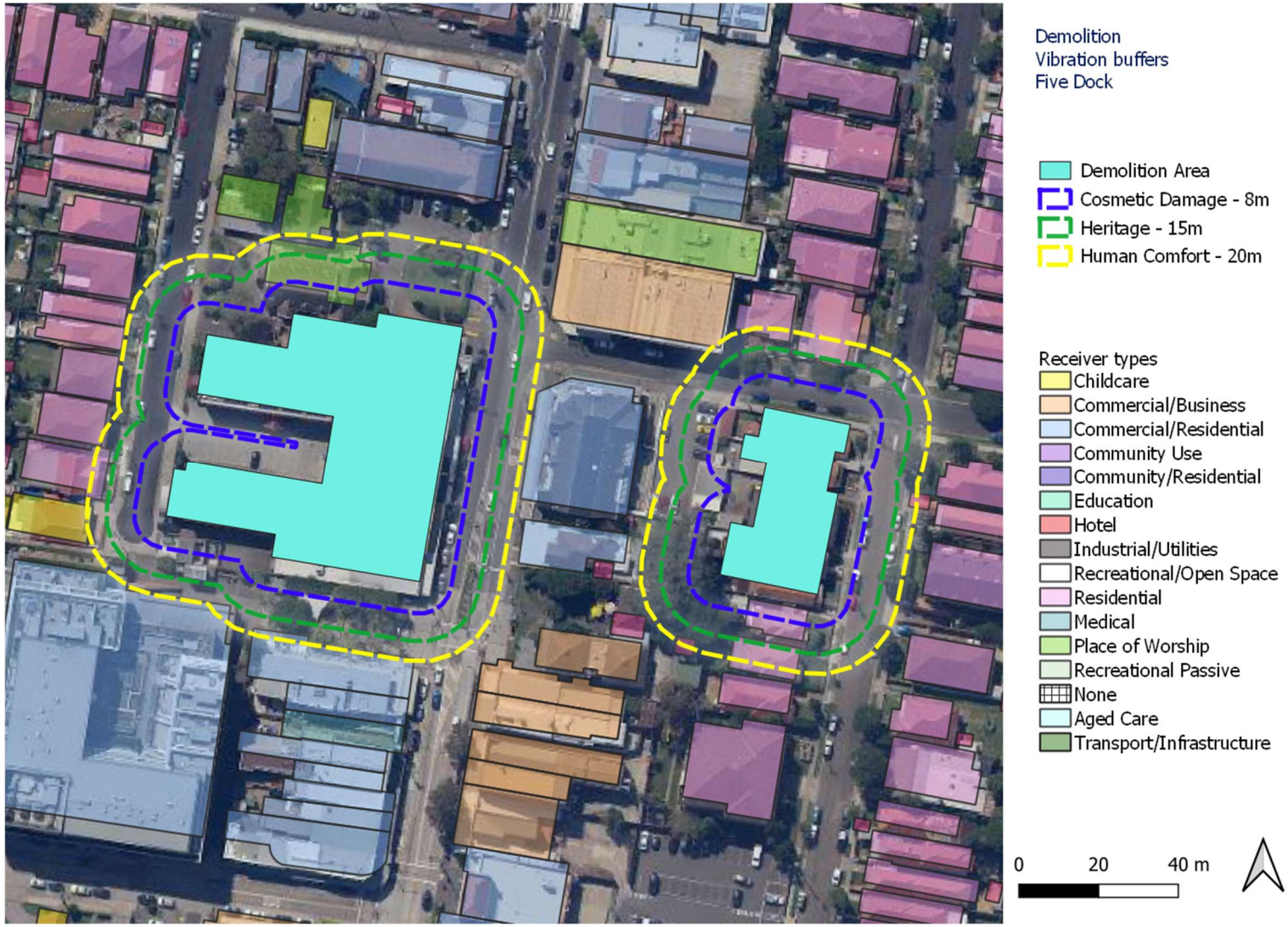
East Acoustic Shed
West Hoarding (3.0m)

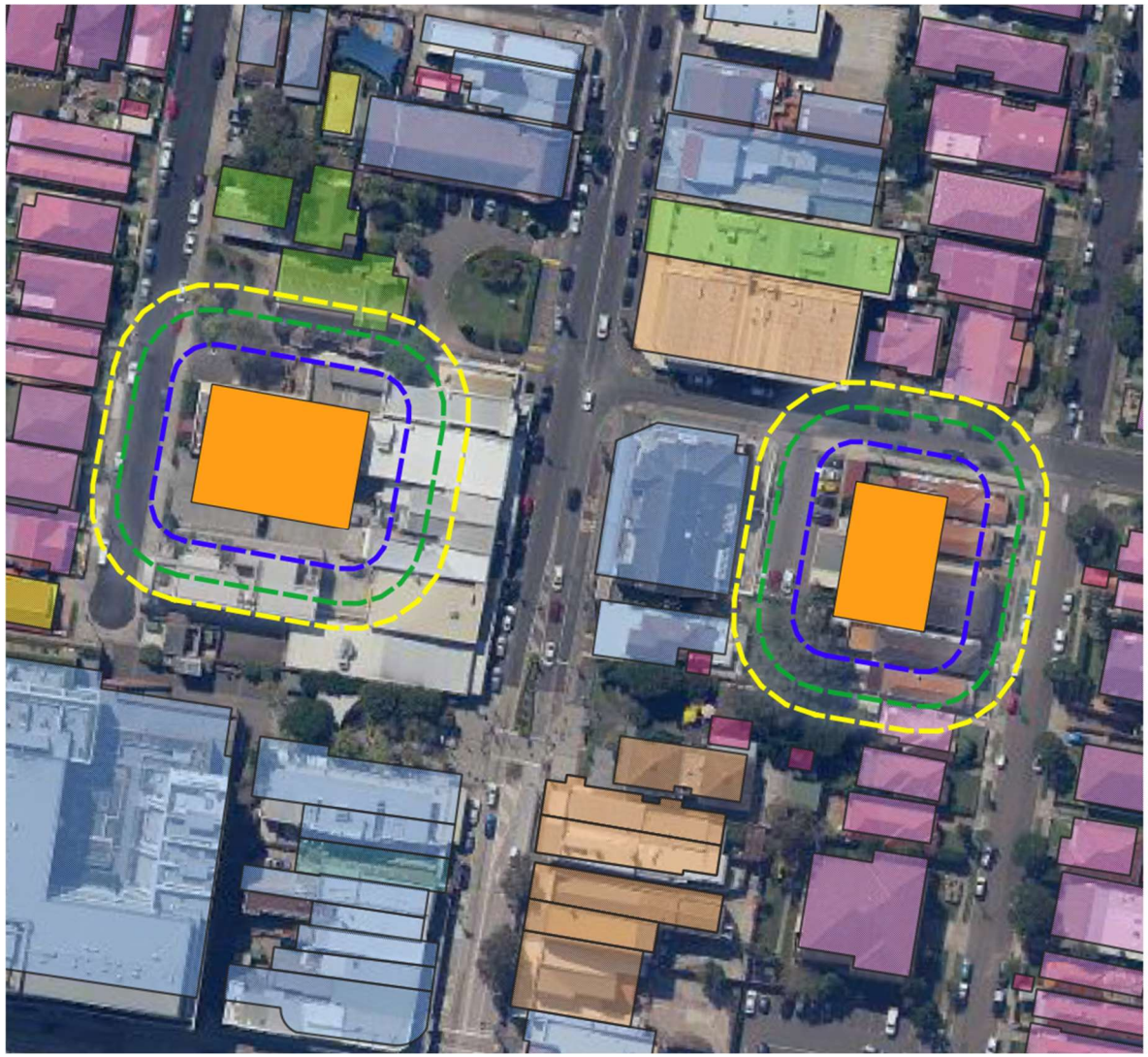
Receiver types
- Childcare
- Commercial/Business
- Commercial/Residential
- Community Use
- Community/Residential
- Education
- Industrial/Utilities
- Residential
- Medical
- Place of Worship

Predicted noise level, dBA
- 40.00
- 45.00
- 50.00
- 55.00
- 60.00
- 65.00
- 70.00
- 75.00

0 20 40 m

C.2 Construction vibration contours





Tunneling Support
Vibration buffers
Five Dock

Acoustic Sheds
Tunneling Support
Cosmetic Damage - 8m
Heritage - 15m
Human Comfort - 20m

Receiver types
Childcare
Commercial/Business
Commercial/Residential
Community Use
Community/Residential
Education
Hotel
Industrial/Utilities
Recreational/Open Space
Residential
Medical
Place of Worship
Recreational Passive
None
Aged Care
Transport/Infrastructure

0 20 40 m

Appendix D. Detailed noise predictions for individual receivers

D.1 Phase 1 and 5 - Site Establishment

D.2 Phase 2 to 8 - Piling and Excavation

D.3 Ground Borne Noise Predictions

Supplied as Excel spreadsheets

Appendix B – Acoustic shed noise scenarios assessments

Detailed noise and vibration impact statement

Acoustic Shed scenarios			
Project	SMW - CTP: Five Dock (May 22 Update)		
Client	AFJV		
Assessment Date	26/04/2023	Assessment Id	FDW_shed
Proposed start date	01/05/2023	Proposed end date	30/06/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Central Tunnelling Package is being delivered by the Acciona Ferrovial Joint Venture (ACJV) and involves excavation of around 11.5 kilometres of twin-bore tunnel linking five station boxes at The Bays, Five Dock, Strathfield, Burwood North and Sydney Olympic Park (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

CoA D43 requires planned works to be assessed within a Detailed Noise and Vibration Impact Statement (DNVIS) where works may exceed the NMLs, vibration criteria and/or ground-borne noise levels specified in CoA D39 and D40 at any residence outside construction hours identified in CoA D35, or where receivers will be highly noise affected.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare site and activity-specific noise assessments for ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This DNVIS has been prepared using KNOWnoise™ and addresses activities for construction of Five Dock station box east and west, as illustrated in Figure 1.

The structure of this DNVIS meets the requirements of CoA D43 and the CNVS and includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Construction vibration assessment
- Section 6 – Mitigation and management, including consultation

1.2 Planned works

The AFJV plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

The AFJV proposes the works subject to this assessment outside approved construction hours for the following reason.

- Noise review for Consistency Assessment (CA20)

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Five Dock construction zones cover two separate locations within the Five Dock village precinct, namely Five Dock East (FDE) and Five Dock West (FDW), as illustrated in Figure 1.

The FDW site is located west of the Great North Road near the intersection of Second Avenue and covers an area of around 3600m^2. Adjacent land uses to this site, fronting the Great North Road, are mostly commercial businesses with some mixed-use commercial/ residential buildings.

West of FDW, the closest residences are located on East Street with the Sunshine childcare facility at the end of the row of residences. To the north of the site is St Albans Church, which is heritage listed, whilst to the south is a Coles supermarket complex which also has some multi storey residences on the upper floors.

The FDE site is located to the east of Great North Road, bounded by Second Avenue and Waterview Street and has a footprint of around 1900 m^2. This site has residences on all four facades with a three-storey mixed use occupancy to the west having commercial premises on the ground floor and residences on the upper two floors.

1.2 Heritage items

Several items of heritage value were identified in the EIS, which include the following. These items will be considered for impacts of vibration-intensive activities.

- St Albans Church and associated buildings
- Canada Bay Police Station

1.3 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Five Docks sites have been divided into Noise Catchment Areas (NCAs).

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description	Ambient noise influences
14	West of Great Northern Road	Commercial and mixed-use receivers adjacent to the Great North Road. Mainly residential one block west from the main road. 'Other sensitive' receivers include Early Learning Centres x 2, Garfield Street Child Centre, Five Dock Public School, and several local medical practices.	Road traffic on the Great North Road, Barnstaple Road and Ramsay Road.
15	East of Great Northern Road.	Commercial and mixed-use receivers adjacent to the Great North Road. Mainly residential one block to the east from the main road. 'Other sensitive' receivers include St Albans Anglican Church, Kiddies on First Early Learning Centre, Domremy Catholic College, and a local medical practice.	Road traffic on the Great North Road, Barnstaple Road and Ramsay Road.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected 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 $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected 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(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The acoustic environment in all areas is described in the EIS as dominated by road traffic noise on the major transport corridors such as Great North Road, Ramsey Road and First Avenue. Contributions from aircraft are also noted.

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
14	52	75	47	46	38	40	52
15	53	75	48	48	43	43	53

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (CNVS)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	B	0 to 10	-
	C	10 to 20	LB
	D	20 to 30	LB, M, SN
	E	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	B	0 to 10	LB
	C	10 to 20	LB, M
	D	20 to 30	LB, M, SN, RO
	E	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	B	0 to 10	LB
	C	10 to 20	LB, M, SN, RO
	D	20 to 30	LB, M, SN, IB, PC, RO, AA
	E	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails; M = Monitoring; IB = Individual briefings; AA = Alternative accommodation; SN = Specific notification; LB = Letterbox drops; RO = Project specific respite offer

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by AFJV were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

A summary of predicted noise levels for the Day period is presented in Table 10, with the worst-case predicted noise level of 82 dB(A) during the works, resulting in 4 receivers classed as highly noise affected.

With reference to the CNVS, 0 receivers are predicted to be classified as Highly Impacted during the Day period.

Table 10 Summary of predicted noise levels with comparison against ICNG criteria for the Day period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level		82 dB(A)
Number of highly noise affected receivers (>75 dB)		4
Impact class	**Predicted noise level**	**Predicted number of receivers**
Noticable	0 <= 10 dB above NML	108
Clearly Audible	10 <= 20 dB above NML	27
Moderately Intrusive	20 <= 30 dB above NML	7
Highly Intrusive	> 30 dB above NML	0

Predicted impact classes for the Day period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

In the event works are planned for more than two consecutive nights, sleep disturbance is considered. Table 11 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 11 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	**Predicted number of receivers**
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	0
Exceed 65 dBA awakening criterion	0

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 12. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 12 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	106
Cosmetic damage	3
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in Table 13 and additional mitigation measures for each receiver identified in Appendix B and summarised in

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	None

Table 14.

Table 13 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	None

Table 14 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.

Code	Measure	Description
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Crane pads

Placement and compaction of material for crane pads
5/1/2023 8:00:00 AM - 6/30/2023 6:00:00 PM

Equipment	Quantity	Usage	Reduction	SWL
Vibratory Roller (10 tonne)*	1	40 %	5	101
Dozer D9 (pushing up)	1	40 %	5	110
Excavator (30 tonne)	1	40 %	5	100

Activity Sound Power Level: 111
* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Trucks

Trucks delivering material for crane pads or removing backfill
5/1/2023 8:00:00 AM - 6/30/2023 6:00:00 PM

Equipment	Quantity	Usage	Reduction	SWL
Truck 30 t on access road	1	30 %	5	100

Activity Sound Power Level: 100
* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Assessment: Acoustic Shed scenarios					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary									
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Screen	Awake	Day	O/day	Eve	Night
NCA_14	707242	1A HENRY ST, FIVE DOCK	1	RES	52	46	46	38			60	65		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707220	2 WEST ST, FIVE DOCK	1	RES	52	46	46	38			59	64		7	13	13	21	-	7	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707184	19 EAST ST, FIVE DOCK	1	RES	52	46	46	38			65	70		13	19	19	27	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707178	14 GARFIELD ST, FIVE DOCK	2	RES	52	46	46	38			52	57		0	6	6	14	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	707151	14 WEST ST, FIVE DOCK	1	RES	52	46	46	38			54	59		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	707139	2A EAST ST, FIVE DOCK	1	COM	70	70	70	70			77	82	Y	7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA_14	707130	2 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			62	67		10	16	16	24	-	10	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707129	2 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			59	65		7	13	13	21	-	7	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707093	135 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			60	65		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707086	189 GREAT NORTH RD, FIVE DOCK	4	RES	52	46	46	38			60	64		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707085	189 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			57	61		5	11	11	19	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	707084	189 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			57	61		5	11	11	19	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	707083	189 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			56	60		4	10	10	18	-	4	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	707066	11 EAST ST, FIVE DOCK	1	RES	52	46	46	38			67	72		15	21	21	29	-	15	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	707063	10 WEST ST, FIVE DOCK	2	RES	52	46	46	38			64	69		12	18	18	26	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707062	10 WEST ST, FIVE DOCK	1	RES	52	46	46	38			57	62		5	11	11	19	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	707042	8 WEST ST, FIVE DOCK	1	RES	52	46	46	38			55	60		3	9	9	17	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706979	3 EAST ST, FIVE DOCK	1	RES	52	46	46	38			68	73		16	22	22	30	-	16	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706972	175 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55			66	70		11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706971	175 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55			63	68		8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA_14	706949	141 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			62	67		10	16	16	24	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706911	15 EAST ST, FIVE DOCK	1	RES	52	46	46	38			67	72		15	21	21	29	-	15	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706898	12 WEST ST, FIVE DOCK	1	RES	52	46	46	38			60	65		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706889	3 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			60	65		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706880	22 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			52	57		0	6	6	14	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706863	2 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			58	63		6	12	12	20	-	6	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706862	2 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			57	62		5	11	11	19	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706854	5 EAST ST, FIVE DOCK	2	RES	52	46	46	38			70	75		18	24	24	32	-	18	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706853	5 EAST ST, FIVE DOCK	1	RES	52	46	46	38			68	73		16	22	22	30	-	16	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706841	139A GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			56	61		4	10	10	18	-	4	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706838	1B HENRY ST, FIVE DOCK	1	RES	52	46	46	38			59	64		7	13	13	21	-	7	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706829	13 EAST ST, FIVE DOCK	1	RES	52	46	46	38			66	71		14	20	20	28	-	14	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706822	12 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			54	59		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706800	17 EAST ST, FIVE DOCK	1	RES	52	46	46	38			66	71		14	20	20	28	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive

NCA_14	706792	137 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			55	64		3	9	9	17	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706790	137 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			59	65		7	13	13	21	-	7	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706787	1 LANCELOT ST, FIVE DOCK	1	RES	52	46	46	38			53	57		1	7	7	15	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706736	143 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			61	69		9	15	15	23	-	9	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706735	143 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			58	68		6	12	12	20	-	6	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706724	25 EAST ST, FIVE DOCK	1	RES	52	46	46	38			53	58		1	7	7	15	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706721	24 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			53	58		1	7	7	15	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706717	23 EAST ST, FIVE DOCK	1	RES	52	46	46	38			56	61		4	10	10	18	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706705	7 EAST ST, FIVE DOCK	2	RES	52	46	46	38			71	76		19	25	25	33	-	19	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706704	7 EAST ST, FIVE DOCK	1	RES	52	46	46	38			68	73		16	22	22	30	-	16	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706692	9 EAST ST, FIVE DOCK	1	RES	52	46	46	38			68	73		16	22	22	30	-	16	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706673	5 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			53	58		1	7	7	15	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706670	4 WEST ST, FIVE DOCK	1	RES	52	46	46	38			62	67		10	16	16	24	-	10	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706668	1A LANCELOT ST, FIVE DOCK	2	RES	52	46	46	38			54	59		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706639	11 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			58	63		6	12	12	20	-	6	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706638	11 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			52	57		0	6	6	14	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706629	8 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			56	60		4	10	10	18	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706618	2 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			55	60		3	9	9	17	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706602	171 GREAT NORTH RD, FIVE DOCK	3	PoW	55	55	55	55			81	86	Y	26	26	26	26	-	26	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706601	171 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55			82	87	Y	27	27	27	27	-	27	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706600	171 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55			80	85	Y	25	25	25	25	-	25	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706582	145 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			61	70		9	15	15	23	-	9	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706581	145 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			60	70		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706579	147-149 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			70	76		18	24	24	32	-	18	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706543	6 WEST ST, FIVE DOCK	1	RES	52	46	46	38			61	66		9	15	15	23	-	9	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706499	4 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			54	59		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706451	1 EAST ST, FIVE DOCK	1	EDU	55	55	55	55			67	72		12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706447	175 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			64	69		12	18	18	26	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706435	6 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			52	57		0	6	6	14	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706430	137 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			60	64		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706429	137 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			55	63		3	9	9	17	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706428	137 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			54	62		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706405	1 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			62	67		10	16	16	24	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706399	175 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55			70	75		15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706393	4-12 GARFIELD ST, FIVE DOCK	6	RES	52	46	46	38			72	77		20	26	26	34	-	20	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706392	4-12 GARFIELD ST, FIVE DOCK	5	RES	52	46	46	38			72	77		20	26	26	34	-	20	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Highly Intrusive

NCA_14	706391	4-12 GARFIELD ST, FIVE DOCK	4	RES	52	46	46	38			73	78		21	27	27	35	-	21	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706390	4-12 GARFIELD ST, FIVE DOCK	3	RES	52	46	46	38			73	78		21	27	27	35	-	21	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706389	4-12 GARFIELD ST, FIVE DOCK	2	RES	52	46	46	38			71	76		19	25	25	33	-	19	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706388	4-12 GARFIELD ST, FIVE DOCK	1	RES	52	46	46	38			70	75		18	24	24	32	-	18	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_15	705838	130 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			58	62		5	10	10	15	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705837	130 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			58	62		5	10	10	15	-	5	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705834	90 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			57	61		4	9	9	14	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705833	90 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			56	61		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705821	86 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			56	60		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705820	86 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			55	59		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705819	86 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			56	61		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705801	12 CORONATION AV, FIVE DOCK	1	RES	53	48	48	43			53	58		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705796	37 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			58	62		5	10	10	15	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705780	2 CORONATION AV, FIVE DOCK	2	RES	53	48	48	43			54	58		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705765	134 GREAT NORTH RD, FIVE DOCK	4	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705764	134 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705763	134 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705762	134 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705743	122 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			64	68		11	16	16	21	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_15	705741	7 CORONATION AV, FIVE DOCK	2	RES	53	48	48	43			54	59		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705740	7 CORONATION AV, FIVE DOCK	1	RES	53	48	48	43			54	58		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705718	118 GREAT NORTH RD, FIVE DOCK	4	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA_15	705717	118 GREAT NORTH RD, FIVE DOCK	3	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA_15	705705	134 FIRST AV, FIVE DOCK	2	RES	53	48	48	43			54	58		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705672	120 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55			66	73		11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705671	120 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55			65	71		10	10	10	10	-	10	Noticable	Noticable	Noticable	Noticable
NCA_15	705670	120 GREAT NORTH RD, FIVE DOCK	3	PoW	55	55	55	55			68	73		13	13	13	13	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705645	84 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			55	59		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705644	84 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			55	59		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705639	84 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			56	60		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705625	92A GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			59	63		6	11	11	16	-	6	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705624	92A GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			58	62		5	10	10	15	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705601	SE 3 128 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			59	63		6	11	11	16	-	6	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705600	SE 3 128 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			58	63		5	10	10	15	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705570	20-22 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			57	61		4	9	9	14	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705564	78 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			54	58		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible

NCA_15	705563	78 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			53	57		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705559	80 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			54	58		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705558	80 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			54	58		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705547	94A GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			58	63		5	10	10	15	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705546	94A GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			57	62		4	9	9	14	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705544	132 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			56	60		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705543	132 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			56	60		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705542	132 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			56	60		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705534	11-13 WATERVIEW ST, FIVE DOCK	2	RES	53	48	48	43			59	63		6	11	11	16	-	6	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705533	11-13 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			56	60		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705506	17 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			59	63		6	11	11	16	-	6	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705503	110 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			72	77		19	24	24	29	-	19	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_15	705502	110 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			70	77		17	22	22	27	-	17	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_15	705493	138 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705492	138 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705491	138 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705488	24 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			55	59		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705487	126 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			55	59		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705462	18 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			54	58		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705450	32 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			54	59		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705444	3 SUTTON ST, FIVE DOCK	1	RES	53	48	48	43			54	59		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705410	28 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			56	60		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705397	30 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705382	4 BARNSTAPLE RD, FIVE DOCK	2	RES	53	48	48	43			53	58		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705381	4 BARNSTAPLE RD, FIVE DOCK	1	RES	53	48	48	43			53	58		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705362	8 CORONATION AV, FIVE DOCK	1	RES	53	48	48	43			53	58		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705361	5 SUTTON ST, FIVE DOCK	2	RES	53	48	48	43			53	58		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705354	15 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			59	63		6	11	11	16	-	6	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705339	82 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			55	59		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705338	82 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			54	58		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705333	26 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			56	60		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705329	16 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705320	2 SECOND AV, FIVE DOCK	1	RES	53	48	48	43			61	65		8	13	13	18	-	8	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705303	108 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			70	78		17	22	22	27	-	17	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_15	705302	108 GREAT NORTH RD, FIVE DOCK	2	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA_15	705291	1 SUTTON ST, FIVE DOCK	1	RES	53	48	48	43			53	58		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact
NCA_14	707242	1A HENRY ST, FIVE DOCK	RES	Human Comfort
NCA_14	707220	2 WEST ST, FIVE DOCK	RES	Human Comfort
NCA_14	707184	19 EAST ST, FIVE DOCK	RES	Human Comfort
NCA_14	707178	14 GARFIELD ST, FIVE DOCK	RES	Human Comfort
NCA_14	707177	14 GARFIELD ST, FIVE DOCK	RES	Human Comfort
NCA_14	707151	14 WEST ST, FIVE DOCK	RES	Human Comfort
NCA_14	707139	2A EAST ST, FIVE DOCK	COM	Human Comfort
NCA_14	707093	135 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	707092	135 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	707066	11 EAST ST, FIVE DOCK	RES	Human Comfort
NCA_14	707063	10 WEST ST, FIVE DOCK	RES	Human Comfort
NCA_14	707062	10 WEST ST, FIVE DOCK	RES	Human Comfort
NCA_14	707042	8 WEST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706979	3 EAST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706972	175 GREAT NORTH RD, FIVE DOCK	PoW	Human Comfort
NCA_14	706971	175 GREAT NORTH RD, FIVE DOCK	PoW	Human Comfort
NCA_14	706949	141 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	706948	141 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706945	187 EAST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706911	15 EAST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706898	12 WEST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706889	3 HENRY ST, FIVE DOCK	RES	Human Comfort

Detailed noise and vibration impact statement

NCA	Receiver	Address	Land use	Vibration Impact
NCA_14	706871	185 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706870	185 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706869	185 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706854	5 EAST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706853	5 EAST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706843	18 WEST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706841	139A GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	706840	139A GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706838	1B HENRY ST, FIVE DOCK	RES	Human Comfort
NCA_14	706829	13 EAST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706800	17 EAST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706792	137 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	706791	137 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706790	137 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	706780	187 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706779	187 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706772	16 WEST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706736	143 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	706735	143 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	706734	143 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706728	7 HENRY ST, FIVE DOCK	RES	Human Comfort
NCA_14	706705	7 EAST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706704	7 EAST ST, FIVE DOCK	RES	Human Comfort

NCA	Receiver	Address	Land use	Vibration Impact
NCA_14	706692	9 EAST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706673	5 HENRY ST, FIVE DOCK	RES	Human Comfort
NCA_14	706670	4 WEST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706602	171 GREAT NORTH RD, FIVE DOCK	PoW	Cosmetic
NCA_14	706601	171 GREAT NORTH RD, FIVE DOCK	PoW	Cosmetic
NCA_14	706600	171 GREAT NORTH RD, FIVE DOCK	PoW	Cosmetic
NCA_14	706591	179 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706590	179 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706582	145 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	706581	145 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	706580	145 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706579	147-149 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	706578	147-149 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706556	14 GARFIELD ST, FIVE DOCK	RES	Human Comfort
NCA_14	706555	14 GARFIELD ST, FIVE DOCK	RES	Human Comfort
NCA_14	706551	181 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706550	181 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706549	181 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_14	706543	6 WEST ST, FIVE DOCK	RES	Human Comfort
NCA_14	706472	14 GARFIELD ST, FIVE DOCK	COM	Human Comfort
NCA_14	706468	9 HENRY ST, FIVE DOCK	RES	Human Comfort
NCA_14	706451	1 EAST ST, FIVE DOCK	EDU	Human Comfort
NCA_14	706447	175 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort

NCA	Receiver	Address	Land use	Vibration Impact
NCA_14	706430	137 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	706429	137 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	706428	137 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_14	706405	1 HENRY ST, FIVE DOCK	RES	Human Comfort
NCA_14	706399	175 GREAT NORTH RD, FIVE DOCK	PoW	Human Comfort
NCA_14	706393	4-12 GARFIELD ST, FIVE DOCK	RES	Human Comfort
NCA_14	706392	4-12 GARFIELD ST, FIVE DOCK	RES	Human Comfort
NCA_14	706391	4-12 GARFIELD ST, FIVE DOCK	RES	Human Comfort
NCA_14	706390	4-12 GARFIELD ST, FIVE DOCK	RES	Human Comfort
NCA_14	706389	4-12 GARFIELD ST, FIVE DOCK	RES	Human Comfort
NCA_14	706388	4-12 GARFIELD ST, FIVE DOCK	RES	Human Comfort
NCA_15	705796	37 WATERVIEW ST, FIVE DOCK	RES	Human Comfort
NCA_15	705776	96A GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705775	96A GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705743	122 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_15	705742	122 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705718	118 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705717	118 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705716	118 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705715	118 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705713	104A GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705712	102 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705672	120 GREAT NORTH RD, FIVE DOCK	PoW	Human Comfort

NCA	Receiver	Address	Land use	Vibration Impact
NCA_15	705671	120 GREAT NORTH RD, FIVE DOCK	PoW	Human Comfort
NCA_15	705670	120 GREAT NORTH RD, FIVE DOCK	PoW	Human Comfort
NCA_15	705615	126 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705614	126 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705609	106 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705547	94A GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_15	705546	94A GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_15	705517	100 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705516	98 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort
NCA_15	705506	17 WATERVIEW ST, FIVE DOCK	RES	Human Comfort
NCA_15	705503	110 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_15	705502	110 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_15	705487	126 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_15	705486	126 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_15	705354	15 WATERVIEW ST, FIVE DOCK	RES	Human Comfort
NCA_15	705320	2 SECOND AV, FIVE DOCK	RES	Human Comfort
NCA_15	705303	108 GREAT NORTH RD, FIVE DOCK	RES	Human Comfort
NCA_15	705302	108 GREAT NORTH RD, FIVE DOCK	COM	Human Comfort

Detailed noise and vibration impact statement

Acoustic Shed scenarios			
Project	SMW - CTP: Five Dock (May 22 Update)		
Client	AFJV		
Assessment Date	26/04/2023	Assessment Id	FDW_shed
Proposed start date	01/05/2023	Proposed end date	30/06/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Central Tunnelling Package is being delivered by the Acciona Ferrovial Joint Venture (ACJV) and involves excavation of around 11.5 kilometres of twin-bore tunnel linking five station boxes at The Bays, Five Dock, Strathfield, Burwood North and Sydney Olympic Park (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

CoA D43 requires planned works to be assessed within a Detailed Noise and Vibration Impact Statement (DNVIS) where works may exceed the NMLs, vibration criteria and/or ground-borne noise levels specified in CoA D39 and D40 at any residence outside construction hours identified in CoA D35, or where receivers will be highly noise affected.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare site and activity-specific noise assessments for ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This DNVIS has been prepared using KNOWnoise™ and addresses activities for construction of Five Dock station box east and west, as illustrated in Figure 1.

The structure of this DNVIS meets the requirements of CoA D43 and the CNVS and includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Construction vibration assessment
- Section 6 – Mitigation and management, including consultation

1.2 Planned works

The AFJV plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

The AFJV proposes the works subject to this assessment outside approved construction hours for the following reason.

- Noise review for Consistency Assessment (CA20)

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Five Dock construction zones cover two separate locations within the Five Dock village precinct, namely Five Dock East (FDE) and Five Dock West (FDW), as illustrated in Figure 1.

The FDW site is located west of the Great North Road near the intersection of Second Avenue and covers an area of around 3600m^2. Adjacent land uses to this site, fronting the Great North Road, are mostly commercial businesses with some mixed-use commercial/ residential buildings.

West of FDW, the closest residences are located on East Street with the Sunshine childcare facility at the end of the row of residences. To the north of the site is St Albans Church, which is heritage listed, whilst to the south is a Coles supermarket complex which also has some multi storey residences on the upper floors.

The FDE site is located to the east of Great North Road, bounded by Second Avenue and Waterview Street and has a footprint of around 1900 m^2. This site has residences on all four facades with a three-storey mixed use occupancy to the west having commercial premises on the ground floor and residences on the upper two floors.

1.2 Heritage items

Several items of heritage value were identified in the EIS, which include the following. These items will be considered for impacts of vibration-intensive activities.

- St Albans Church and associated buildings
- Canada Bay Police Station

1.3 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Five Docks sites have been divided into Noise Catchment Areas (NCAs).

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description	Ambient noise influences
14	West of Great Northern Road	Commercial and mixed-use receivers adjacent to the Great North Road. Mainly residential one block west from the main road. 'Other sensitive' receivers include Early Learning Centres x 2, Garfield Street Child Centre, Five Dock Public School, and several local medical practices.	Road traffic on the Great North Road, Barnstaple Road and Ramsay Road.
15	East of Great Northern Road.	Commercial and mixed-use receivers adjacent to the Great North Road. Mainly residential one block to the east from the main road. 'Other sensitive' receivers include St Albans Anglican Church, Kiddies on First Early Learning Centre, Domremy Catholic College, and a local medical practice.	Road traffic on the Great North Road, Barnstaple Road and Ramsay Road.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected 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 $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected 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(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The acoustic environment in all areas is described in the EIS as dominated by road traffic noise on the major transport corridors such as Great North Road, Ramsey Road and First Avenue. Contributions from aircraft are also noted.

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
14	52	75	47	46	38	40	52
15	53	75	48	48	43	43	53

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (CNVS)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	B	0 to 10	-
	C	10 to 20	LB
	D	20 to 30	LB, M, SN
	E	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	B	0 to 10	LB
	C	10 to 20	LB, M
	D	20 to 30	LB, M, SN, RO
	E	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	B	0 to 10	LB
	C	10 to 20	LB, M, SN, RO
	D	20 to 30	LB, M, SN, IB, PC, RO, AA
	E	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails
M = Monitoring
IB = Individual briefings
AA = Alternative accommodation
SN = Specific notification
LB = Letterbox drops
RO = Project specific respite offer

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by AFJV were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

A summary of predicted noise levels for the Day period is presented in Table 10, with the worst-case predicted noise level of 81 dB(A) during the works, resulting in 4 receivers classed as highly noise affected.

With reference to the CNVS, 0 receivers are predicted to be classified as Highly Impacted during the Day period.

Table 10 Summary of predicted noise levels with comparison against ICNG criteria for the Day period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level		81 dB(A)
Number of highly noise affected receivers (>75 dB)		4
Impact class	**Predicted noise level**	**Predicted number of receivers**
Noticable	0 <= 10 dB above NML	99
Clearly Audible	10 <= 20 dB above NML	27
Moderately Intrusive	20 <= 30 dB above NML	5
Highly Intrusive	> 30 dB above NML	0

Predicted impact classes for the Day period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

In the event works are planned for more than two consecutive nights, sleep disturbance is considered. Table 11 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 11 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	**Predicted number of receivers**
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	0
Exceed 65 dBA awakening criterion	0

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 12. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 12 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	0
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in Table 13 and additional mitigation measures for each receiver identified in Appendix B and summarised in

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	None

Table 14.

Table 13 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	None

Table 14 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.

Code	Measure	Description
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Trucks

Trucks delivering material for crane pads or removing backfill
5/1/2023 8:00:00 AM - 6/30/2023 6:00:00 PM

Equipment	Quantity	Usage	Reduction	SWL
Truck 30 t on access road	1	30 %	5	100

Activity Sound Power Level: 100
* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Crane pads removal

Removal of placed material for crane pads
5/1/2023 8:00:00 AM - 6/30/2023 6:00:00 PM

Equipment	Quantity	Usage	Reduction	SWL
Dozer D9 (pushing up)	1	40 %	5	110
Excavator (30 tonne)	1	40 %	5	100

Activity Sound Power Level: 110
* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Assessment: Acoustic Shed scenarios					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary									
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Screen	Awake	Day	O/day	Eve	Night
NCA_14	707242	1A HENRY ST, FIVE DOCK	1	RES	52	46	46	38			60	65		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707220	2 WEST ST, FIVE DOCK	1	RES	52	46	46	38			59	64		7	13	13	21	-	7	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707184	19 EAST ST, FIVE DOCK	1	RES	52	46	46	38			64	70		12	18	18	26	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707151	14 WEST ST, FIVE DOCK	1	RES	52	46	46	38			53	59		1	7	7	15	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	707139	2A EAST ST, FIVE DOCK	1	COM	70	70	70	70			76	82	Y	6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA_14	707130	2 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			61	67		9	15	15	23	-	9	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707129	2 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			59	65		7	13	13	21	-	7	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707093	135 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			60	65		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707086	189 GREAT NORTH RD, FIVE DOCK	4	RES	52	46	46	38			59	64		7	13	13	21	-	7	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707085	189 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			57	61		5	11	11	19	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	707084	189 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			56	61		4	10	10	18	-	4	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	707083	189 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			56	60		4	10	10	18	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	707066	11 EAST ST, FIVE DOCK	1	RES	52	46	46	38			67	72		15	21	21	29	-	15	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	707063	10 WEST ST, FIVE DOCK	2	RES	52	46	46	38			64	69		12	18	18	26	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707062	10 WEST ST, FIVE DOCK	1	RES	52	46	46	38			56	62		4	10	10	18	-	4	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	707042	8 WEST ST, FIVE DOCK	1	RES	52	46	46	38			55	60		3	9	9	17	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706979	3 EAST ST, FIVE DOCK	1	RES	52	46	46	38			67	73		15	21	21	29	-	15	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706972	175 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55			65	70		10	10	10	10	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706971	175 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55			63	68		8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA_14	706949	141 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			62	67		10	16	16	24	-	10	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706911	15 EAST ST, FIVE DOCK	1	RES	52	46	46	38			66	72		14	20	20	28	-	14	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706898	12 WEST ST, FIVE DOCK	1	RES	52	46	46	38			60	65		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706889	3 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			60	65		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706863	2 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			57	63		5	11	11	19	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706862	2 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			56	62		4	10	10	18	-	4	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706854	5 EAST ST, FIVE DOCK	2	RES	52	46	46	38			69	75		17	23	23	31	-	17	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706853	5 EAST ST, FIVE DOCK	1	RES	52	46	46	38			67	73		15	21	21	29	-	15	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706841	139A GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			56	61		4	10	10	18	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706838	1B HENRY ST, FIVE DOCK	1	RES	52	46	46	38			59	64		7	13	13	21	-	7	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706829	13 EAST ST, FIVE DOCK	1	RES	52	46	46	38			66	71		14	20	20	28	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706822	12 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			54	59		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706800	17 EAST ST, FIVE DOCK	1	RES	52	46	46	38			65	71		13	19	19	27	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706792	137 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			55	64		3	9	9	17	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706790	137 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			59	65		7	13	13	21	-	7	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive

NCA_14	706787	1 LANCELOT ST, FIVE DOCK	1	RES	52	46	46	38			52	57		0	6	6	14	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706736	143 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			60	69		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706735	143 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			58	68		6	12	12	20	-	6	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706724	25 EAST ST, FIVE DOCK	1	RES	52	46	46	38			52	58		0	6	6	14	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706721	24 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			53	58		1	7	7	15	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706717	23 EAST ST, FIVE DOCK	1	RES	52	46	46	38			55	61		3	9	9	17	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706705	7 EAST ST, FIVE DOCK	2	RES	52	46	46	38			70	76		18	24	24	32	-	18	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706704	7 EAST ST, FIVE DOCK	1	RES	52	46	46	38			68	73		16	22	22	30	-	16	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706692	9 EAST ST, FIVE DOCK	1	RES	52	46	46	38			68	73		16	22	22	30	-	16	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706673	5 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			53	58		1	7	7	15	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706670	4 WEST ST, FIVE DOCK	1	RES	52	46	46	38			61	67		9	15	15	23	-	9	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706668	1A LANCELOT ST, FIVE DOCK	2	RES	52	46	46	38			54	59		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706639	11 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			57	63		5	11	11	19	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706629	8 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			55	60		3	9	9	17	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706618	2 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			55	60		3	9	9	17	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706602	171 GREAT NORTH RD, FIVE DOCK	3	PoW	55	55	55	55			81	86	Y	26	26	26	26	-	26	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706601	171 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55			81	87	Y	26	26	26	26	-	26	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706600	171 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55			80	85	Y	25	25	25	25	-	25	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706582	145 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			61	70		9	15	15	23	-	9	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706581	145 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			60	70		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706579	147-149 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			70	76		18	24	24	32	-	18	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706543	6 WEST ST, FIVE DOCK	1	RES	52	46	46	38			61	66		9	15	15	23	-	9	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706499	4 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			53	59		1	7	7	15	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706451	1 EAST ST, FIVE DOCK	1	EDU	55	55	55	55			67	72		12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706447	175 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			63	69		11	17	17	25	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706430	137 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			60	64		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706429	137 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			55	63		3	9	9	17	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706428	137 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			54	62		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706405	1 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			62	67		10	16	16	24	-	10	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706399	175 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55			70	75		15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706393	4-12 GARFIELD ST, FIVE DOCK	6	RES	52	46	46	38			72	77		20	26	26	34	-	20	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706392	4-12 GARFIELD ST, FIVE DOCK	5	RES	52	46	46	38			72	77		20	26	26	34	-	20	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706391	4-12 GARFIELD ST, FIVE DOCK	4	RES	52	46	46	38			72	78		20	26	26	34	-	20	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706390	4-12 GARFIELD ST, FIVE DOCK	3	RES	52	46	46	38			72	78		20	26	26	34	-	20	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706389	4-12 GARFIELD ST, FIVE DOCK	2	RES	52	46	46	38			71	76		19	25	25	33	-	19	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706388	4-12 GARFIELD ST, FIVE DOCK	1	RES	52	46	46	38			70	75		18	24	24	32	-	18	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive

NCA_15	705838	130 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			58	62		5	10	10	15	-	5	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705837	130 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			57	62		4	9	9	14	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705834	90 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			57	61		4	9	9	14	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705833	90 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			56	61		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705821	86 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705820	86 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			55	59		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705819	86 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			56	61		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705796	37 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			58	62		5	10	10	15	-	5	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705780	2 CORONATION AV, FIVE DOCK	2	RES	53	48	48	43			53	58		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705765	134 GREAT NORTH RD, FIVE DOCK	4	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705764	134 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705763	134 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705762	134 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705743	122 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			63	68		10	15	15	20	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_15	705741	7 CORONATION AV, FIVE DOCK	2	RES	53	48	48	43			54	59		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705740	7 CORONATION AV, FIVE DOCK	1	RES	53	48	48	43			53	58		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705718	118 GREAT NORTH RD, FIVE DOCK	4	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA_15	705717	118 GREAT NORTH RD, FIVE DOCK	3	COM	70	70	70	70			71	76		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA_15	705705	134 FIRST AV, FIVE DOCK	2	RES	53	48	48	43			53	58		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705672	120 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55			66	73		11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705671	120 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55			64	71		9	9	9	9	-	9	Noticable	Noticable	Noticable	Noticable
NCA_15	705670	120 GREAT NORTH RD, FIVE DOCK	3	PoW	55	55	55	55			67	73		12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705645	84 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			55	59		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705644	84 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			54	59		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705639	84 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705625	92A GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			58	63		5	10	10	15	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705624	92A GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			58	62		5	10	10	15	-	5	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705601	SE 3 128 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			58	63		5	10	10	15	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705600	SE 3 128 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			58	63		5	10	10	15	-	5	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705570	20-22 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			56	61		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705564	78 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			54	58		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705559	80 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			54	58		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705558	80 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			53	58		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705547	94A GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			58	63		5	10	10	15	-	5	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705546	94A GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			57	62		4	9	9	14	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705544	132 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			56	60		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible

NCA_15	705543	132 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			56	60		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705542	132 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705534	11-13 WATERVIEW ST, FIVE DOCK	2	RES	53	48	48	43			58	63		5	10	10	15	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705533	11-13 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705506	17 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			59	63		6	11	11	16	-	6	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705503	110 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			72	77		19	24	24	29	-	19	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_15	705502	110 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			70	77		17	22	22	27	-	17	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_15	705493	138 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705492	138 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705491	138 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705488	24 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			54	59		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705487	126 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			54	59		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705462	18 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			53	58		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705450	32 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			54	59		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705444	3 SUTTON ST, FIVE DOCK	1	RES	53	48	48	43			54	59		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705410	28 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705397	30 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			55	60		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705354	15 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			59	63		6	11	11	16	-	6	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705339	82 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			54	59		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705338	82 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			54	58		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705333	26 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			56	60		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705329	16 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			54	60		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705320	2 SECOND AV, FIVE DOCK	1	RES	53	48	48	43			61	65		8	13	13	18	-	8	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705303	108 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			70	78		17	22	22	27	-	17	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_15	705302	108 GREAT NORTH RD, FIVE DOCK	2	COM	70	70	70	70			71	78		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact

Acoustic Shed scenarios			
Project	SMW - CTP: Five Dock (May 22 Update)		
Client	AFJV		
Assessment Date	26/04/2023	Assessment Id	FDW_shed
Proposed start date	01/05/2023	Proposed end date	30/06/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Central Tunnelling Package is being delivered by the Acciona Ferrovial Joint Venture (ACJV) and involves excavation of around 11.5 kilometres of twin-bore tunnel linking five station boxes at The Bays, Five Dock, Strathfield, Burwood North and Sydney Olympic Park (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

CoA D43 requires planned works to be assessed within a Detailed Noise and Vibration Impact Statement (DNVIS) where works may exceed the NMLs, vibration criteria and/or ground-borne noise levels specified in CoA D39 and D40 at any residence outside construction hours identified in CoA D35, or where receivers will be highly noise affected.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare site and activity-specific noise assessments for ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This DNVIS has been prepared using KNOWnoise™ and addresses activities for construction of Five Dock station box east and west, as illustrated in Figure 1.

The structure of this DNVIS meets the requirements of CoA D43 and the CNVS and includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Construction vibration assessment
- Section 6 – Mitigation and management, including consultation

1.2 Planned works

The AFJV plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

The AFJV proposes the works subject to this assessment outside approved construction hours for the following reason.

- Noise review for Consistency Assessment (CA20)

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Five Dock construction zones cover two separate locations within the Five Dock village precinct, namely Five Dock East (FDE) and Five Dock West (FDW), as illustrated in Figure 1.

The FDW site is located west of the Great North Road near the intersection of Second Avenue and covers an area of around 3600m^2. Adjacent land uses to this site, fronting the Great North Road, are mostly commercial businesses with some mixed-use commercial/ residential buildings.

West of FDW, the closest residences are located on East Street with the Sunshine childcare facility at the end of the row of residences. To the north of the site is St Albans Church, which is heritage listed, whilst to the south is a Coles supermarket complex which also has some multi storey residences on the upper floors.

The FDE site is located to the east of Great North Road, bounded by Second Avenue and Waterview Street and has a footprint of around 1900 m^2. This site has residences on all four facades with a three-storey mixed use occupancy to the west having commercial premises on the ground floor and residences on the upper two floors.

1.2 Heritage items

Several items of heritage value were identified in the EIS, which include the following. These items will be considered for impacts of vibration-intensive activities.

- St Albans Church and associated buildings
- Canada Bay Police Station

1.3 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Five Docks sites have been divided into Noise Catchment Areas (NCAs).

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description	Ambient noise influences
14	West of Great Northern Road	Commercial and mixed-use receivers adjacent to the Great North Road. Mainly residential one block west from the main road. 'Other sensitive' receivers include Early Learning Centres x 2, Garfield Street Child Centre, Five Dock Public School, and several local medical practices.	Road traffic on the Great North Road, Barnstaple Road and Ramsay Road.
15	East of Great Northern Road.	Commercial and mixed-use receivers adjacent to the Great North Road. Mainly residential one block to the east from the main road. 'Other sensitive' receivers include St Albans Anglican Church, Kiddies on First Early Learning Centre, Domremy Catholic College, and a local medical practice.	Road traffic on the Great North Road, Barnstaple Road and Ramsay Road.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected 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 $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected 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(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The acoustic environment in all areas is described in the EIS as dominated by road traffic noise on the major transport corridors such as Great North Road, Ramsey Road and First Avenue. Contributions from aircraft are also noted.

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
14	52	75	47	46	38	40	52
15	53	75	48	48	43	43	53

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (CNVS)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	B	0 to 10	-
	C	10 to 20	LB
	D	20 to 30	LB, M, SN
	E	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	B	0 to 10	LB
	C	10 to 20	LB, M
	D	20 to 30	LB, M, SN, RO
	E	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	B	0 to 10	LB
	C	10 to 20	LB, M, SN, RO
	D	20 to 30	LB, M, SN, IB, PC, RO, AA
	E	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails
M = Monitoring
IB = Individual briefings
AA = Alternative accommodation
SN = Specific notification
LB = Letterbox drops
RO = Project specific respite offer

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by AFJV were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

A summary of predicted noise levels for the Day period is presented in Table 10, with the worst-case predicted noise level of 86 dB(A) during the works, resulting in 5 receivers classed as highly noise affected.

With reference to the CNVS, 1 receivers are predicted to be classified as Highly Impacted during the Day period.

Table 10 Summary of predicted noise levels with comparison against ICNG criteria for the Day period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level		86 dB(A)
Number of highly noise affected receivers (>75 dB)		5
Impact class	**Predicted noise level**	**Predicted number of receivers**
Noticable	0 <= 10 dB above NML	43
Clearly Audible	10 <= 20 dB above NML	25
Moderately Intrusive	20 <= 30 dB above NML	5
Highly Intrusive	> 30 dB above NML	1

Predicted impact classes for the Day period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

In the event works are planned for more than two consecutive nights, sleep disturbance is considered. Table 11 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 11 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	**Predicted number of receivers**
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	0
Exceed 65 dBA awakening criterion	0

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 12. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 12 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	0
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in Table 13 and additional mitigation measures for each receiver identified in Appendix B and summarised in

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	None

Table 14.

Table 13 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	None

Table 14 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.

Code	Measure	Description
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

Panels install and removal

Installation and removal of panels at height

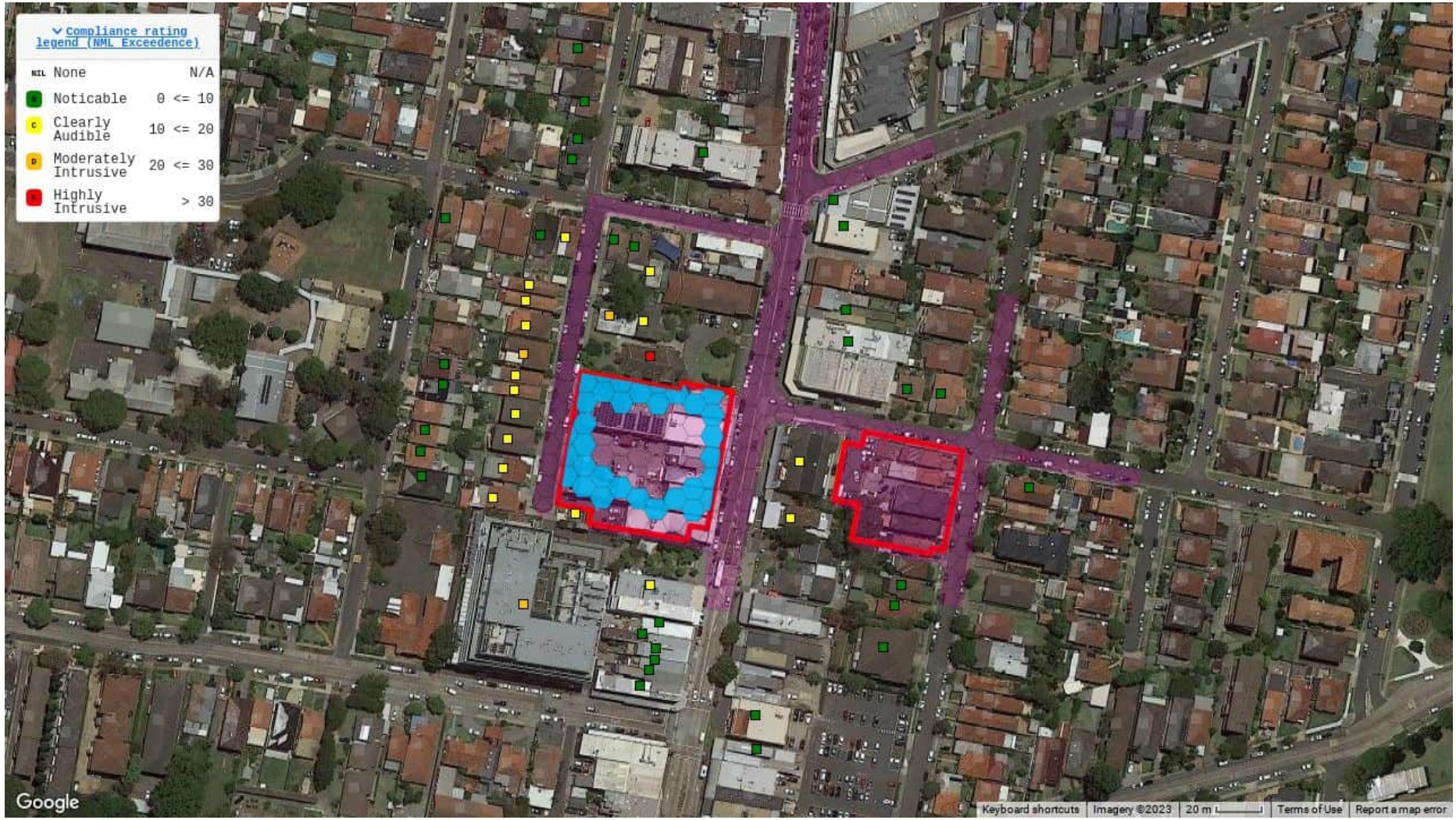
5/1/2023 7:00:00 AM - 6/30/2023 6:00:00 PM

Equipment	Quantity	Usage	Reduction	SWL
Elevated Working Platform	2	30 %	0	87
Rattle Gun (Hand held)	2	70 %	0	106
Crawler crane 100 tonne	1	50 %	0	96
Hand Tools (electric)	2	20 %	0	90

Activity Sound Power Level: 107

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class



Appendix C Detailed predictions

C.1 Noise

Assessment: Acoustic Shed scenarios					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary									
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Screen	Awake	Day	O/day	Eve	Night
NCA_14	707242	1A HENRY ST, FIVE DOCK	1	RES	52	46	46	38			58	64		6	12	12	20	-	6	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707220	2 WEST ST, FIVE DOCK	1	RES	52	46	46	38			58	64		6	12	12	20	-	6	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	707184	19 EAST ST, FIVE DOCK	1	RES	52	46	46	38			67	73		15	21	21	29	-	15	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	707139	2A EAST ST, FIVE DOCK	1	COM	70	70	70	70			85	91	Y	15	15	15	15	-	15	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	707130	2 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			60	66		8	14	14	22	-	8	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707129	2 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			58	64		6	12	12	20	-	6	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	707093	135 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			56	62		4	10	10	18	-	4	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	707086	189 GREAT NORTH RD, FIVE DOCK	4	RES	52	46	46	38			56	62		4	10	10	18	-	4	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	707085	189 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			56	62		4	10	10	18	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	707084	189 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			54	60		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	707066	11 EAST ST, FIVE DOCK	1	RES	52	46	46	38			65	71		13	19	19	27	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707063	10 WEST ST, FIVE DOCK	2	RES	52	46	46	38			59	65		7	13	13	21	-	7	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	707062	10 WEST ST, FIVE DOCK	1	RES	52	46	46	38			53	59		1	7	7	15	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706979	3 EAST ST, FIVE DOCK	1	RES	52	46	46	38			66	72		14	20	20	28	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706972	175 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55			72	78		17	17	17	17	-	17	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706971	175 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55			72	78		17	17	17	17	-	17	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706949	141 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			59	66		7	13	13	21	-	7	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706911	15 EAST ST, FIVE DOCK	1	RES	52	46	46	38			72	78		20	26	26	34	-	20	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706898	12 WEST ST, FIVE DOCK	1	RES	52	46	46	38			57	63		5	11	11	19	-	5	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706889	3 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			59	66		7	13	13	21	-	7	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706863	2 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			56	62		4	10	10	18	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706862	2 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			55	61		3	9	9	17	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706854	5 EAST ST, FIVE DOCK	2	RES	52	46	46	38			67	73		15	21	21	29	-	15	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706853	5 EAST ST, FIVE DOCK	1	RES	52	46	46	38			64	71		12	18	18	26	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706841	139A GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			54	60		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706838	1B HENRY ST, FIVE DOCK	1	RES	52	46	46	38			61	67		9	15	15	23	-	9	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706829	13 EAST ST, FIVE DOCK	1	RES	52	46	46	38			74	80		22	28	28	36	-	22	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706800	17 EAST ST, FIVE DOCK	1	RES	52	46	46	38			69	75		17	23	23	31	-	17	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706792	137 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			54	60		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706790	137 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			53	59		1	7	7	15	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706736	143 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			53	59		1	7	7	15	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706717	23 EAST ST, FIVE DOCK	1	RES	52	46	46	38			54	60		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706705	7 EAST ST, FIVE DOCK	2	RES	52	46	46	38			67	73		15	21	21	29	-	15	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706704	7 EAST ST, FIVE DOCK	1	RES	52	46	46	38			65	71		13	19	19	27	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive

NCA_14	706692	9 EAST ST, FIVE DOCK	1	RES	52	46	46	38			65	71		13	19	19	27	-	13	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706670	4 WEST ST, FIVE DOCK	1	RES	52	46	46	38			58	64		6	12	12	20	-	6	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706639	11 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			55	61		3	9	9	17	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706618	2 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			54	60		2	8	8	16	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706602	171 GREAT NORTH RD, FIVE DOCK	3	PoW	55	55	55	55			81	87	Y	26	26	26	26	-	26	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706601	171 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55			84	90	Y	29	29	29	29	-	29	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706600	171 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55			86	92	Y	31	31	31	31	-	31	Highly Intrusive	Highly Intrusive	Highly Intrusive	Highly Intrusive
NCA_14	706579	147-149 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			68	75		16	22	22	30	-	16	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706543	6 WEST ST, FIVE DOCK	1	RES	52	46	46	38			58	64		6	12	12	20	-	6	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706451	1 EAST ST, FIVE DOCK	1	EDU	55	55	55	55			67	73		12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706447	175 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			63	69		11	17	17	25	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706430	137 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38			58	64		6	12	12	20	-	6	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706405	1 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			62	68		10	16	16	24	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706399	175 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55			76	82	Y	21	21	21	21	-	21	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_14	706393	4-12 GARFIELD ST, FIVE DOCK	6	RES	52	46	46	38			71	77		19	25	25	33	-	19	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706392	4-12 GARFIELD ST, FIVE DOCK	5	RES	52	46	46	38			72	78		20	26	26	34	-	20	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706391	4-12 GARFIELD ST, FIVE DOCK	4	RES	52	46	46	38			72	78		20	26	26	34	-	20	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706390	4-12 GARFIELD ST, FIVE DOCK	3	RES	52	46	46	38			72	78		20	26	26	34	-	20	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706389	4-12 GARFIELD ST, FIVE DOCK	2	RES	52	46	46	38			72	78		20	26	26	34	-	20	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_14	706388	4-12 GARFIELD ST, FIVE DOCK	1	RES	52	46	46	38			72	78		20	26	26	34	-	20	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Highly Intrusive
NCA_15	705838	130 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			53	59		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705796	37 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			56	62		3	8	8	13	-	3	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705743	122 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			60	66		7	12	12	17	-	7	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_15	705672	120 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55			62	68		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA_15	705671	120 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55			60	66		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA_15	705670	120 GREAT NORTH RD, FIVE DOCK	3	PoW	55	55	55	55			62	68		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA_15	705625	92A GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			55	61		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705624	92A GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			55	61		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705601	SE 3 128 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			54	60		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705600	SE 3 128 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			54	60		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705547	94A GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			53	60		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705546	94A GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			53	59		0	5	5	10	-	0	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705534	11-13 WATERVIEW ST, FIVE DOCK	2	RES	53	48	48	43			55	61		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705506	17 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			55	61		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705503	110 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			67	73		14	19	19	24	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_15	705502	110 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			65	71		12	17	17	22	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive

NCA_15	705354	15 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			54	60		1	6	6	11	-	1	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705333	26 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			55	61		2	7	7	12	-	2	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705320	2 SECOND AV, FIVE DOCK	1	RES	53	48	48	43			57	63		4	9	9	14	-	4	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705303	108 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			63	70		10	15	15	20	-	10	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact

Detailed noise and vibration impact statement

Night Time Activities - West Shaft with Acoustic Shed

Project SMW - CTP: Five Dock (May 22 Update)
Client AFJV

Assessment Date	26/04/2023	Assessment Id	0002
Proposed start date	13/02/2023	Proposed end date	19/07/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Central Tunnelling Package is being delivered by the Acciona Ferrovial Joint Venture (ACJV) and involves excavation of around 11.5 kilometres of twin-bore tunnel linking five station boxes at The Bays, Five Dock, Strathfield, Burwood North and Sydney Olympic Park (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

CoA D43 requires planned works to be assessed within a Detailed Noise and Vibration Impact Statement (DNVIS) where works may exceed the NMLs, vibration criteria and/or ground-borne noise levels specified in CoA D39 and D40 at any residence outside construction hours identified in CoA D35, or where receivers will be highly noise affected.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare site and activity-specific noise assessments for ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This DNVIS has been prepared using KNOWnoise™ and addresses activities for construction of Five Dock station box east and west, as illustrated in Figure 1.

The structure of this DNVIS meets the requirements of CoA D43 and the CNVS and includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Construction vibration assessment
- Section 6 – Mitigation and management, including consultation

1.2 Planned works

The AFJV plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

The AFJV proposes the works subject to this assessment outside approved construction hours for the following reason.

-

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Five Dock construction zones cover two separate locations within the Five Dock village precinct, namely Five Dock East (FDE) and Five Dock West (FDW), as illustrated in Figure 1.

The FDW site is located west of the Great North Road near the intersection of Second Avenue and covers an area of around 3600m^2. Adjacent land uses to this site, fronting the Great North Road, are mostly commercial businesses with some mixed-use commercial/ residential buildings.

West of FDW, the closest residences are located on East Street with the Sunshine childcare facility at the end of the row of residences. To the north of the site is St Albans Church, which is heritage listed, whilst to the south is a Coles supermarket complex which also has some multi storey residences on the upper floors.

The FDE site is located to the east of Great North Road, bounded by Second Avenue and Waterview Street and has a footprint of around 1900 m^2. This site has residences on all four facades with a three-storey mixed use occupancy to the west having commercial premises on the ground floor and residences on the upper two floors.

1.2 Heritage items

Several items of heritage value were identified in the EIS, which include the following. These items will be considered for impacts of vibration-intensive activities.

- St Albans Church and associated buildings
- Canada Bay Police Station

1.3 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Five Docks sites have been divided into Noise Catchment Areas (NCAs).

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description	Ambient noise influences
14	West of Great Northern Road	Commercial and mixed-use receivers adjacent to the Great North Road. Mainly residential one block west from the main road. 'Other sensitive' receivers include Early Learning Centres x 2, Garfield Street Child Centre, Five Dock Public School, and several local medical practices.	Road traffic on the Great North Road, Barnstaple Road and Ramsay Road.
15	East of Great Northern Road.	Commercial and mixed-use receivers adjacent to the Great North Road. Mainly residential one block to the east from the main road. 'Other sensitive' receivers include St Albans Anglican Church, Kiddies on First Early Learning Centre, Domremy Catholic College, and a local medical practice.	Road traffic on the Great North Road, Barnstaple Road and Ramsay Road.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected 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 $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected 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(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The acoustic environment in all areas is described in the EIS as dominated by road traffic noise on the major transport corridors such as Great North Road, Ramsey Road and First Avenue. Contributions from aircraft are also noted.

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
14	52	75	47	46	38	40	52
15	53	75	48	48	43	43	53

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (CNVS)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	B	0 to 10	-
	C	10 to 20	LB
	D	20 to 30	LB, M, SN
	E	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	B	0 to 10	LB
	C	10 to 20	LB, M
	D	20 to 30	LB, M, SN, RO
	E	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	B	0 to 10	LB
	C	10 to 20	LB, M, SN, RO
	D	20 to 30	LB, M, SN, IB, PC, RO, AA
	E	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails
M = Monitoring
IB = Individual briefings
AA = Alternative accommodation
SN = Specific notification
LB = Letterbox drops
RO = Project specific respite offer

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by AFJV were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

A summary of predicted noise levels for the Night period is presented in Table 10, with the worst-case predicted noise level of 70 dB(A) during the works, resulting in 0 receivers classed as highly noise affected.

With reference to the CNVS, 0 receivers are predicted to be classified as Highly Impacted during the Night period.

Table 10 Summary of predicted noise levels with comparison against ICNG criteria for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level		70 dB(A)
Number of highly noise affected receivers (>75 dB)		0
Impact class	**Predicted noise level**	**Predicted number of receivers**
Noticable	0 <= 10 dB above NML	117
Clearly Audible	10 <= 20 dB above NML	35
Moderately Intrusive	20 <= 30 dB above NML	7
Highly Intrusive	> 30 dB above NML	0

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

In the event works are planned for more than two consecutive nights, sleep disturbance is considered. Table 11 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 11 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	96
Exceed 65 dBA awakening criterion	4

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 12. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 12 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	0
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in Table 13 and additional mitigation measures for each receiver identified in Appendix B and summarised in

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	None

Table 14.

Table 13 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	None

Table 14 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.

Code	Measure	Description
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

OOHW Crane

Crane for shed construction

2/13/2023 6:00:00 AM - 7/19/2023 5:00:00 AM

Equipment	Quantity	Usage	Reduction	SWL
Crawler crane 100 tonne	1	50 %	0	96
Elevated Working Platform	2	30 %	0	87
Semi Trailer	1	30 %	0	95

Activity Sound Power Level: 99

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Assessment: Day Time Activities - West Shaft with Acoustic Shed					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary										
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Screen	Awake	Day	O/day	Eve	Night
NCA_14	707242	1A HENRY ST, FIVE DOCK	1	RES	52	46	46	38	Y		49	55		0	3	3	11	-	11	None	Noticable	Noticable	Clearly Audible
NCA_14	707220	2 WEST ST, FIVE DOCK	1	RES	52	46	46	38	Y		47	53		0	1	1	9	-	9	None	Noticable	Noticable	Noticable
NCA_14	707184	19 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		49	55		0	3	3	11	-	11	None	Noticable	Noticable	Clearly Audible
NCA_14	707178	14 GARFIELD ST, FIVE DOCK	2	RES	52	46	46	38			39	45		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	707176	SE 6 87 GREAT NORTH RD, FIVE DOCK	4	RES	52	46	46	38			40	46		0	0	0	2	-	2	None	None	None	Noticable
NCA_14	707163	203-211 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			40	47		0	0	0	2	-	2	None	None	None	Noticable
NCA_14	707162	203-211 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			40	46		0	0	0	2	-	2	None	None	None	Noticable
NCA_14	707151	14 WEST ST, FIVE DOCK	1	RES	52	46	46	38			41	48		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	707130	2 HENRY ST, FIVE DOCK	2	RES	52	46	46	38	Y		44	51		0	0	0	6	-	6	None	None	None	Noticable
NCA_14	707129	2 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			40	46		0	0	0	2	-	2	None	None	None	Noticable
NCA_14	707112	219 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			38	45		0	0	0	0	-	0	None	None	None	Noticable
NCA_14	707093	135 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		51	57		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	707086	189 GREAT NORTH RD, FIVE DOCK	4	RES	52	46	46	38	Y		50	56		0	4	4	12	-	12	None	Noticable	Noticable	Clearly Audible
NCA_14	707085	189 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		49	56		0	3	3	11	-	11	None	Noticable	Noticable	Clearly Audible
NCA_14	707084	189 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		49	55		0	3	3	11	-	11	None	Noticable	Noticable	Clearly Audible
NCA_14	707083	189 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38	Y		48	55		0	2	2	10	-	10	None	Noticable	Noticable	Clearly Audible
NCA_14	707073	109 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		43	49		0	0	0	5	-	5	None	None	None	Noticable
NCA_14	707072	109 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		43	49		0	0	0	5	-	5	None	None	None	Noticable
NCA_14	707071	109 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			42	48		0	0	0	4	-	4	None	None	None	Noticable
NCA_14	707066	11 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		52	58		0	6	6	14	-	14	None	Noticable	Noticable	Clearly Audible
NCA_14	707063	10 WEST ST, FIVE DOCK	2	RES	52	46	46	38	Y		48	54		0	2	2	10	-	10	None	Noticable	Noticable	Noticable
NCA_14	707062	10 WEST ST, FIVE DOCK	1	RES	52	46	46	38	Y		42	49		0	0	0	4	-	4	None	None	None	Noticable
NCA_14	707042	8 WEST ST, FIVE DOCK	1	RES	52	46	46	38			39	45		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	707013	115 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		45	51		0	0	0	7	-	7	None	None	None	Noticable
NCA_14	707012	115 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38	Y		44	51		0	0	0	6	-	6	None	None	None	Noticable
NCA_14	706985	223 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			38	45		0	0	0	0	-	0	None	None	None	Noticable
NCA_14	706984	223 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			38	44		0	0	0	0	-	0	None	None	None	Noticable
NCA_14	706979	3 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		51	57		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	706972	175 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55	Y		58	64		3	3	3	3	-	3	Noticable	Noticable	Noticable	Noticable
NCA_14	706971	175 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55	Y		56	63		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA_14	706949	141 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		48	54		0	2	2	10	-	10	None	Noticable	Noticable	Clearly Audible
NCA_14	706945	187 EAST ST, FIVE DOCK	1	RES	52	46	46	38			38	45		0	0	0	0	-	0	None	None	None	Noticable
NCA_14	706936	213 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			39	45		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	706935	213 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			39	45		0	0	0	1	-	1	None	None	None	Noticable

NCA_14	706911	15 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		51	57		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	706898	12 WEST ST, FIVE DOCK	1	RES	52	46	46	38	Y		47	53		0	1	1	9	-	9	None	Noticable	Noticable	Noticable
NCA_14	706889	3 HENRY ST, FIVE DOCK	1	RES	52	46	46	38	Y		47	53		0	1	1	9	-	9	None	Noticable	Noticable	Noticable
NCA_14	706880	22 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			41	47		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	706875	123 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		45	51		0	0	0	7	-	7	None	None	None	Noticable
NCA_14	706874	123 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		44	50		0	0	0	6	-	6	None	None	None	Noticable
NCA_14	706873	123 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38	Y		43	49		0	0	0	5	-	5	None	None	None	Noticable
NCA_14	706863	2 HENRY ST, FIVE DOCK	2	RES	52	46	46	38	Y		44	50		0	0	0	6	-	6	None	None	None	Noticable
NCA_14	706862	2 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			39	45		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	706854	5 EAST ST, FIVE DOCK	2	RES	52	46	46	38	Y		53	59		1	7	7	15	-	15	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706853	5 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		51	57		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	706841	139A GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		44	50		0	0	0	6	-	6	None	None	None	Noticable
NCA_14	706838	1B HENRY ST, FIVE DOCK	1	RES	52	46	46	38	Y		49	55		0	3	3	11	-	11	None	Noticable	Noticable	Clearly Audible
NCA_14	706829	13 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		51	58		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	706822	12 HENRY ST, FIVE DOCK	2	RES	52	46	46	38	Y		43	49		0	0	0	5	-	5	None	None	None	Noticable
NCA_14	706800	17 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		50	56		0	4	4	12	-	12	None	Noticable	Noticable	Clearly Audible
NCA_14	706792	137 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		53	59		1	7	7	15	-	15	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706790	137 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		54	60		2	8	8	16	-	16	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706787	1 LANCELOT ST, FIVE DOCK	1	RES	52	46	46	38	Y		42	49		0	0	0	4	-	4	None	None	None	Noticable
NCA_14	706772	16 WEST ST, FIVE DOCK	1	RES	52	46	46	38			40	47		0	0	0	2	-	2	None	None	None	Noticable
NCA_14	706736	143 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		57	64		5	11	11	19	-	19	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706735	143 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		56	63		4	10	10	18	-	18	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706721	24 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			41	47		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	706705	7 EAST ST, FIVE DOCK	2	RES	52	46	46	38	Y		53	60		1	7	7	15	-	15	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706704	7 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		51	57		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	706692	9 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		52	58		0	6	6	14	-	14	None	Noticable	Noticable	Clearly Audible
NCA_14	706673	5 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			38	45		0	0	0	0	-	0	None	None	None	Noticable
NCA_14	706670	4 WEST ST, FIVE DOCK	1	RES	52	46	46	38	Y		48	54		0	2	2	10	-	10	None	Noticable	Noticable	Noticable
NCA_14	706668	1A LANCELOT ST, FIVE DOCK	2	RES	52	46	46	38			41	47		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	706660	223 GREAT NORTH RD, FIVE DOCK	4	RES	52	46	46	38			38	45		0	0	0	0	-	0	None	None	None	Noticable
NCA_14	706654	105 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		42	49		0	0	0	4	-	4	None	None	None	Noticable
NCA_14	706653	105 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			42	48		0	0	0	4	-	4	None	None	None	Noticable
NCA_14	706652	105 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			42	48		0	0	0	4	-	4	None	None	None	Noticable
NCA_14	706639	11 HENRY ST, FIVE DOCK	2	RES	52	46	46	38	Y		45	51		0	0	0	7	-	7	None	None	None	Noticable
NCA_14	706638	11 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			39	45		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	706629	8 HENRY ST, FIVE DOCK	2	RES	52	46	46	38	Y		43	49		0	0	0	5	-	5	None	None	None	Noticable

NCA_14	706602	171 GREAT NORTH RD, FIVE DOCK	3	PoW	55	55	55	55	Y		66	72		11	11	11	11	-	11	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706601	171 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55	Y		67	73		12	12	12	12	-	12	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706600	171 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55	Y		62	68		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA_14	706582	145 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		59	65		7	13	13	21	-	21	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706581	145 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		59	65		7	13	13	21	-	21	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706579	147-149 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y	Y	64	71		12	18	18	26	6	26	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706543	6 WEST ST, FIVE DOCK	1	RES	52	46	46	38	Y		48	54		0	2	2	10	-	10	None	Noticable	Noticable	Noticable
NCA_14	706503	15 LANCELOT ST, FIVE DOCK	2	RES	52	46	46	38			38	45		0	0	0	0	-	0	None	None	None	Noticable
NCA_14	706483	197 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			42	48		0	0	0	4	-	4	None	None	None	Noticable
NCA_14	706482	197 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			41	48		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	706481	1 WEST ST, FIVE DOCK	2	RES	52	46	46	38			39	46		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	706468	9 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			38	44		0	0	0	0	-	0	None	None	None	Noticable
NCA_14	706447	175 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38	Y		52	58		0	6	6	14	-	14	None	Noticable	Noticable	Clearly Audible
NCA_14	706435	6 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			42	48		0	0	0	4	-	4	None	None	None	Noticable
NCA_14	706430	137 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		53	59		1	7	7	15	-	15	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706429	137 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		52	58		0	6	6	14	-	14	None	Noticable	Noticable	Clearly Audible
NCA_14	706428	137 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38	Y		51	57		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	706415	24A HENRY ST, FIVE DOCK	2	RES	52	46	46	38			39	45		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	706405	1 HENRY ST, FIVE DOCK	1	RES	52	46	46	38	Y		43	49		0	0	0	5	-	5	None	None	None	Noticable
NCA_14	706393	4-12 GARFIELD ST, FIVE DOCK	6	RES	52	46	46	38	Y		58	64		6	12	12	20	-	20	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706392	4-12 GARFIELD ST, FIVE DOCK	5	RES	52	46	46	38	Y		58	64		6	12	12	20	-	20	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706391	4-12 GARFIELD ST, FIVE DOCK	4	RES	52	46	46	38	Y		58	64		6	12	12	20	-	20	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706390	4-12 GARFIELD ST, FIVE DOCK	3	RES	52	46	46	38	Y		57	63		5	11	11	19	-	19	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706389	4-12 GARFIELD ST, FIVE DOCK	2	RES	52	46	46	38	Y		55	61		3	9	9	17	-	17	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706388	4-12 GARFIELD ST, FIVE DOCK	1	RES	52	46	46	38	Y		52	58		0	6	6	14	-	14	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705838	130 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		50	56		0	2	2	7	-	7	None	Noticable	Noticable	Noticable
NCA_15	705837	130 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y		49	55		0	1	1	6	-	6	None	Noticable	Noticable	Noticable
NCA_15	705834	90 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		49	55		0	1	1	6	-	6	None	Noticable	Noticable	Noticable
NCA_15	705833	90 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y		48	55		0	0	0	5	-	5	None	Noticable	Noticable	Noticable
NCA_15	705821	86 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		48	54		0	0	0	5	-	5	None	None	None	Noticable
NCA_15	705820	86 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y		47	54		0	0	0	4	-	4	None	None	None	Noticable
NCA_15	705819	86 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43	Y		48	55		0	0	0	5	-	5	None	Noticable	Noticable	Noticable
NCA_15	705796	37 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43	Y		50	57		0	2	2	7	-	7	None	Noticable	Noticable	Noticable
NCA_15	705780	2 CORONATION AV, FIVE DOCK	2	RES	53	48	48	43			46	53		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705779	2 CORONATION AV, FIVE DOCK	1	RES	53	48	48	43			46	52		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705765	134 GREAT NORTH RD, FIVE DOCK	4	RES	53	48	48	43			47	53		0	0	0	4	-	4	None	None	None	Noticable

NCA_15	705764	134 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			46	53		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705763	134 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			46	52		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705762	134 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			46	52		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705743	122 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		57	63		4	9	9	14	-	14	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705705	134 FIRST AV, FIVE DOCK	2	RES	53	48	48	43			44	51		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705672	120 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55	Y		62	68		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA_15	705671	120 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55	Y		60	66		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA_15	705670	120 GREAT NORTH RD, FIVE DOCK	3	PoW	55	55	55	55	Y		62	68		7	7	7	7	-	7	Noticable	Noticable	Noticable	Noticable
NCA_15	705645	84 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		47	54		0	0	0	4	-	4	None	None	None	Noticable
NCA_15	705644	84 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			47	53		0	0	0	4	-	4	None	None	None	Noticable
NCA_15	705639	84 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43	Y		48	54		0	0	0	5	-	5	None	None	None	Noticable
NCA_15	705630	10 CORONATION AV, FIVE DOCK	1	RES	53	48	48	43			44	50		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705625	92A GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		51	57		0	3	3	8	-	8	None	Noticable	Noticable	Noticable
NCA_15	705624	92A GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y		50	56		0	2	2	7	-	7	None	Noticable	Noticable	Noticable
NCA_15	705601	SE 3 128 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		51	57		0	3	3	8	-	8	None	Noticable	Noticable	Noticable
NCA_15	705600	SE 3 128 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y		50	56		0	2	2	7	-	7	None	Noticable	Noticable	Noticable
NCA_15	705570	20-22 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			46	52		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705564	78 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			46	52		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705563	78 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			45	52		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705559	80 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			46	53		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705558	80 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			46	52		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705547	94A GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		50	56		0	2	2	7	-	7	None	Noticable	Noticable	Noticable
NCA_15	705546	94A GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y		48	54		0	0	0	5	-	5	None	None	None	Noticable
NCA_15	705544	132 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43	Y		48	54		0	0	0	5	-	5	None	None	None	Noticable
NCA_15	705543	132 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		47	54		0	0	0	4	-	4	None	None	None	Noticable
NCA_15	705542	132 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			47	53		0	0	0	4	-	4	None	None	None	Noticable
NCA_15	705534	11-13 WATERVIEW ST, FIVE DOCK	2	RES	53	48	48	43	Y		51	57		0	3	3	8	-	8	None	Noticable	Noticable	Noticable
NCA_15	705533	11-13 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			46	53		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705506	17 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43	Y		51	57		0	3	3	8	-	8	None	Noticable	Noticable	Noticable
NCA_15	705503	110 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y	Y	70	76		17	22	22	27	11	27	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_15	705502	110 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y	Y	70	76		17	22	22	27	11	27	Clearly Audible	Moderately Intrusive	Moderately Intrusive	Moderately Intrusive
NCA_15	705499	74 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			45	52		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705498	74 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			45	51		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705493	138 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			45	52		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705492	138 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			45	51		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705491	138 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			45	51		0	0	0	2	-	2	None	None	None	Noticable

NCA_15	705488	24 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			46	53		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705462	18 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			43	50		0	0	0	0	-	0	None	None	None	Noticable
NCA_15	705450	32 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			45	51		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705410	28 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			47	53		0	0	0	4	-	4	None	None	None	Noticable
NCA_15	705398	4 CORONATION AV, FIVE DOCK	1	RES	53	48	48	43			45	52		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705397	30 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			46	53		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705362	8 CORONATION AV, FIVE DOCK	1	RES	53	48	48	43			44	50		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705361	5 SUTTON ST, FIVE DOCK	2	RES	53	48	48	43			44	50		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705354	15 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43	Y		51	57		0	3	3	8	-	8	None	Noticable	Noticable	Noticable
NCA_15	705339	82 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			47	53		0	0	0	4	-	4	None	None	None	Noticable
NCA_15	705338	82 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			46	53		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705333	26 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43	Y		49	55		0	1	1	6	-	6	None	Noticable	Noticable	Noticable
NCA_15	705329	16 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			44	50		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705320	2 SECOND AV, FIVE DOCK	1	RES	53	48	48	43	Y		53	59		0	5	5	10	-	10	None	Noticable	Noticable	Noticable
NCA_15	705314	6 CORONATION AV, FIVE DOCK	1	RES	53	48	48	43			44	50		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705303	108 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y	Y	68	74		15	20	20	25	9	25	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_15	705291	1 SUTTON ST, FIVE DOCK	1	RES	53	48	48	43			44	51		0	0	0	1	-	1	None	None	None	Noticable

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact

Detailed noise and vibration impact statement

Night Time Activities - West Shaft with Acoustic Shed

Project SMW - CTP: Five Dock (May 22 Update)
Client AFJV

Assessment Date	26/04/2023	Assessment Id	0002
Proposed start date	13/02/2023	Proposed end date	19/07/2023

Contents

Acoustic terms and acronyms

AA	Acoustic Advisor
AMM	Additional mitigation measures – applicable where standard measures have been implemented and NML is still expected to be exceeded.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear.
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline (Department of Environment and Climate Change 2009)
NCA	Noise Catchment Area
Noise level statistics	L_{A90} - The A-weighted sound pressure level exceeded 90% of the monitoring period. This is considered to represent the background noise. L_{Aeq} - The equivalent continuous A-weighted noise level—the level of noise equivalent to the energy average of noise levels occurring over a measurement period. L_{A1} – The A-weighted sound pressure level exceeded 1% of the monitoring period. L_{Amax} – The maximum A-weighted noise level associated with the measurement period.
NML	Noise Management Level
PPV	Peak Particle Velocity – Measurement of ground-borne vibration in units of mm/s
RBL	Rating Background Level - a single figure that represents the background noise level for assessment purposes
ROL	Road Occupancy Licence – granted by Transport for NSW and required for any activity likely to impact on traffic flow.
SWL	Sound Power Level - The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10-12 watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
SPL	Sound pressure level - This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone. The sound pressure level in dB(A) gives a close indication of the subjective loudness of noise. A technical definition for the sound pressure level, in decibels, is 20 times the logarithm (base 10) of the ratio of any two quantities related to a given sound pressure to a reference pressure (typically 20 µPa equivalent to 0 dB).
Tonal noise	Noise with perceptible and definite pitch or tone
VDV	Vibration dose value – used when assessing intermittent vibration as it is sensitive to peaks in vibration acceleration and accumulates the vibration energy received over the daytime and night-time periods

1 Introduction

1.1 Overview

The Sydney Metro Central Tunnelling Package is being delivered by the Acciona Ferrovial Joint Venture (ACJV) and involves excavation of around 11.5 kilometres of twin-bore tunnel linking five station boxes at The Bays, Five Dock, Strathfield, Burwood North and Sydney Olympic Park (the Project).

During the Project, there is potential for nearby sensitive receivers to experience adverse impacts relating to noise and vibration. The project's Noise and Vibration Management Sub Plan (NVMP) was developed to satisfy the project's Conditions of Approval (CoA) and addresses the assessment and management of noise and vibration impacts during construction.

CoA D43 requires planned works to be assessed within a Detailed Noise and Vibration Impact Statement (DNVIS) where works may exceed the NMLs, vibration criteria and/or ground-borne noise levels specified in CoA D39 and D40 at any residence outside construction hours identified in CoA D35, or where receivers will be highly noise affected.

Under the NVMP, KNOWnoise™, a project-specific noise prediction tool, has been developed to prepare site and activity-specific noise assessments for ongoing risk analysis during project delivery and for when out-of-hours work is proposed (as per the Project's out-of-hours protocol).

This DNVIS has been prepared using KNOWnoise™ and addresses activities for construction of Five Dock station box east and west, as illustrated in Figure 1.

The structure of this DNVIS meets the requirements of CoA D43 and the CNVS and includes:

- Section 1.2 – Construction works and hours with justification for these works in Section 1.3
- Section 2 – Existing environment
- Section 3 – Assessment framework including noise and vibration management levels
- Section 4 – Construction noise assessment
- Section 5 – Construction vibration assessment
- Section 6 – Mitigation and management, including consultation

1.2 Planned works

The AFJV plans to carry out the works described in Appendix A, which lists each assessed activity, its timing and proposed equipment.

1.3 Justification of the works

In line with the Interim Construction Noise Guidelines (DECC 2009), justification is typically required to work outside approved construction hours. These situations may involve low impact or emergency works and works under an out-of-hours work protocol.

The AFJV proposes the works subject to this assessment outside approved construction hours for the following reason.

-

Figure 1 Location map

1 Existing environment

1.1 Sensitive receivers

The Five Dock construction zones cover two separate locations within the Five Dock village precinct, namely Five Dock East (FDE) and Five Dock West (FDW), as illustrated in Figure 1.

The FDW site is located west of the Great North Road near the intersection of Second Avenue and covers an area of around 3600m^2. Adjacent land uses to this site, fronting the Great North Road, are mostly commercial businesses with some mixed-use commercial/ residential buildings.

West of FDW, the closest residences are located on East Street with the Sunshine childcare facility at the end of the row of residences. To the north of the site is St Albans Church, which is heritage listed, whilst to the south is a Coles supermarket complex which also has some multi storey residences on the upper floors.

The FDE site is located to the east of Great North Road, bounded by Second Avenue and Waterview Street and has a footprint of around 1900 m^2. This site has residences on all four facades with a three-storey mixed use occupancy to the west having commercial premises on the ground floor and residences on the upper two floors.

1.2 Heritage items

Several items of heritage value were identified in the EIS, which include the following. These items will be considered for impacts of vibration-intensive activities.

- St Albans Church and associated buildings
- Canada Bay Police Station

1.3 Noise catchment areas

To facilitate the assessment of noise impacts from the project and to apply representative Noise Management Levels (NMLs) to all receivers, receivers adjacent to the Five Docks sites have been divided into Noise Catchment Areas (NCAs).

NCAs group individual sensitive receivers by representative traits such as existing noise environment and potential exposure to noise and vibration from the Project.

NCAs established as part of the EIS are summarised in Table 1 and illustrated in Figure 1. Background noise monitoring has been completed as part of the EIS to apply appropriate NML to each NCA.

Table 1 Summary of work areas, Noise Catchment Areas and land uses

NCA	Location	Description	Ambient noise influences
14	West of Great Northern Road	Commercial and mixed-use receivers adjacent to the Great North Road. Mainly residential one block west from the main road. 'Other sensitive' receivers include Early Learning Centres x 2, Garfield Street Child Centre, Five Dock Public School, and several local medical practices.	Road traffic on the Great North Road, Barnstaple Road and Ramsay Road.
15	East of Great Northern Road.	Commercial and mixed-use receivers adjacent to the Great North Road. Mainly residential one block to the east from the main road. 'Other sensitive' receivers include St Albans Anglican Church, Kiddies on First Early Learning Centre, Domremy Catholic College, and a local medical practice.	Road traffic on the Great North Road, Barnstaple Road and Ramsay Road.

2 Assessment framework

2.1 Approved construction hours

Working hours are set by CoA D35 to D36 as summarised in Table 2. Use of power saws, rock breakers, drills and other tonal or impulsive activities are defined as annoying under the Interim Construction Noise Guideline (ICNG) and are 'highly noise intensive works'.

Table 2 Approved construction hours

CoA	Construction activity	Monday to Friday	Saturday	Sunday / Public holiday
D35	Approved construction	7:00 am to 6:00 pm	8:00 am to 6:00 pm	No work (unless approved under out-of-hours work protocol)
D36	Highly noise intensive works	8:00 am to 6:00 pm[1]	8:00 am to 1:00 pm[1]	No work (unless approved under out-of-hours work protocol)

Notes:

1. if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour.

2.2 Noise assessment criteria

2.2.1 Construction noise

The ICNG describes noise in excess of the background level as potentially having an adverse impact on sensitive receivers and increasing the likelihood of complaint. During standard construction hours, where construction noise is within 10 dB(A) of the RBL, impacts would be acceptable.

Where construction noise is more than 10 dB(A) above the RBL during standard construction hours, a residential receiver is considered noise affected and the proponent should undertake all reasonable and feasible steps necessary to manage the impact and consult with the affected community.

Above a $L_{Aeq,\ 15\ minute}$ noise level of 75 dB(A), a receiver is highly affected, requiring consideration of additional mitigation measures including alternative accommodation in the night period.

Outside standard construction hours, construction noise at a residential receiver more than 5 dB(A) above the RBL is taken to be noise affected. Table 1 (reproduced from Table 2 of the ICNG) sets out the NMLs for residences and how they are to be applied.

In addition, annoying noise such as rock hammers, impact piling, or other impulsive noise sources usually result in greater annoyance than continuous construction noise. A 5 dB(A) penalty is applicable to such activities prior to comparison with the NMLs.

2.2.2 Sleep disturbance

The CNVS requires maximum noise levels to be analysed in terms of the extent and number of times the maximum noise exceeds specific noise trigger levels, in general accordance with the Noise Policy for Industry (NPfI) (EPA 2017). These triggers are:

- LAeq, 15 minute 40 dBA or the prevailing RBL plus 5 dB, whichever is greater, and the
- LAmax 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

The NPfI also recommends the DECCW (2011) Road Noise Policy (RNP) be reviewed for further risk assessment. The RNP recommends maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep and one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.

Table 3 Residential noise management levels

Time of day	NML $L_{Aeq\ (15\ min)}$ *	How to apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm	Noise affected 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 $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences); - if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected 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(A) above the noise affected level, the proponent should negotiate with the community.

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

Other sensitive land uses, such as schools and offices, typically find noise from construction disruptive when the properties are being used (such as during work and school times). The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 4. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption that windows are open for ventilation. Buildings where windows are fixed or cannot otherwise be opened may achieve a greater noise level performance.

Table 4 Non-residential sensitive land uses noise management levels

Land use	Noise assessment location	NML ($L_{Aeq,15min}$)
Classrooms at schools and other educational institutions	Internal	45
Places of worship		
Active recreation areas (such as sporting activities and activities which generate their own noise or focus for participants)	External	65
Passive recreation areas (contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External	60
Industrial premises	External	75
Office, retail outlets	External	70

2.3 Project construction noise management levels

The acoustic environment in all areas is described in the EIS as dominated by road traffic noise on the major transport corridors such as Great North Road, Ramsey Road and First Avenue. Contributions from aircraft are also noted.

The Project specific construction noise management levels for residential receivers have been established in line with the ICNG based on the RBLs relevant to each NCA. These are presented in Table 5. NMLs for non-residential sensitive receivers are described in Table 4.

Table 5 Project specific construction NMLs

NCA	Noise Management Level, $L_{Aeq\ 15\ minute}$						
	Approved hours		Outside approved hours				
	Noise affected	Highly noise affected	Day	Evening	Night	Sleep disturbance (CNVS)	
						$L_{Aeq,\ 15\ minute}$	L_{Amax}
14	52	75	47	46	38	40	52
15	53	75	48	48	43	43	53

As part of planning for out of hours works, standard mitigation measures, as described in the CNVMP, are implemented where reasonable and feasible. However, after these measures have been applied, noise and vibration levels may continue to exceed the NMLs.

In this case, additional mitigation measures outlined in the CNVS, which largely focus on engagement with affected sensitive receivers, should be implemented where reasonable and feasible, unless other agreements are in place with the impacted receiver.

Triggers and additional mitigation measures for airborne noise are taken from the Project's OOHW Protocol and summarised in Table 6. Further details of specific additional mitigation measures are described in the CNVS.

Table 6 Triggers for additional mitigation measures – Airborne noise (CNVS)

Construction hours	Class	dB above NML	Additional management measures
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	B	0 to 10	-
	C	10 to 20	LB
	D	20 to 30	LB, M, SN
	E	>30	LB, M, SN
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	B	0 to 10	LB
	C	10 to 20	LB, M
	D	20 to 30	LB, M, SN, RO
	E	> 30	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	B	0 to 10	LB
	C	10 to 20	LB, M, SN, RO
	D	20 to 30	LB, M, SN, IB, PC, RO, AA
	E	> 30	LB, M, SN, IB, PC, RO, AA

Notes: PC = Phone Calls and emails
M = Monitoring
IB = Individual briefings
AA = Alternative accommodation
SN = Specific notification
LB = Letterbox drops
RO = Project specific respite offer

2.4 Vibration management

2.4.1 Human comfort

When assessing human exposure to construction-related vibration, the CNVS requires vibration goals to be established using *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006), which provides criteria for the assessment of vibration impacts on humans.

Construction activities typically generate vibration of an intermittent nature, which is assessed using a Vibration Dose Value (VDV). Acceptable values of vibration doses are presented in Table 7 for sensitive receivers.

Table 7 VDV Vibration criteria

Receiver type	Low probability of adverse comment ($m/s^{1.75}$)	Adverse comment possible ($m/s^{1.75}$)	Adverse comment probable ($m/s^{1.75}$)
Residential buildings – 16 hour day (7am to 11pm)[1]	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings – 8 hour night (11pm to 7am)[1]	0.13	0.26	0.51

Note 1: Day time and night time as described in BS6472:1992 (as referenced in the CNVS), i.e. a daytime period of 16 h or a night time period of 8 h, for example 23.00 h to 07.00 h.

2.4.2 Buildings

Potential building damage from construction vibration requires the application of values in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2. These values are presented in Table 8 and relate to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

Table 8 Guideline values for vibration velocity for the effects of short-term vibration on structures (BS 7385).

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz to 50 mm/s at 40 Hz and above

Where vibration may give rise to magnification due to resonance, especially at lower frequencies where lower guide values apply, the guide values may be reduced by 50%. The CNVS describes rock breaking/hammering and sheet piling activities as having potential to cause dynamic loading in some structures (e.g. residences).

For activity involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10 Hz to 100 Hz range. On this basis, a conservative vibration damage screening level is:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

2.4.3 Heritage

Heritage buildings and structures would be assessed under a conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity (from DIN 4150). Where vibration levels at heritage items are identified as exceeding this screening level, structural assessment would be completed by the Project team to confirm the structure's sensitivity to vibration. If a heritage building or structure is found to be structurally unsound (following inspection) the conservative criterion would stand. Where the structure is suitably sound, the guideline values from Table 8 would be applicable.

2.4.4 Additional mitigation measures

The CNVS recommends additional mitigation measures where all standard mitigation measures to minimise vibration at the nearest receivers have been implemented and vibration is still predicted to exceed the maximum guideline values. The Additional Mitigation Measures Matrix (AMMM) for vibration from the CNVS is presented in Table 9.

Table 9 Additional Vibration Mitigation Measures (CNVS)

Construction hours	Mitigation measures where predicted vibration levels exceed maximum levels
Approved hours Monday – Friday: 7am – 6pm, Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm; Saturday: 7am – 8am, 6pm – 10pm; Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10am – 7am Saturday: 10pm –8am); Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

3 Impact assessment

3.1 Modelling method

Predictions of noise impacts were performed using KNOWnoise™, a project-specific noise assessment tool developed by Hutchison Weller for the CTP Project. KNOWnoise calculates the maximum $L_{Aeq,15minute}$ noise level for each identified receiver for each proposed activity using predictions from SoundPlan noise modelling software. Predictions include geometric spreading, air and ground absorptions as well as topographical and structural screening and reflection.

The following components were incorporated in the model:

- Topography – Based on terrain data of 1 m resolution.
- Individual sensitive receivers – Worst-affected façade of each building to 700 metres from the works
- Construction noise sources –Activities and equipment provided by AFJV were included in the noise model as individual sources across the nominated work areas for each activity. The maximum predicted LAeq noise level within each work area was identified for each receiver.
- Cumulative impacts – all activities with overlapping time periods are included in cumulative results
- Source height – construction noise sources assumed to be at 1.5 metres above ground level.
- Ground Absorption – Ground assumed to be mixed hard and soft with absorption factor of 0.5
- Meteorology –worst-case meteorological conditions (gentle breeze from source to receiver and stable conditions).
- Residential building structures are included in the model, meaning screening provided by neighboring houses is considered.
- Results are shown for all floors of assessed buildings with the worst-case façade result assumed for the whole floor.

Equipment proposed to be used for OOHW activities together with estimated sound power levels for each item are summarised in Appendix A.

The sound power levels and ultimate predicted noise levels will depend on the number of plant items operating at any one time and their precise location relative to a sensitive receiver. In practice, the predicted levels will vary due to plant moving around the site and not operating intensively or concurrently for a 15 minute assessment period. Shielding and reflection provided by buildings will also vary as plant moves around the site. Therefore, predicted noise levels are conservative.

3.2 Predicted noise levels

Detailed predicted noise levels for each potentially affected receiver are presented Appendix C.

A summary of predicted noise levels for the Night period is presented in Table 10, with the worst-case predicted noise level of 69 dB(A) during the works, resulting in 0 receivers classed as highly noise affected.

With reference to the CNVS, 0 receivers are predicted to be classified as Highly Impacted during the Night period.

Table 10 Summary of predicted noise levels with comparison against ICNG criteria for the Night period.

Maximum cumulative predicted $L_{Aeq,\ 15\ minute}$ noise level		69 dB(A)
Number of highly noise affected receivers (>75 dB)		0
Impact class	**Predicted noise level**	**Predicted number of receivers**
Noticable	0 <= 10 dB above NML	100
Clearly Audible	10 <= 20 dB above NML	28
Moderately Intrusive	20 <= 30 dB above NML	8
Highly Intrusive	> 30 dB above NML	0

Predicted impact classes for the Night period are illustrated graphically in Appendix B. Each identified receiver in the study area has been coloured to highlight the predicted level of impact.

In the event works are planned for more than two consecutive nights, sleep disturbance is considered. Table 11 summarises the number of residents predicted to exceed the sleep disturbance screening criterion. Further analysis is also provided to indicate the number of receivers expected to be woken, at LAmax noise levels greater than 65 dBA.

Where exceedances of the awakening criteria are predicted, additional care should be taken, and mitigation measures implemented in line with the CNVS.

Table 11 Summary of predicted exceedances of sleep disturbance screening criterion and awakening criterion.

Criterion	Predicted number of receivers
Potentially Sleep Disturbed (exceed RBL + 15 screening criterion)	94
Exceed 65 dBA awakening criterion	8

3.3 Vibration

The CNVS requires attended vibration measurements at commencement of vibration generating activities to confirm vibration levels satisfy the criteria for that activity.

Where there is potential for exceedances of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

Based on the proposed work locations and selected equipment, indicative exceedances of the vibration criteria are summarised in Table 12. The exceedances are based on recommended minimum working distances from vibration intensive plant given in Appendix D of the Construction Noise and Vibration Strategy (Transport for NSW 2019). Vibration impacts for each sensitive receiver are listed in Appendix C.

Table 12 Predicted exceedances of vibration criteria

Impact classification	Number of potentially affected receivers
Human comfort	0
Cosmetic damage	0
Heritage structure	0

4 Controls and safeguards

The Project represents a risk of adverse impacts on sensitive receivers, particularly when working close to the project boundary and outside approved hours.

Where short term noise impacts are unavoidable, mitigation measures described in the project construction environment management plan should be implemented together with the recommendations in Table 13 and additional mitigation measures for each receiver identified in Appendix B and summarised in

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	None

Table 14.

Table 13 Standard mitigation measures

Community consultation	• Potentially affected receivers will be notified of OOH works in accordance with project requirements. • Where practicable, works will be scheduled to not conflict with major student examination periods, church congregation times, and other sensitive periods identified through community consultation.
Site induction	• All workers will be inducted to the project prior to commencing work and will be cognisant of their noise and vibration obligations under the CNVMP.
Behavioural practices	• Avoid swearing and unnecessary shouting or loud radios onsite. • Avoid dropping materials from height.
Equipment selection	• Priority given to the use of quieter and less vibration emitting construction methods and plant alternatives where feasible and reasonable. • The noise levels of plant and equipment would meet the maximum noise requirements of the CNVS.
Use and siting of plant	• Locate compounds away from sensitive receivers and discourage access from local roads. • Plant used intermittently to be throttled down or shut down. • Noise-emitting plant to be directed away from sensitive receivers where possible. • Stationary plant should be located behind a structure or enclosed if practicable. • Deliveries should be made as far as practical from sensitive receivers. Dedicated loading/unloading sites should be shielded where possible, if close to receivers. • Plan traffic flow, parking and loading/unloading areas to minimise reversing. • Avoid compression breaking on approach to the site. • Where additional activities or plant may result in marginal noise increases and speed works up, consider concentrating activities at one location and complete works as quickly as possible.
Non-tonal reversing alarms.	• Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.
Noise monitoring	• Monitoring should be completed to verify the assumptions of this CNVIS regarding estimated equipment noise emissions and to ensure compliance with the CNVS.
Vibration monitoring	• Attended vibration measurements should be completed at commencement of vibration generating activities predicted to occur within safe working distances for cosmetic damage. • Where monitoring demonstrates maximum levels exceeded, consider alternative methodologies/equipment
Implement any project specific mitigation measures	
1	None

Table 14 Additional mitigation measures

Code	Measure	Description
AA	Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis.
M	Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.

Code	Measure	Description
IB	Individual briefings	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
LB	Letterbox drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.
RO	Respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
PC	Phone calls	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work. Phone calls and/or emails provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc.
SN	Specific notifications	Specific notifications would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Appendix A Proposed activities and associated sound power levels

OOHW deliveries

Night deliveries

2/13/2023 6:00:00 AM - 7/19/2023 5:00:00 AM

Equipment	Quantity	Usage	Reduction	SWL
Semi Trailer	1	30 %	0	95
Franna Crane	1	40 %	0	94

Activity Sound Power Level: 97

* includes 5 dB penalty for potentially annoying characteristics in line with the ICNG

Appendix B Map showing predicted noise impacts by impact class

Appendix C Detailed predictions

C.1 Noise

Assessment: Day Time Activities - West Shaft with Acoustic Shed					NML, LAeq, 15 minute				Sleep, LAmax		Predicted noise level, dBA		Exceedance summary										
														Exceed NML by (dB):				Exceed sleep disturbance by (dB):		Impact classification			
NCA	Rec	Address	Flr	Land use	Day	O/day	Eve	Night	Screen	Awake	Cumulative LAeq, 15 minute	LMax	Highly Affected?	Day	O/day	Eve	Night	Screen	Awake	Day	O/day	Eve	Night
NCA_14	707242	1A HENRY ST, FIVE DOCK	1	RES	52	46	46	38	Y		48	55		0	2	2	10	-	10	None	Noticable	Noticable	Noticable
NCA_14	707220	2 WEST ST, FIVE DOCK	1	RES	52	46	46	38	Y		46	54		0	0	0	8	-	8	None	Noticable	Noticable	Noticable
NCA_14	707184	19 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		48	55		0	2	2	10	-	10	None	Noticable	Noticable	Noticable
NCA_14	707176	SE 6 87 GREAT NORTH RD, FIVE DOCK	4	RES	52	46	46	38			38	46		0	0	0	0	-	0	None	None	None	Noticable
NCA_14	707163	203-211 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			39	47		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	707162	203-211 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			39	46		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	707151	14 WEST ST, FIVE DOCK	1	RES	52	46	46	38			40	48		0	0	0	2	-	2	None	None	None	Noticable
NCA_14	707130	2 HENRY ST, FIVE DOCK	2	RES	52	46	46	38	Y		44	52		0	0	0	6	-	6	None	None	None	Noticable
NCA_14	707129	2 HENRY ST, FIVE DOCK	1	RES	52	46	46	38	Y		42	50		0	0	0	4	-	4	None	None	None	Noticable
NCA_14	707093	135 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		50	57		0	4	4	12	-	12	None	Noticable	Noticable	Clearly Audible
NCA_14	707086	189 GREAT NORTH RD, FIVE DOCK	4	RES	52	46	46	38	Y		49	56		0	3	3	11	-	11	None	Noticable	Noticable	Clearly Audible
NCA_14	707085	189 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		48	56		0	2	2	10	-	10	None	Noticable	Noticable	Clearly Audible
NCA_14	707084	189 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		48	55		0	2	2	10	-	10	None	Noticable	Noticable	Noticable
NCA_14	707083	189 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38	Y		47	55		0	1	1	9	-	9	None	Noticable	Noticable	Noticable
NCA_14	707073	109 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		42	49		0	0	0	4	-	4	None	None	None	Noticable
NCA_14	707072	109 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		41	49		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	707071	109 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			41	48		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	707066	11 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		51	59		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	707063	10 WEST ST, FIVE DOCK	2	RES	52	46	46	38	Y		48	55		0	2	2	10	-	10	None	Noticable	Noticable	Noticable
NCA_14	707062	10 WEST ST, FIVE DOCK	1	RES	52	46	46	38	Y		41	49		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	707042	8 WEST ST, FIVE DOCK	1	RES	52	46	46	38			39	46		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	707013	115 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		42	49		0	0	0	4	-	4	None	None	None	Noticable
NCA_14	707012	115 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38	Y		41	49		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	706979	3 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		50	58		0	4	4	12	-	12	None	Noticable	Noticable	Clearly Audible
NCA_14	706972	175 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55	Y		56	64		1	1	1	1	-	1	Noticable	Noticable	Noticable	Noticable
NCA_14	706949	141 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		47	55		0	1	1	9	-	9	None	Noticable	Noticable	Noticable
NCA_14	706911	15 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		50	58		0	4	4	12	-	12	None	Noticable	Noticable	Clearly Audible
NCA_14	706898	12 WEST ST, FIVE DOCK	1	RES	52	46	46	38	Y		45	53		0	0	0	7	-	7	None	None	None	Noticable
NCA_14	706889	3 HENRY ST, FIVE DOCK	1	RES	52	46	46	38	Y		45	53		0	0	0	7	-	7	None	None	None	Noticable
NCA_14	706880	22 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			39	47		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	706875	123 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		42	50		0	0	0	4	-	4	None	None	None	Noticable
NCA_14	706874	123 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			39	47		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	706863	2 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			40	48		0	0	0	2	-	2	None	None	None	Noticable
NCA_14	706854	5 EAST ST, FIVE DOCK	2	RES	52	46	46	38	Y		53	60		1	7	7	15	-	15	Noticable	Noticable	Noticable	Clearly Audible

NCA_14	706853	5 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		50	58		0	4	4	12	-	12	None	Noticable	Noticable	Clearly Audible
NCA_14	706841	139A GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		43	50		0	0	0	5	-	5	None	None	None	Noticable
NCA_14	706838	1B HENRY ST, FIVE DOCK	1	RES	52	46	46	38	Y		47	55		0	1	1	9	-	9	None	Noticable	Noticable	Noticable
NCA_14	706829	13 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		50	58		0	4	4	12	-	12	None	Noticable	Noticable	Clearly Audible
NCA_14	706822	12 HENRY ST, FIVE DOCK	2	RES	52	46	46	38	Y		41	49		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	706800	17 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		49	57		0	3	3	11	-	11	None	Noticable	Noticable	Clearly Audible
NCA_14	706792	137 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		51	59		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	706790	137 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		52	60		0	6	6	14	-	14	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706787	1 LANCELOT ST, FIVE DOCK	1	RES	52	46	46	38	Y		41	49		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	706772	16 WEST ST, FIVE DOCK	1	RES	52	46	46	38			39	47		0	0	0	1	-	1	None	None	None	Noticable
NCA_14	706736	143 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		56	64		4	10	10	18	-	18	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706735	143 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		55	63		3	9	9	17	-	17	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706721	24 HENRY ST, FIVE DOCK	2	RES	52	46	46	38			40	47		0	0	0	2	-	2	None	None	None	Noticable
NCA_14	706705	7 EAST ST, FIVE DOCK	2	RES	52	46	46	38	Y		53	61		1	7	7	15	-	15	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706704	7 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		51	58		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	706692	9 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		51	59		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	706692	9 EAST ST, FIVE DOCK	1	RES	52	46	46	38	Y		51	59		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	706670	4 WEST ST, FIVE DOCK	1	RES	52	46	46	38	Y		46	54		0	0	0	8	-	8	None	Noticable	Noticable	Noticable
NCA_14	706668	1A LANCELOT ST, FIVE DOCK	2	RES	52	46	46	38			38	46		0	0	0	0	-	0	None	None	None	Noticable
NCA_14	706654	105 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		41	49		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	706653	105 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			41	48		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	706652	105 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			40	48		0	0	0	2	-	2	None	None	None	Noticable
NCA_14	706639	11 HENRY ST, FIVE DOCK	2	RES	52	46	46	38	Y		43	51		0	0	0	5	-	5	None	None	None	Noticable
NCA_14	706629	8 HENRY ST, FIVE DOCK	2	RES	52	46	46	38	Y		41	49		0	0	0	3	-	3	None	None	None	Noticable
NCA_14	706602	171 GREAT NORTH RD, FIVE DOCK	3	PoW	55	55	55	55	Y		69	77		14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706601	171 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55	Y		69	76		14	14	14	14	-	14	Clearly Audible	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706600	171 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55	Y		63	71		8	8	8	8	-	8	Noticable	Noticable	Noticable	Noticable
NCA_14	706582	145 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		58	65		6	12	12	20	-	20	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706581	145 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		57	65		5	11	11	19	-	19	Noticable	Clearly Audible	Clearly Audible	Clearly Audible
NCA_14	706579	147-149 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y	Y	63	71		11	17	17	25	6	25	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706543	6 WEST ST, FIVE DOCK	1	RES	52	46	46	38	Y		46	54		0	0	0	8	-	8	None	Noticable	Noticable	Noticable
NCA_14	706483	197 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38			40	48		0	0	0	2	-	2	None	None	None	Noticable
NCA_14	706482	197 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38			40	48		0	0	0	2	-	2	None	None	None	Noticable
NCA_14	706447	175 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38	Y		51	58		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible
NCA_14	706435	6 HENRY ST, FIVE DOCK	1	RES	52	46	46	38			40	48		0	0	0	2	-	2	None	None	None	Noticable
NCA_14	706430	137 GREAT NORTH RD, FIVE DOCK	3	RES	52	46	46	38	Y		52	59		0	6	6	14	-	14	None	Noticable	Noticable	Clearly Audible
NCA_14	706429	137 GREAT NORTH RD, FIVE DOCK	2	RES	52	46	46	38	Y		51	58		0	5	5	13	-	13	None	Noticable	Noticable	Clearly Audible

NCA_14	706428	137 GREAT NORTH RD, FIVE DOCK	1	RES	52	46	46	38	Y		50	57		0	4	4	12	-	12	None	Noticable	Noticable	Clearly Audible
NCA_14	706405	1 HENRY ST, FIVE DOCK	1	RES	52	46	46	38	Y		44	52		0	0	0	6	-	6	None	None	None	Noticable
NCA_14	706393	4-12 GARFIELD ST, FIVE DOCK	6	RES	52	46	46	38	Y	Y	58	66		6	12	12	20	1	20	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706392	4-12 GARFIELD ST, FIVE DOCK	5	RES	52	46	46	38	Y	Y	59	66		7	13	13	21	1	21	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706391	4-12 GARFIELD ST, FIVE DOCK	4	RES	52	46	46	38	Y	Y	59	66		7	13	13	21	1	21	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706390	4-12 GARFIELD ST, FIVE DOCK	3	RES	52	46	46	38	Y	Y	58	66		6	12	12	20	1	20	Noticable	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_14	706389	4-12 GARFIELD ST, FIVE DOCK	2	RES	52	46	46	38	Y		55	62		3	9	9	17	-	17	Noticable	Noticable	Noticable	Clearly Audible
NCA_14	706388	4-12 GARFIELD ST, FIVE DOCK	1	RES	52	46	46	38	Y		53	60		1	7	7	15	-	15	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705838	130 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		48	56		0	0	0	5	-	5	None	Noticable	Noticable	Noticable
NCA_15	705837	130 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y		48	55		0	0	0	5	-	5	None	None	None	Noticable
NCA_15	705834	90 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		48	55		0	0	0	5	-	5	None	None	None	Noticable
NCA_15	705833	90 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y		47	55		0	0	0	4	-	4	None	None	None	Noticable
NCA_15	705821	86 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		47	54		0	0	0	4	-	4	None	None	None	Noticable
NCA_15	705820	86 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y		46	54		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705819	86 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43	Y		47	55		0	0	0	4	-	4	None	None	None	Noticable
NCA_15	705796	37 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43	Y		49	57		0	1	1	6	-	6	None	Noticable	Noticable	Noticable
NCA_15	705780	2 CORONATION AV, FIVE DOCK	2	RES	53	48	48	43			45	53		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705779	2 CORONATION AV, FIVE DOCK	1	RES	53	48	48	43			44	52		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705765	134 GREAT NORTH RD, FIVE DOCK	4	RES	53	48	48	43			46	53		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705764	134 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			45	53		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705763	134 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			45	52		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705762	134 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			44	52		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705743	122 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		56	63		3	8	8	13	-	13	Noticable	Noticable	Noticable	Clearly Audible
NCA_15	705705	134 FIRST AV, FIVE DOCK	2	RES	53	48	48	43			43	51		0	0	0	0	-	0	None	None	None	Noticable
NCA_15	705672	120 GREAT NORTH RD, FIVE DOCK	2	PoW	55	55	55	55	Y		60	68		5	5	5	5	-	5	Noticable	Noticable	Noticable	Noticable
NCA_15	705671	120 GREAT NORTH RD, FIVE DOCK	1	PoW	55	55	55	55	Y		59	66		4	4	4	4	-	4	Noticable	Noticable	Noticable	Noticable
NCA_15	705670	120 GREAT NORTH RD, FIVE DOCK	3	PoW	55	55	55	55	Y		61	68		6	6	6	6	-	6	Noticable	Noticable	Noticable	Noticable
NCA_15	705645	84 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		46	54		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705644	84 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			46	53		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705639	84 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43	Y		47	54		0	0	0	4	-	4	None	None	None	Noticable
NCA_15	705625	92A GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		49	57		0	1	1	6	-	6	None	Noticable	Noticable	Noticable
NCA_15	705624	92A GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y		49	56		0	1	1	6	-	6	None	Noticable	Noticable	Noticable
NCA_15	705601	SE 3 128 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		49	57		0	1	1	6	-	6	None	Noticable	Noticable	Noticable
NCA_15	705600	SE 3 128 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y		49	56		0	1	1	6	-	6	None	Noticable	Noticable	Noticable
NCA_15	705570	20-22 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			44	52		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705564	78 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			45	52		0	0	0	2	-	2	None	None	None	Noticable

NCA_15	705563	78 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			44	52		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705559	80 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			45	53		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705558	80 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			44	52		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705547	94A GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		48	56		0	0	0	5	-	5	None	Noticable	Noticable	Noticable
NCA_15	705546	94A GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y		47	54		0	0	0	4	-	4	None	None	None	Noticable
NCA_15	705544	132 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43	Y		46	54		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705543	132 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y		46	54		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705542	132 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			46	53		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705534	11-13 WATERVIEW ST, FIVE DOCK	2	RES	53	48	48	43	Y		50	57		0	2	2	7	-	7	None	Noticable	Noticable	Noticable
NCA_15	705533	11-13 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			45	53		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705506	17 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43	Y		50	57		0	2	2	7	-	7	None	Noticable	Noticable	Noticable
NCA_15	705503	110 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43	Y	Y	65	73		12	17	17	22	8	22	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_15	705502	110 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y	Y	65	73		12	17	17	22	8	22	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_15	705499	74 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			44	52		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705498	74 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			44	51		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705493	138 GREAT NORTH RD, FIVE DOCK	3	RES	53	48	48	43			44	52		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705492	138 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			44	51		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705491	138 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			43	51		0	0	0	0	-	0	None	None	None	Noticable
NCA_15	705488	24 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			45	53		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705450	32 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			44	51		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705410	28 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			46	53		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705398	4 CORONATION AV, FIVE DOCK	1	RES	53	48	48	43			44	52		0	0	0	1	-	1	None	None	None	Noticable
NCA_15	705397	30 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43			45	53		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705354	15 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43	Y		49	57		0	1	1	6	-	6	None	Noticable	Noticable	Noticable
NCA_15	705339	82 GREAT NORTH RD, FIVE DOCK	2	RES	53	48	48	43			46	53		0	0	0	3	-	3	None	None	None	Noticable
NCA_15	705338	82 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43			45	53		0	0	0	2	-	2	None	None	None	Noticable
NCA_15	705333	26 WATERVIEW ST, FIVE DOCK	1	RES	53	48	48	43	Y		48	55		0	0	0	5	-	5	None	None	None	Noticable
NCA_15	705320	2 SECOND AV, FIVE DOCK	1	RES	53	48	48	43	Y		51	59		0	3	3	8	-	8	None	Noticable	Noticable	Noticable
NCA_15	705303	108 GREAT NORTH RD, FIVE DOCK	1	RES	53	48	48	43	Y	Y	66	73		13	18	18	23	8	23	Clearly Audible	Clearly Audible	Clearly Audible	Moderately Intrusive
NCA_15	705291	1 SUTTON ST, FIVE DOCK	1	RES	53	48	48	43			43	51		0	0	0	0	-	0	None	None	None	Noticable

C.2 Vibration

NCA	Receiver	Address	Land use	Vibration Impact