Metro Body of Knowledge

Planning Approval Consistency Assessment Form

SM-17-00000111

Sydney Metro – Metro Body of Knowledge (MBoK)

Assessment Name:	Hunter Street Station eastern tunnel refinement
Prepared by:	Sydney Metro
Prepared for:	Sydney Metro and John Holland CPB Contractors Ghella Joint Venture (JCG)
Assessment number:	SMW11
Type of assessment:	Assessment under EP&A Act 1979, Division 5.2
Version:	Final
Planning approval No. (where relevant):	SSI – 19238057
Date required:	28 August 2023
iCentral number	SM-23-00815722

Form information – do not alter

Form number	SM-17-00000111
Applicable to:	Sydney Metro
Document Owner:	Director, Planning Approvals
System Owner:	Executive Director, Environment, Sustainability & Planning
Status:	Final
Version:	4.0
Date of issue:	JUNE 2023
Review date:	As required

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1. Existing Approved Project

Planning approval reference details (Application/Document No. (including modifications)):			
SSI-19238057: Sydney Metro West – Major civil construction between The Bays to Sydney CBD (Stage 2 of the planning approval process for Sydney Metro West)			
Date of determination:	24 August 2022	Type of planning approval:	Critical State Significant Infrastructure (CSSI) (Division 5.2)
Relevant background information (including EA, REF, Submissions Report, Director General's Report, MCoA):			
Sydney Metro West Environmental Impact Statement – Major civil construction between The Bays and Sydney CBD (Sydney Metro, November 2021) (referred to throughout this document as 'the EIS') *Sydney Metro West Submissions Report – Major civil construction work between The Bays and Sydney CBD* (Sydney Metro, April 2022) *Sydney Metro West Stage 2 - Assessment Report (SSI 19238057) (24 August 2022)* *Sydney Metro West Stage 2 – Instrument of Approval - Conditions of approval (CoA) (24 August 2022)* All proposed work identified in the assessment would be carried out in accordance with the mitigation measures identified in the Environmental Impact Statement (EIS), Submissions Report and the Conditions of Approval (CoA).			
Description of existing approved project you are assessing for consistency:			

Sydney Metro West - all major civil construction work between Westmead and The Bays (Stage 1)

Sydney Metro West – Concept and Stage 1 (major civil construction between Westmead and The Bays), including station excavation and tunnelling, was determined on 11 March 2021.

It is noted that this consistency assessment does not relate to any aspects of Stage 1.

Sydney Metro West - all major civil construction work and tunnelling between The Bays and Sydney CBD (Stage 2, the Approved Project)

The major civil construction work between The Bays and Sydney CBD was determined on 24 August 2022. The scope of the Approved Project is described in Chapter 5 of the EIS and would include:

- Enabling work such as demolition, utility supply to construction sites, utility adjustments, and modifications to the existing transport network
- Tunnel excavation including tunnel support activities
- Station excavation for new metro stations at Pyrmont and at Hunter Street, in the Sydney CBD.

An administrative Modification (SSI 19238057-Mod 1) to Stage 2 was approved on 24 April 2022. The Modification changed Condition D23(D)(i) to allow tunnelling (and associated activities of rockbolting, shotcreting and mucking out) to be undertaken 24 hours a day, seven days a week.

Sydney Metro West - Rail infrastructure, stations, precincts and operations (Stage 3)

The Sydney Metro West planning approval for rail infrastructure, stations, precincts and operations was determined on 26 January 2023. The Approved Project includes construction elements relating to the tunnel fit-out, construction of stations, ancillary facilities and station precincts, as well as the operation and maintenance of the Sydney Metro West line. Provisions were made for structures and spaces for non-station uses such as retail, commercial and/or community facilities which would generally be provided within, around and above the station infrastructure and would be integrated with the overall design of the Stations. It is noted that this consistency assessment relates to some aspects of Stage 3. Operational impacts associated with the proposed refinement will be assessed separately against Stage 3 (SSI-22765520).

Tunnel construction methodology for the Approved Project

The work for the Approved Project was described in the *Sydney Metro West Environmental Impact Statement – Sydney Metro West – The Bays to Sydney CBD* (Sydney Metro, 2021) (Stage 2 of the planning approvals process).

Based on the indicative long section presented in the EIS, the depth of the tunnels to rail level would vary from about 27 to 52 metres due to changes in topography, with depths to the top of the tunnel typically measuring about seven metres less than this. The shallower tunnel sections would generally be near the stations, with the deeper sections generally under the major water bodies of Johnstons Bay and Cockle Bay. Section 1.3 of the EIS for the Approved Project stated that components of the proposal are subject to further design and construction planning, and that changes may be made during the ongoing design which take into account the outcomes of community and stakeholder engagement, and environmental field investigations. Furthermore, Section 5.1 of the EIS noted that the tunnel alignment assessed for the Approved Project was indicative and may be subject to design development and construction planning.

The total tunnel length between The Bays and Sydney CBD is about 3.5 kilometres, of which about 2.3 kilometres would be excavated by tunnel boring machines. The centre lines of the two tracks would typically be about 14 metres apart. This would depend, however, on specific geological constraints and the need to avoid building basements. The tunnels would be lined with precast concrete segments to ensure the long-term life of the asset and minimise groundwater inflow into the tunnel.

As identified in the EIS for the Approved Project the following tunnel features would be excavated using roadheaders and/or rock hammers:

- Crossover cavern between The Bays Station and Pyrmont Station (subject of Consistency Assessment SMW07)
- Cross passages between the two tunnels to allow for emergency access
- Tunnel turnback at the end of the line, east of the eastern Hunter Street Station (Sydney CBD) construction site, to allow for the future operational ability to turn trains around for services travelling from the Hunter Street Station (Sydney CBD) west towards Westmead
- Stub tunnels to safeguard a potential future extension to the Metro network.

Previous refinements related to the Approved Project

A Consistency Assessment (SMW05 - Hunter Street Station undercut and turnback tunnels) was prepared and approved in September 2022 which refined the tunnel alignment between the Hunter Street Station eastern site and the Domain. This resulted in a reconfiguration of the turnback tunnels at the end of the alignment (beneath the Domain) from two tunnels to one tunnel. The refinement was within the study area assessed for the Approved Project and was generally within the approved project corridor, with the end of the tunnels extending about 300 metres past the approved corridor into The Domain. There was no change to the depth of the tunnels as a result of this refinement to the tunnel alignment.

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

This Consistency Assessment assesses potential impacts associated with a reduction to the depth of the tunnel alignment subject of Consistency Assessment SMW05 - Hunter Street Station undercut and turnback tunnels.

Following determination of the Approved Project, the design process identified that the indicative tunnel alignment would encroach on the Ausgrid easement of the City East Cable Tunnel (CECT). The CECT is about 3.5 metres in diameter and is about 30 metres below ground. The CECT is a critical trunk utility that provides power supply to the Sydney CBD. The utility runs through the eastern area of Sydney CBD including below Macquarie Street. Consistent with the approach to utilities management outlined in Section 5.6.4 of the EIS, it was found that it would not be possible to adjust or relocate the CECT without resulting in unacceptable disruptions to the power supply of the Sydney CBD. A minor refinement to the vertical alignment of the Sydney Metro West tunnels between Hunter Street Station eastern site and The Domain is required to achieve a suitable clearance from the Ausgrid easement and CECT and minimise potential impacts to the utility from construction.

Noting the above, this Consistency Assessment proposes a reduction to the depth of the indicative tunnel alignment between the Hunter Street eastern site and The Domain by a maximum of about four metres. A map of the indicative tunnel alignment is shown at Appendix A of this Consistency Assessment. A Detailed Noise and Vibration Impact Statements (DNVIS) has been prepared in accordance with Conditions of Approval D43 and D44 and is attached at Appendix B. All work subject of this Consistency Assessment must be undertaken in accordance with the mitigation measures outlined in the DNVIS, to be endorsed by the appointed Acoustics Advisor.

Table 1 – Comparison of relevant elements of the Approved Project with the proposed refinement.

Relevant elements of the Approved Project	Proposed refinement
Tunnel depth Section 5.1 of the EIS stated that the tunnel alignment assessed for the Approved Project was indicative and may be subject to design development and construction planning. The indicative tunnel depth for the Approved Project between the Hunter Street eastern site and The Domain is shown in Figure 5-3 – Indicative alignment plan and long section of the EIS. The depth of the tunnels would vary from about 15 to 50 metres below surface level due to changes in topography. The indicative alignment shown in the EIS identified the tunnels would be excavated at a depth of about 27 metres at Hunter Street Station, and about 47 metres at Macquarie Street.	The depth of the indicative tunnel alignment presented in the EIS would be reduced by up to about four metres. The depth of Hunter Street Station eastern site would remain at about 27 metres below ground. The depth of the tunnels west of the Hunter Street Station eastern site vary between about 27 metres and 48 metres and would be reduced by a maximum of about four metres.
Construction methodology and tunnelling methods Construction methods are described in Section 5.5 of the EIS for the Approved Project. Tunnel boring machines would be used to excavate the majority of the twin underground tunnels between The Bays and Sydney CBD. The two bored tunnels would have a circular cross-section with an internal lined diameter of about six metres and an excavated diameter of about seven metres. The turnback tunnel at the end of the line, east of the eastern Hunter Street Station (Sydney CBD) construction site would be excavated using roadheaders and rock hammers.	There would be no change to the construction and tunnelling methodology. Tunnel boring machines would be used to excavate the majority of the twin tunnels. The turnback tunnels would be excavated using rockbreakers and roadheaders.

3. Timeframe

An indicative construction program for the major civil construction work between The Bays and Sydney CBD is shown in Figure 5-6 of the EIS. Tunnelling was proposed to occur from Q2 2023 to Q4 2025. Excavation of the turnback tunnel would occur from the Hunter Street Station eastern construction site. The indicative construction program for the Hunter Street Station construction site is shown in Figure 5-13 of the EIS and shows shaft excavation to occur from Q1 2023 to Q3 2025 and Station cavern excavation and lining to extend from Q3 2023 to Q4 2025. Section 5.3 of the EIS notes that the actual program and commencement of the civil work at each construction site may vary and is subject to ongoing design development and construction planning to be agreed with the successful contractor for each work package.

The proposed refinement would fit within the indicative construction program described in the EIS for the Approved Project and would not require any change to the Approved Project's indicative construction program for tunnelling or excavation at Hunter Street Station eastern construction site.

4. Site description

The proposed refinement to the tunnel alignment would be substratum only (entirely underground). The tunnel alignment is located directly beneath the State Library (SHR Item no. 01071), Chifley Square (SHR Item no. 01512), and the Royal Botanical Gardens and Domain (including Governor's Domain and Civic Precinct) (NHL Place ID 106103).

5. Site Environmental Characteristics

The proposed refinement would be substratum and would not have any effect at ground surface level. The proposed tunnel realignment would be excavated in geology and hydrogeological conditions that are consistent with the adjoining areas of the Approved Project (Hawkesbury Sandstone) and using the same methods as described in Section 5.5.3 of the EIS.

6. Justification for the proposed refinement

Section 5.6.4 of the EIS for the Approved Project, described the approach to utilities management and stated that utilities would need to be adjusted, relocated and/or protected where there is a possibility they would otherwise be impacted by construction.

The CECT is a critical piece of utilities infrastructure which provides power supply to the Sydney CBD. The indicative approved tunnel alignment between the Hunter Street eastern site and The Domain (as assessed in Consistency Assessment SMW05) is at a depth of about 27 metres at Hunter Street Station and about 48 metres beneath Macquarie Street. In order to mitigate potential impacts from vibration and ground-settlement during tunnelling and operations, greater clearance is required between the approved tunnel alignment east of the Hunter Street eastern site and the CECT. Due to the significant role of the CECT in providing power to the Sydney CBD, it would not be possible relocate or reinforce the utility without disrupting the power supply to the CBD. As such, the most suitable mitigation approach would involve reducing the depth of the Sydney Metro West tunnels between the Hunter Street Station eastern site and turnback tunnels beneath The Domain by up to about four metres to mitigate potential impacts and to ensure that sufficient clearance is provided between the Sydney Metro West tunnels and the Ausgrid assets.

7. Environmental Benefit

The proposed refinement would mitigate potential vibration impacts to the CECT and Ausgrid easement during construction and operation of Sydney Metro West.

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 / Environmental mitigation measures

Number	Condition of Approval/ Environmental mitigation measure	Discussion on relevance and consistency for proposed refinement
D8	The Former Skinners Family Hotel, Tank Stream, Bennelong Stormwater Channel No. 29A, NSW Club house Building, Delfin House, Richard Johnson Square, Railway Cutting (Pyrmont), and St James Railway Station must not be destroyed, modified or otherwise affected, except as identified in the documents listed in Condition A1. *Note: Affected in this condition means any impact above "little to no impact" as defined in the Material Threshold Policy (Heritage NSW, 2020).*	The proposed refinement to the tunnel alignment would not result in a notable change to construction vibration or ground settlement impacts to these heritage items. As a result, tunnelling work between Hunter Street station eastern site and The Domain would result in little to no impact to The Former Skinners Family Hotel, Tank Stream, Bennelong Stormwater Channel No. 29A, NSW Club house Building, Delfin House, Richard Johnson Square or St James Railways Station.
D23(d)(i)	Tunnelling (and associated activities of rockbolting, shotcreting and mucking out, but excluding cut and cover tunnelling and surface works) are permitted 24 hours a day, seven days a week.	As permissible under Condition D23(d)(i), tunnelling between Hunter Street eastern site and The Domain would occur 24 hours a day, seven days a week.

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

10. Impact Assessment – Construction

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed refinement, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Consistent Impact Y/N	Do any CoA need to be changed? Y/N	Endorsed	
					Y/N	Comments
Biodiversity	The proposed refinement would not result in any removal of vegetation. There would be no change to the biodiversity impacts of the Approved Project.	No additional mitigation measures required.	Y	N		
Water	Hydrology, flooding and water quality impacts for the Approved Project were assessed in Technical Paper 9 of the EIS. The assessment found that as the tunnel alignment would be underground, there would be no flooding impacts from excavation of the tunnels. Chapter 14 of the Approved Project assessed that groundwater level drawdown would not be likely to be significant as tunnels would be tanked to prevent the inflow of groundwater, typically using concrete lining and waterproofing membranes The construction methodology for tunnel excavation would not change as a result of the proposed refinement to the tunnel alignment. The turnback and stub tunnelling would be undertaken using roadheaders. Tunnel support for roadheader sections would consist of a primary lining (likely to be pattern rock bolting and shotcreting) and a final cast in-situ or sprayed concrete lining. This would reinforce the structure of the tunnel and minimise the ingress of groundwater.	No additional mitigation measures required.	Y	N		
Soils and contamination	Contamination is assessed in Chapter 16 of the EIS for the Approved Project. The assessment found three recorded contaminated sites within	No additional mitigation measures required.	Y	N		

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					Y/N	Comments
	and nearby the Hunter Street Station site with a low or very low potential for contamination. There were no identified areas of environmental interest that were considered to have moderate or higher potential contamination impact for the Approved Project. As the proposed refinement would be within the same study area of the Approved Project, there would be no change to the contamination risk. Indicative spoil generation for the Hunter Street station eastern and western construction sites are shown in Table 5-7 of the EIS. The Approved Project assessed there to be about 123,100 cubic metres of spoil removed from the western construction site and 396,200 cubic metres of spoil removed from the eastern construction site. There would be no change to the extent of tunnels excavated as part of the proposed refinement and therefore, the proposed refinement to the depth of the tunnel would not result in a material change to the volume of spoil generated through excavation and tunnelling.					
Air quality	The proposed refinement to the tunnel alignment would not result in any change to the indicative construction vehicle volumes from the Approved Project, construction material volumes construction methodology or construction machinery to be used for tunnel boring and excavation. As a result there would be no change to air quality impacts as a result of the proposed refinement.	No additional Measures required.	Y	N		

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed refinement, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Consistent Impact Y/N	Do any CoA need to be changed? Y/N	Endorsed	
					Y/N	Comments
Noise and vibration	Construction noise and vibration was assessed in Chapter 7 and Technical Paper 2 of the EIS for the Approved Project. The assessment considered potential noise and vibration impacts from the excavation of irregular shaped tunnels, including stub tunnels, cross passages, crossover and turnback caverns and niches, by roadheaders. No residential receivers were identified nearby the Hunter Street Station sites. Neighbouring sensitive receivers included several hotels, one Place of Worship, and one media studio with recording equipment. Ground-borne noise levels were predicted to comply with the relevant noise management levels (NMLs) at all but one receiver in the vicinity of the turnback and stub tunnels to the east of Hunter Street Station. The affected receiver was identified as the Sofitel at 101 Philip Street, Sydney which would have a worst case predicted exceedance between 1-5 dBA during the evening out-of-hours work period, and an exceedance between 11-20 dBA during the night-time out-of-hours works period. It was noted that despite these potential worst-case impacts being identified, that these impacts would last for a duration of about six to 12 weeks. The assessment found that no cosmetic damage vibration impacts would be expected from tunnelling. In the vicinity of the Hunter Street Station, eight receivers would experience a temporary exceedance of the human comfort criteria during the day and four during the night. This impact would last for about six to 12 weeks.	No additional mitigation measures required.	Y	N		

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed refinement, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Consistent Impact Y/N	Do any CoA need to be changed? Y/N	Endorsed	
					Y/N	Comments
	For excavation of the turnback and stub tunnels east of Hunter Street station, three buildings at the Sydney Hospital would have potential to experience exceedances of the sensitive equipment criteria. The assessment noted that additional assessment of the potential vibration impacts would be undertaken during development of the detailed noise and vibration impact statement and that appropriate mitigation options would be confirmed in consultation with Sydney Hospital. A Detailed Noise and Vibration Impact Statement (DNVIS) (Appendix B) was prepared by JCG to support the proposed works and is subject to the endorsement of the Acoustics Advisor. As the tunnelling works and proposed refinement would occur underground, airborne noise impacts were not assessed in the DNVIS. This is consistent with the assessment approach for Technical Paper 2 of the EIS. The DNVIS found that no new receivers would experience ground borne noise impacts as a result of the proposed refinement. Consistent with the Approved Project, the proposed refinement to the tunnel depth would result in potential exceedances of ground borne noise management levels at the Sofitel at 110 Phillip Street, Sydney between 1 – 10 dBA during the night-time out of hours works period. This is a reduction to the predicted ground borne noise impacts assessed in Technical Paper 2 of the EIS. For both the evening and night-time out-of-hours works periods, ground borne noise levels					

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					Y/N	Comments
	would not exceed those predicted at the Sofitel at 110 Phillip Street and would therefore be consistent with the findings of Technical Paper 2 of the EIS. The DNVIS noted that despite the identified NML exceedance from the proposed refinement, that the predictions were based on a worst-case scenario that assumes tunnelling would occur at the closest distance to the receiver. Due to the nature of tunnelling activities, noise levels would reduce as the roadheader moves through the cavern away from receivers. The DNVIS found that the proposed refinement to the tunnel alignment would not result in any exceedances of the cosmetic damage screening criteria and would not result in vibration above the screening limit for human annoyance which is consistent with the impacts associated with the Approved Project. Vibration levels predicted at the Sydney Hospital were found to not result in any exceedances of the sensitive equipment criteria and would therefore result in a reduced impact from that assessed in Technical Paper 2 of the EIS. Overall, the ground borne vibration impacts from the proposed tunnel refinement would be consistent with the Approved Project. Overall, Sydney Metro would continue to manage potential noise and vibration impacts from tunnelling in accordance with the measures and processes outlined in the Construction Noise and Vibration Standard.					

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed refinement, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Consistent Impact Y/N	Do any CoA need to be changed? Y/N	Endorsed	
					Y/N	Comments
Aboriginal Culture and Heritage	The proposed refinement to reduce the depth of the tunnel alignment between the Hunter Street eastern site and The Domain by a maximum of about four metres would be minor and would remain within the study area of the Approved Project. As all works associated with the proposed refinement would be below ground, it is not expected that there would be any impacts to Aboriginal archaeology.	No additional Measures required.	Y	N		
Historic Heritage	Potential impacts to items of Historic Heritage were assessed in Chapter 8 and Technical Paper 4 of the EIS. The following potential heritage impacts to items in the vicinity of the tunnel alignment were identified: • Former Railway House (part of Transport House) including interiors (SHR Item no. 01271 Sydney Trains s170 register (no item number retrievable)) • Wynyard Park including parkland, mature trees, remnant fences, underground conveniences and Lang Statue (SLEP 2012 Item no. I1971) • Former 'Shell House' including interior (SLEP 2012 Item no. I1691) • Former 'Qantas House' (SHR Item no. 01512) • Wentworth Hotel (SLEP 2012 Item no. I1674) • Chifley Square (SHR Item no. 01512)	No additional mitigation measures required.	Y	N		

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed refinement, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Consistent Impact Y/N	Do any CoA need to be changed? Y/N	Endorsed	
					Y/N	Comments
	• Terrace house 'Horbury House' (SLEP 2012 Item no. I1877) • St James Railway Station (SHR Item no. 01248) • Shakespeare Place (SLEP 2012 Item no. I1949) • State Library of NSW (SHR Item no. 01071) • Royal Botanical Gardens and Domain (including Governor's Domain and Civic Precinct) (NHL Place ID 106103). All of the above items that were identified as being proximal to the tunnel alignment at Hunter Street Station were found to have neutral vibration impacts and negligible settlement impacts, resulting in an overall negligible impact at all items. St James Railway Station, The Royal Botanic Gardens and Domain, Chifley Square Wynyard Park and the Former Railway House (part of Transport House) including interiors were all found to be outside of the zone of influence for potential settlement impacts and would be unlikely to be impacted by tunnelling. The assessment identified potential exceedances of the cosmetic damage vibration screening criteria at the Bennelong Stormwater Channel, the NSW Club House Building, and the Former Bank House – Delfin House, however, these impacts were generally associated with major excavation and other non-tunnelling activities. The assessment stated that tunnel sections between stations would generally be too deep to					

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed refinement, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Consistent Impact Y/N	Do any CoA need to be changed? Y/N	Endorsed	
					Y/N	Comments
	affect heritage items or archaeological study areas. An updated technical memo was prepared by Artefact heritage to assess potential impacts to heritage items associated with the revised tunnel alignment assessed in Consistency Assessment SMW05. The technical memo found impacts from the revised tunnel alignment to be consistent with those of the Approved Project. As the proposed refinement to the revised tunnel alignment (as assessed in SMW05) would be minor, it is not expected that the impacts associated with the Approved Project would change. The Detailed Noise and Vibration Impact Statement prepared by JCG (and is subject to endorsement by the Acoustics Advisor) found that reducing the depth of the tunnel alignment between Hunter Street Station and The Domain by a maximum of about four metres would result in no exceedances of the cosmetic damage screening criteria at the respective Historic Heritage items which is consistent with the findings of the Approved Project. As a result, potential impacts to the respective Historic Heritage items from the proposed refinement to the tunnel depth would be managed in accordance with the environmental mitigation outlined in the RtS and CNVS, and the project's Conditions of Approval.					
Community and socio-economic	The community and socio-economic impacts would not change as a result of the proposed refinement to the tunnel alignment.	No additional Measures required.	Y	N		

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed refinement, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Consistent Impact Y/N	Do any CoA need to be changed? Y/N	Endorsed	
					Y/N	Comments
	Whilst noise and vibration impacts from tunnelling were found to be consistent with the impacts of the Approved Project, in accordance with the project Conditions of Approval A29 and D30, Sydney Metro would undertake consultation with affected sensitive land users to assist with determining site-specific mitigation measures to minimise impacts during construction.					
Traffic and transport	There would be no change to the volume of spoil generated by tunnelling, as well as no change to the construction methodology or construction machinery. As a result, the proposed refinement would not alter the indicative construction vehicle movements from the Approved Project at the Hunter Street eastern site.	No additional Measures required.	Y	N		
Waste and resource management	The proposed refinement would not alter the volume of spoil generated by excavation. The construction and tunnelling methodology would remain the same as that described in Section 5.5 of the EIS for the Approved Project. As the tunnelling methodology and extent of tunnelling would not change as a result of the proposed refinement, there would be no material change to the indicative volumes of construction resources identified in the Approved Project.	No additional mitigation measures required.	Y	N		
Visual	As the proposed refinement is wholly underground, there would be no visual impacts associated with the proposed refinement.	No additional Measures required.	Y	N		
Land use and property	The need for substratum acquisition for underground elements of the Approved Project, including the tunnels, was described in Chapter	No additional Measures required.	Y	N		

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed refinement, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Consistent Impact Y/N	Do any CoA need to be changed? Y/N	Endorsed	
					Y/N	Comments
	10 of the EIS. Property acquisitions are currently underway. As the proposed refinement to the indicative tunnel alignment would only result in a decrease to the depth of the tunnels, there would be no change to the properties subject to substratum acquisition. Consistent with the Approved Project, property acquisition would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* and the NSW Government's property acquisition process.					
Hazard and risk	There would be no change to hazard and risks identified for the Approved Project.	No additional mitigation measures required.	Y	N		

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed refinement, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Consistent Impact Y/N	Do any CoA need to be changed? Y/N	Endorsed	
					Y/N	Comments
Other – Ground movement	Preliminary settlement contours were developed for the Approved Project to identify the expected zone of influence and magnitude of induced settlement from construction, as described in Section 14.6.1 of the EIS. The identified buildings, infrastructure and utilities currently fall within risk category 1 or 2 where the damage is negligible or slight. As the alignment would remain within the indicative corridor and study area, there would be no change to the preliminary settlement contours, and no change to the buildings, infrastructure and utilities identified as being within the fall risk categories. The proposed refinement to reduce the tunnel depth by up to about four metres is not a significant change, the maximum estimated ground movement would be anticipated to be substantially unchanged.	No additional mitigation measures required.	Y	N		

11. Impact Assessment – Operation

Stage 2 of the planning application for Sydney Metro West (subject of this Consistency Assessment) is for tunnelling and major civil construction work for Sydney Metro West between The Bays and Sydney CBD. Potential impacts may include noise and vibration, ground movement and ground settlement. All potential impacts applicable to the operational aspects of Sydney Metro West including operational stage environmental mitigation measures are subject to the *Sydney Metro West - Rail infrastructure, stations, precincts and operations* (Stage 3) (SSI-22765520) planning application which was approved on 26 January 2023. Operational impacts associated with the proposed refinement will be assessed for consistency against Stage 3 of Sydney Metro West under a separate Consistency Assessment.

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed refinement, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Consistent Impact Y/N	Do any CoA need to be changed? Y/N	Endorsed	
					Y/N	Comments
Biodiversity	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		
Water	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		
Soils and contamination	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		
Air quality	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		
Noise and vibration	The Approved Project covers the major civil construction between The Bays and Sydney CBD. This Consistency Assessment relates to the potential construction impacts of these proposed changes only. Given that the revised tunnel alignment is within the proposed corridor of the Approved Project, it is anticipated that operational noise impacts can be appropriately managed to achieve compliance with the applicable guidelines.	No additional mitigation measures required.	N/A	N/A		
Aboriginal Culture and Heritage	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed refinement, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Consistent Impact Y/N	Do any CoA need to be changed? Y/N	Endorsed	
					Y/N	Comments
Historic Heritage	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		
Community and socio-economic	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		
Traffic and transport	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		
Waste and resource management	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		
Visual	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		
Land use and property	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		
Hazard and risk	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		
Other	No change from the Approved Project.	No additional mitigation measures required.	N/A	N/A		

12. Consistency with the Approved Project

Question	Response
Is the project (including the proposed refinement) consistent with the conditions of approval?	Yes, the proposed refinement would be consistent with the Approved Project's Conditions of Approval.
Is the project (including the proposed refinement) consistent with the objectives and functions of elements of the Approved Project?	Yes. The proposed refinement would be consistent with the objectives and functions of the Approved Project. Adjusting the vertical alignment of the tunnel between Hunter Street and The Domain in order to avoid critical utilities infrastructure for the Sydney CBD would mitigate any potential impacts to the power supply of the Sydney CBD.
Are the environmental impacts of the proposed refinement consistent with the impacts of the approved project?	The proposed works would not result in any changes to environmental impacts as assessed in the Approved Project.
Are there any new environmental impacts as a result of the proposed works/project refinement?	No new environmental impacts would occur as a result of the proposed refinement. Impacts assessed in this Consistency Assessment are consistent with those found for the Approved Project and would be managed under the Approved Project's existing Conditions of Approval and Environmental Mitigation Measures.
Are the impacts of the proposed activity/works known and understood?	Yes. The impacts of the proposed works are understood and will be managed by implementing the control measures within this document, as well as the Detailed Noise and Vibration Impact Statement prepared by JCG.
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.
Would any Conditions of Approval be required to be changed as a result of the proposed refinement (having regard to the above assessment)?	☐ Yes ☒ No
Is the proposed refinement/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:	None.

14. Recommendation

Based on the above impact assessment, and with reference to the Environmental Impact Statement and Response to Submissions Report, including the Conditions of Approval, it is recommended that:

	Tick relevant box
The proposed refinement 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).	X
The proposed refinement is not consistent with the Approved Project including the conditions of approval and would be subject to a separate modification application.	
The proposed refinement 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 refinement; and • Examines the consistency of the proposed refinement with the Approved Project; is accurate in all material respects and does not omit any material information.			
Name:	Charlotte Brogan	Signature:	Charlotte Brogan
Title:	Planning Approvals Officer		
Company:	Sydney Metro	Date:	23/08/2023

Assessment Supporting Signature

Application supported and submitted by			
Name:	Todd Brookes	Date:	23/08/2023
Title:	Senior Manager Planning Approvals	Comments:	
Signature:			

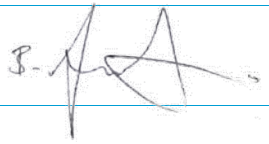
Assessment Endorsement

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

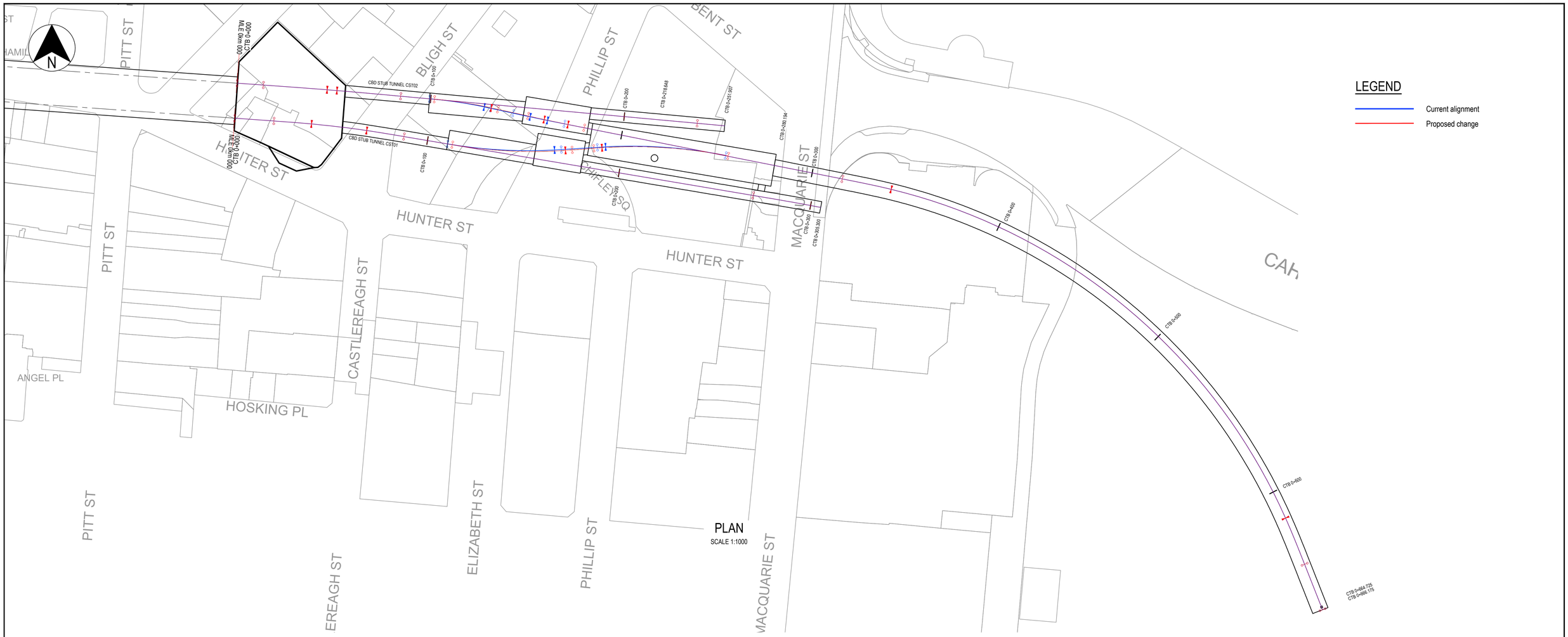
Yes ☑ The proposed refinement is consistent with the Approved Project and no further assessment is required.

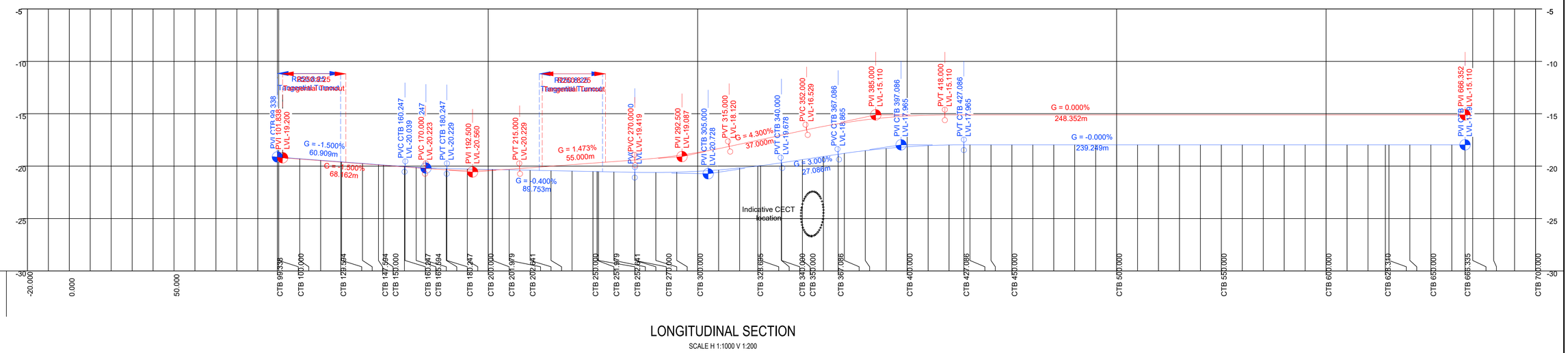
No ☐ The proposed refinement is not consistent with the Approved Project.

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:	24 August 2023
Title:	Director, Project ESP	Comments:	
Signature:			

Appendix A – Longitudinal section of revised vertical alignment





KILOMETRAGE

LONGITUDINAL SECTION
SCALE H 1:1000 V 1:200

OFFICIAL

FOR INFORMATION

REV.	AMENDMENT DESCRIPTION	Design by	Verified by	Approved by	Date
A.1	FOR INFORMATION				

SCALE: As Shown

1 : 200 FULL SIZE A1

1 : 1000 FULL SIZE A1

A1 Original | Co-ordinate System: GDA2020/MGAZONE 56 | Height Datum: A.H.D. | This sheet may be prepared using colour and may be incomplete if copied

NOTE: Do not scale from this drawing.

CLIENT: NSW GOVERNMENT / sydney METRO

AEO COMPANY: Engineering Design & Assurance Technical Partner — Mott MacDonald

STRUCTURAL — Mott MacDonald

DESIGN COMPANY/CONTRACTOR: MOTT MACDONALD

DRAWN | DESIGNED | DRG CHECK | DESIGN CHECK | APPROVED

SYDNEY METRO WEST
TUNNELS SPECIFIC
TUNNEL STRUCTURES
CBD TURNBACK -V5.9 AND V6.3A COMPARISON
PLAN AND LONGITUDINAL SECTION

FILE No: | SHEET: 1 OF 1 | ©

STATUS: PRELIMINARY / INITIAL DESIGN - CONCEPT DESIGN | EDMS No:

DRG No: SMWSTEDS-SMD-SWD-TU000-TU-SKE-CT0001 | REV A.1 | VER

100mm AT FULL SIZE Plot Date & Time: Wednesday, 13 September 2023 1:37:58 pm

File Path: C:\OneDrive\OneDrive - Mott MacDonald\ProjecWise\SM-EDS\dms69215\SMWSTEDS-SMD-SWD-TU000-TU-SKE-CT0001.dwg

Title block Revision: v6.2 EDA-TP

Appendix B – Detailed Noise and Vibration Impact Statement

RENZO TONIN & ASSOCIATES
Inspired to achieve

Acoustics
Vibration
Structural Dynamics

SYDNEY METRO EASTERN TUNNELLING PACKAGE

Detailed Noise and Vibration Impact Statement - Tunnelling

24 August 2023

John Holland CPB Contractors Ghella Joint Venture

TM372-02-1-04F01 SMW-ETP_DNVIS-TUN (revB.1)

40 YEARS 1982-2022 ACOUSTIC ENGINEERING EXCELLENCE

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Document details

Detail	Reference
Doc reference:	TM372-02-1-04F01 SMW-ETP_DNVIS-TUN (revB.1)
Prepared for:	John Holland CPB Contractors Ghella Joint Venture
Address:	Level 6, 60 Union Street Pyrmont NSW 2009
Attention:	Sally Reynolds

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
16.06.2023	Initial issue to JCG	0	1	D. Auld	T. Gowen	T. Gowen
22.06.2023	Respond to initial comments	-	A.1	T. Gowen	-	T. Gowen
27.06.2023	Additional comments response	-	A.2	T. Gowen	-	M. Tabacchi
04.08.2023	Respond to SM/ER/AA comments	-	B	T. Gowen	-	M. Tabacchi
17.08.2023	Respond to SM/ER/AA comments	-	B.1	T. Gowen	-	M. Tabacchi
25.08.2023	Endorsed by AA		1			

File Path: https://johnholland.sharepoint.com/sites/SMWETP/e/01/02 Noise & Vib/01 DNVIS/DNVIS Tunnelling/Rev B.1/TM372-02-1-04F01 SMW-ETP_DNVIS-TUN (rev1).docx

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1 Introduction

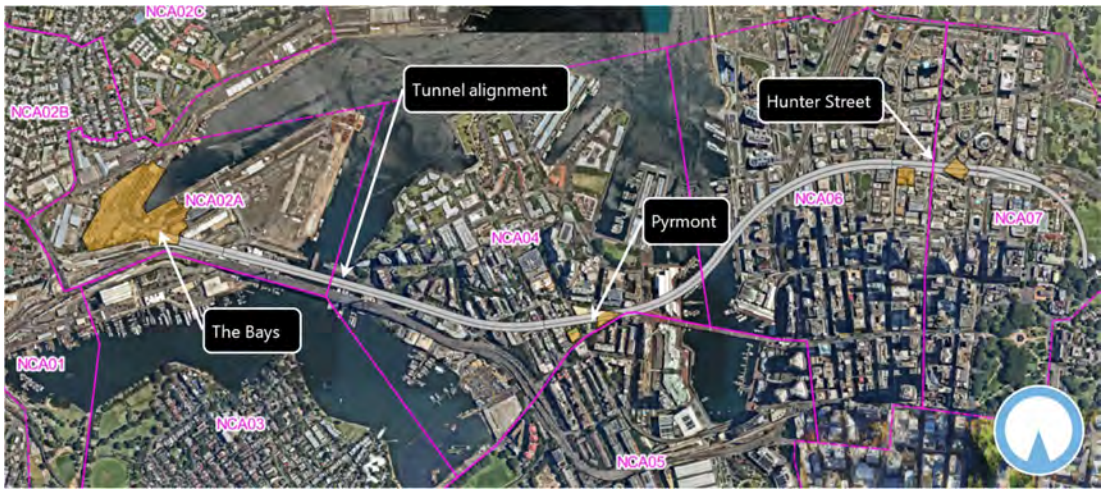
1.1 Purpose and application

This Detailed Noise and Vibration Impact Statement (DNVIS) has been prepared on behalf of John Holland CPB Ghella Joint Venture (JCG) in accordance with the Sydney Metro Construction Noise and Vibration Standard (CNVS)[1] for the construction of the Sydney Metro West – Eastern Tunnelling Package (ETP) Works. This DNVIS has been prepared to satisfy Planning Approval (SSI 19238057) Condition D29.

1.2 Overview

Sydney Metro West ETP is Stage 2 of the Sydney Metro West a new 24-kilometre metro line that will connect Greater Parramatta with the Sydney CBD via stations at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock, The Bays, Pyrmont and Hunter Street (Sydney CBD). The Project includes all major civil construction work including station excavation (at Pyrmont and Hunter Street Station (Sydney CBD) construction sites) and tunnelling between The Bays and Sydney CBD. An overview of the construction work locations for Sydney Metro West ETP is presented in Figure 1.1.

Figure 1.1: Overview of Sydney Metro West ETP construction work between The Bays and Sydney CBD



The aim of this assessment is to minimise the impact of construction noise and vibration on sensitive receivers and demonstrate compliance with relevant Conditions of Approval, the CSSI Stage 2 Environmental Impact Statement (EIS)[4], the Revised Environmental Mitigation Measures (REMMs) included in the Submissions Report [5] and the Construction Noise and Vibration Management Plan (CNVMP) (SMWSTETP-JCG-SWD-SW000-EN-PLN-002019).

1.3 Detailed Noise and Vibration Impact Statement

DNVIS prepared for this Project provide a quantitative noise and vibration assessment of activities and/ or locations where construction work will occur. They clarify details provided in the EIS Noise and Vibration technical Paper [4], updated to include the more detailed information available at the detailed design and construction planning stage of the Project. This DNVIS is structured to meet the requirements of Condition of Approval D29 and the CNVS, including specific mitigation measures to be implemented for the duration of the assessed works, identified through consultation with affected sensitive land user(s).

This DNVIS provides a noise and vibration assessment of the ETP tunnelling excavation works Project-wide that are required to be completed within and outside of standard construction hours. Note that this DNVIS excludes the surface works that support tunnelling excavation. Surface works are assessed in a separate DNVIS for The Bays, Pyrmont Station and Hunter Street Station worksites (ref: TM372-02-1-01F01 SMW-ETP_DNVIS-TBY; TM372-02-1-02F01 SMW-ETP_DNVIS-PYR; and TM372-02-1-03F01 SMW-ETP_DNVIS-HUN respectively).

The works covered by this DNVIS will be undertaken in accordance with the CEMP (incorporating the CNVMP), following its approval.

1.4 Quality assurance

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Construction works and hours

2.1 Construction works addressed in this DNVIS

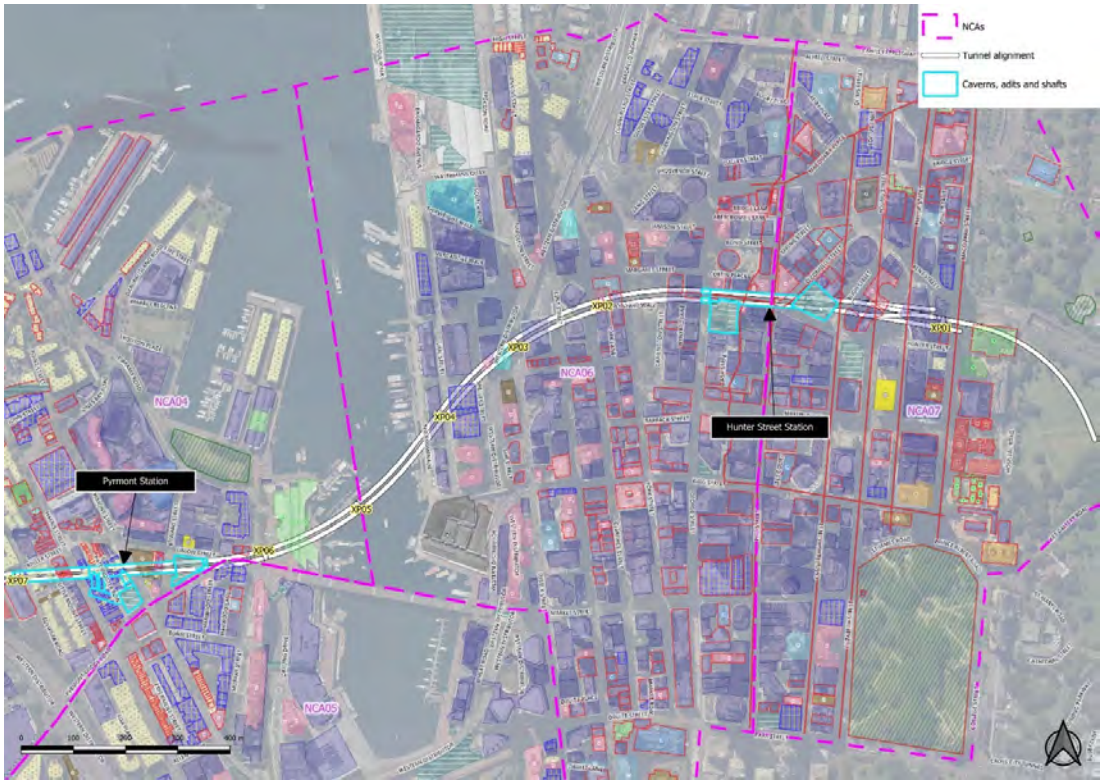
2.1.1 Location of worksite

Tunnelling excavation for this Project will occur between The Bays worksite and the Hunter Street turnbacks, to the east of Hunter Station. Tunnelling excavation works include the mainline tunnel from The Bays worksite to Hunter Street Station (approximately 3.5 kilometres), with cross passages approx. every 200-250 metres between the two rail tunnels. A large station cavern and crossover cavern will be excavated at Pyrmont, accessed from the Pyrmont Station East and West worksites. At Hunter Street a station cavern will be excavated between the Hunter Street East and West worksites, with a turnback and stub tunnels excavated to the east of the Hunter Street East worksite.

The tunnel excavation locations are shown in Figure 2.1 and Figure 2.2 following.

Figure 2.1: Mainline tunnel alignment, cross passages and caverns - The Bays to Pyrmont Station

Figure 2.2:Mainline tunnel alignment, cross passages and caverns - Pyrmont to Hunter Street Station



2.1.2 Construction works

The ETP tunnelling works will be delivered as follows:

- Mainline tunnel excavation of two rail tunnels by Slurry Tunnel Boring Machines (TBM)
  - Starting from The Bays worksite and tunnelling approximately 1.2 kilometres to Pyrmont crossover cavern at a depth of 22 to 45 metres below surface level
  - TBM breakthrough, traverse across crossover and station caverns and re-launch to allow tunnelling approximately 1.1 kilometres to Hunter Street Station cavern
- Cross passage excavation connecting the two rail tunnels approx. every 200 to 250 metres
  - Twelve cross passages are to be excavated by small (~ 5 to 15 tonne), robotic rock hammer between The Bays worksite and Hunter Street Station
  - Ground support by rock bolting and shotcrete spray
- Mined tunnel excavation by roadheader, with ground support by rock bolting and shotcrete spray
  - At Pyrmont Station, to excavate the pedestrian and ventilation adits, and the station cavern and crossover cavern (approx. 370 metres long and 23 to 31 metres below surface level)

- At Hunter Street Station, to excavate the pedestrian and ventilation adits, station cavern (approx. 170 metres long and 17 to 45 metres below surface level), stub tunnels and turnback tunnel (approx. 650 metres long and 30 to 40 metres below surface level).

All tunnelling works will occur 24 hours per day. The out of hours works (OOHW) are justified (see Section 2.2.1). The works are summarised in Table 2.1.

Table 2.1: Summary of construction works under this DNVIS

Activity/ work area	Aspect	Construction hours	Timing of activity
TBM tunnelling	The Bays to Pyrmont Station	Standard hours + OOHW (D/E/N)	Feb-24 to Sep-24
	Pyrmont Station to Hunter Street Station	Standard hours + OOHW (D/E/N)	Sep-24 to Jan-25
Cross passage excavation	The Bays to Hunter Street Station	Standard hours + OOHW (D/E/N)	Oct-24 to Jul-25
Mined tunnelling	Pyrmont Station cavern, crossover cavern, and adits	Standard hours + OOHW (D/E/N)	Nov-23 to Oct-24
	Hunter Street Station cavern, stub and turnback tunnels, and adits	Standard hours + OOHW (D/E/N)	Jun-23 to Sep-25

Notes: 'OOHW' means Out of Hours works, or work outside the standard construction hours (see Section 2.2)

'OOHW(D)' is the OOH 'Day' period,; 8am to 6pm Sunday

'OOHW(E)' is the 'Evening' period, 6pm to 10pm Monday to Sunday

'OOHW(N) is the OOH 'Night' period, 10pm to 7am Sunday/Monday to Thursday/ Friday; 10pm to 8am Friday/Saturday and Saturday/ Sunday

A detailed summary of the construction activities assessed in this report is presented in Section 6 and in Table C.1 of APPENDIX C.

2.1.3 Construction traffic

Construction generated traffic related to the public road network, is addressed in the separate DNVISs prepared for surface works at The Bays, Pyrmont Station and Hunter Street Station worksites (ref: TM372-02-1-01F01 SMW-ETP_DNVIS-TBY; TM372-02-1-02F01 SMW-ETP_DNVIS-PYR; and TM372-02-1-03F01 SMW-ETP_DNVIS-HUN respectively).

There is no assessment of construction traffic noise in this DNVIS.

2.2 Construction Hours

Construction hours for the Project are outlined in Conditions of Approval D21, D22 and D23. Table 2.2 below consolidates the information provided in these Conditions regarding construction working hours for the Project.

Table 2.2: Working hours for construction worksites

CoA	Construction Activity[9]	Monday to Friday	Saturday	Sunday / Public holiday
D21	Standard construction	07:00 to 1800	08:00 to 18:00	No work[1]

CoA	Construction Activity[9]	Monday to Friday	Saturday	Sunday / Public holiday
D22	Highly noise intensive works[2]	08:00 to 18:00 (plus respite[2])	08:00 to 13:00 (plus respite[2])	No work[1]
D23(a)	Safety and emergency work	18:00 to 07:00	18:00 to 08:00	08:00 to 0:700
D23(b)	Low noise impact work[3]	18:00 to 07:00	18:00 to 08:00	08:00 to 07:00
D23(c)	Works approved under an EPL or Out-of-Hours Work Protocol or through negotiated agreement with directly affected residents and sensitive land user(s)	18:00 to 07:00	18:00 to 08:00	08:00 to 07:00
D23(d)	Prescribed activity: ▪ Tunnelling (and associated activities of rockbolting, shotcreting and mucking out, but excluding cut and cover tunnelling and surface works)[4] ▪ Delivery of material to directly support tunnelling activities ▪ Haulage of spoil ▪ Work within an acoustic shed or enclosure[5].	24 hours	24 hours	24 hours

Notes:

1. No work unless permitted and approved.
2. Minimum respite from highly noise intensive works of not less than one (1) hour between each continuous block of works not exceeding three (3) hours.
3. Construction that causes $L_{Aeq(15\ minute)}$ noise levels no more than 5dB(A) above the Rating Background Level (RBL) at any residence; and/or no more than the 'noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s). Construction that causes continuous/impulsive/intermittent vibration values at the most affected residence, no more than the preferred values for human exposure to vibration, specified in Table 2.2 and Table 2.4 of the AVTG.
4. Tunnelling does not include station box excavation and the requirements of Condition D26 apply.
5. Where there is no exceedance of noise levels under Low Noise Impact Work circumstances identified in D23(b), unless otherwise agreed by the Planning Secretary.

2.2.1 Justification for OOHW

The CSSI Stage 2 Environmental Impact Statement (EIS)[4] states that tunnelling and tunnelling support work will be undertaken 24-hours per day, seven days per week, including for TBM tunnelling, cross passage excavation and for mined tunnelling of station and crossover caverns. The justification for OOH tunnelling and support operations includes:

- The need to install ground support systems immediately following excavation in the form of shotcrete, steel sets and rockbolts immediately to ensure stability of the work and to minimise any potential ground movement or settlement. Grouting is also required to occur immediately after bolt installation for safety and quality reasons, to transfer load directly to the adjacent rock.;
- The need to construct cross passages closely following the progress of the tunnel boring machines to provide a critical secondary egress for people to evacuate and access for emergency services in the event of an incident
- Reducing peak demand on the electricity network
- The need to pour the permanent lining concrete in a continuous fashion with minimum quantities per pour driven by the size of the station caverns and turnback tunnels and to avoid quality issues such as cold joints.

Tunnelling (and associated activities of rockbolting, shotcreting and mucking out, but excluding cut and cover tunnelling and surface works) is a prescribed activity under Condition of Approval D23(d) and is permitted 24 hours a day, seven days a week. It is noted that tunnelling does not include station box excavation and the requirements of D26 apply.

Condition of Approval D26 requires all reasonable and feasible mitigation and management measures to be applied when the following residential ground-borne noise levels are exceeded:

(a) Evening (6:00 pm to 10:00 pm) – internal $L_{Aeq(15minute)}$: 40 dB(A); and

(b) Night (10:00 pm to 7:00 am) – internal $L_{Aeq(15minute)}$: 35 dB(A).

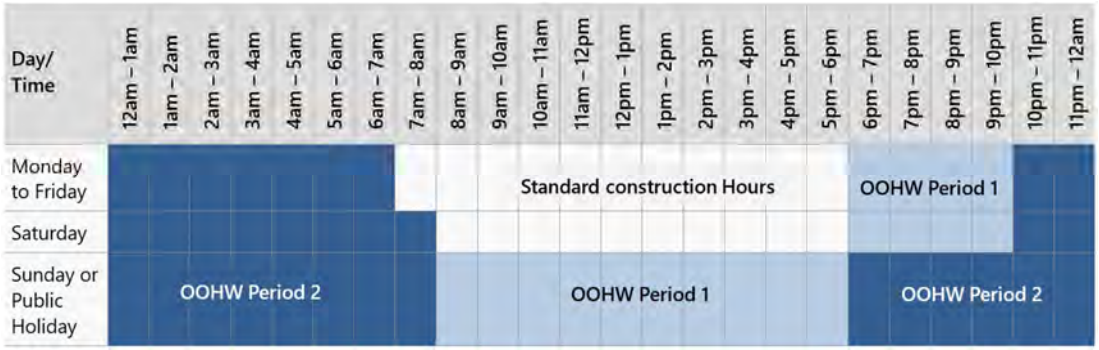
Mitigation measures outlined in the CNVMP have been included into this DNVIS. All reasonable and feasible mitigation and management measures will be implemented to reduce noise from the works to within NMLs.

Out-of-hours work under CoA D29(c) would be undertaken through the Sydney Metro West Out of Hours Works Protocol [3] (OOHW Protocol) prepared for the project or under the Environment Protection Licence (EPL) number 21784 for works subject to an EPL.

2.2.2 Assessment periods

The standard hours and out of hours work (OOHW) periods for construction works are depicted in Table 2.3. The OOHW periods are further defined as OOHW Period 1 and 2, based on the CNVS [1].

Table 2.3: Assessment periods



3 Existing environment

3.1 Land use survey

To assess and manage construction noise and vibration impact, a Land Use Survey has been undertaken to satisfy Condition D20. The Land Use Survey identifies existing land use and development along the Project alignment, including a mix of residential, commercial and industrial uses; along with other noise and vibration-sensitive businesses, such as Hotels, medical or dental surgeries and childcare facilities. At The Bays there are residential receivers surrounding the two worksites.

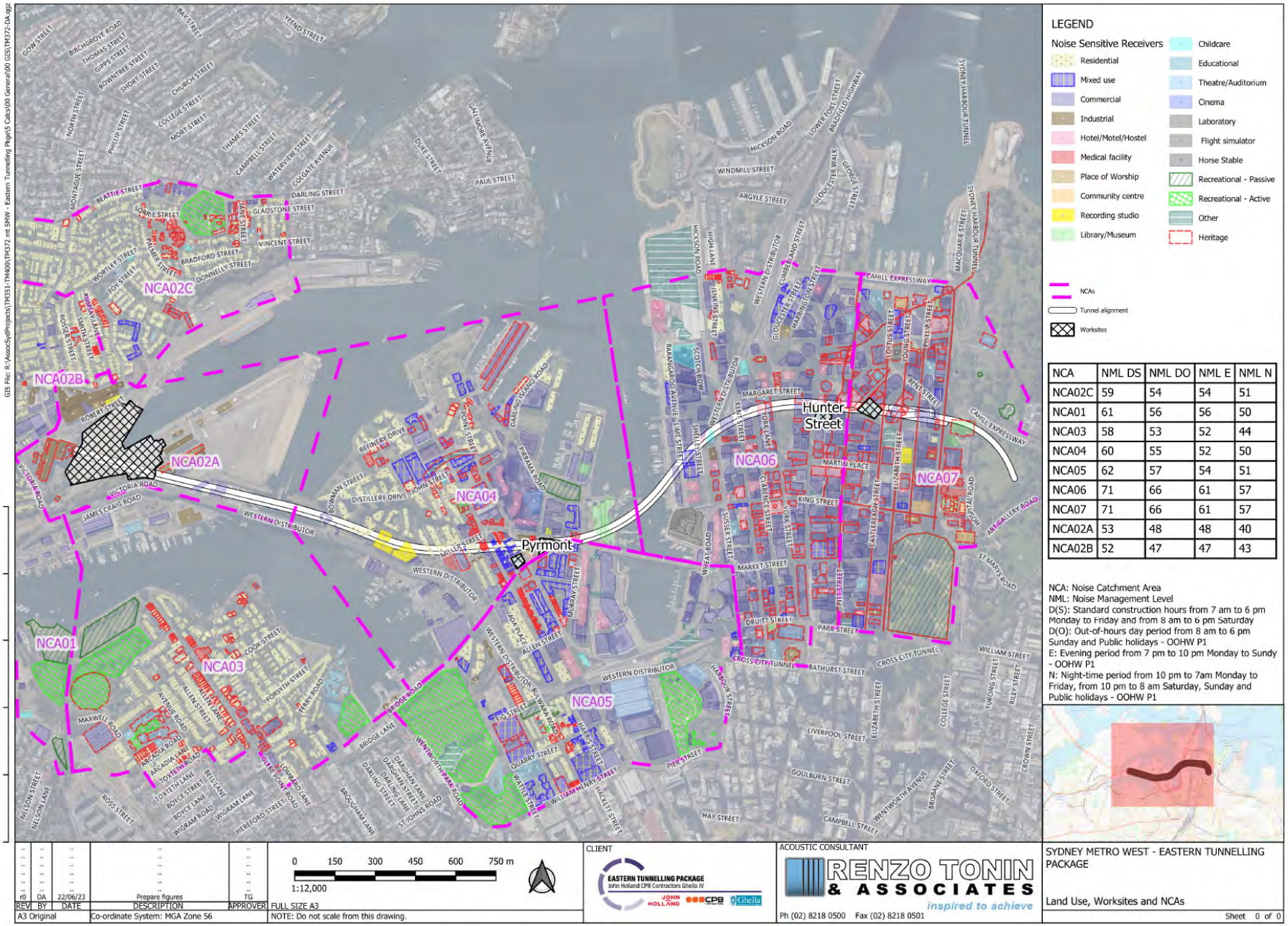
Heritage receivers have been identified in EIS [4] and in the land use survey.

The Land Use Survey is maintained in a Geographic Information System (GIS) established for the Project and was used in the preparation of this DNVIS. The land use at the time of issue of this DNVIS is identified on an aerial photograph in Figure 3.1 (and in APPENDIX B). The land use revision date is shown in the top left corner of the drawing.

3.2 Noise Catchment Areas

Further to the Land Use Survey, residential areas have been divided into Noise Catchment Areas (NCAs) based on those established in the Environmental Impact Statement (EIS) [4] for the project. NCAs group individual sensitive receivers by common traits, such as existing noise environment and location in relation to the ETP works. NCAs relevant to tunnelling (i.e. Project-wide) are identified in Figure 3.1.

Figure 3.1: Noise Catchment Areas appliable to the Project



NCA	NML DS	NML DO	NML E	NML N
NCA02C	59	54	54	51
NCA01	61	56	56	50
NCA03	58	53	52	44
NCA04	60	55	52	50
NCA05	62	57	54	51
NCA06	71	66	61	57
NCA07	71	66	61	57
NCA02A	53	48	48	40
NCA02B	52	47	47	43

NCA: Noise Catchment Area
NML: Noise Management Level
D(S): Standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday
D(O): Out-of-hours day period from 8 am to 6 pm Sunday and Public holidays - OOHW P1
E: Evening period from 7 pm to 10 pm Monday to Sundy - OOHW P1
N: Night-time period from 10 pm to 7am Monday to Friday, from 10 pm to 8 am Saturday, Sunday and Public holidays - OOHW P1

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	22/06/23	Prepare figures	TG

4 Construction noise and vibration objectives

Construction noise and vibration objectives are detailed in the CNVS Section 2 and the CNVMP. A summary of the objectives as applicable to the ETP tunnelling excavation works is provided in Table 4.1.

Table 4.1: Summary of construction noise and vibration objectives

Impact	Relevant guideline	Construction noise/ vibration objective
Ground-borne noise	NSW Interim Construction Noise Guideline (ICNG) [6] CNVS [1]	Receivers are considered 'ground-borne noise affected' where construction noise levels are greater than the noise management levels identified in Table B.2 of APPENDIX B. The ground-borne noise management levels are given below: • Evening (6.00 pm to 10.00 pm) Internal Residential: 40 dB $L_{Aeq(15minute)}$ • Night-time (10.00 pm to 7.00 am) Internal Residential: 35 dB $L_{Aeq(15minute)}$ Daytime ground-borne noise NMLs are not specified in the ICNG or Sydney Metro CNVS. Disturbance to building occupants vibration limit applies during the day. • An internal Residential: 50 dB $L_{Aeq(15minute)}$ used as screening guideline as this correlates to disturbance to building occupants vibration limit. • EIS Daytime ground-borne NML 45 dB(A) also considered for consistency.
	Highly noise intensive activity (CoA D38)	The Proponent must identify all receivers at Pyrmont and Hunter Street Sydney CBD likely to experience internal noise levels greater than $L_{eq(15\ minute)}$ 60 dB(A) inclusive of a 5 dB penalty between 7am and 8pm.
Vibration – disturbance to building occupants	NSW 'Environmental Noise Management Assessing Vibration: A Technical Guideline' (AVTG) [9] CNVS [1]	To assess the potential for vibration impact on human comfort, an initial screening test will be done based on peak velocity units, as this metric is also used for the cosmetic damage vibration assessment. The initial screening test values are: • Critical areas - 0.28 mm/s (day or night) • Residential buildings - 0.56 mm/s (15h day); 0.40 mm/s (9h night) • Hotels*, offices, schools, educational institutions and places of worship - 1.10 mm/s (day or night) • Workshops - 2.20 mm/s (day or night). If the predicted vibration exceeds the initial screening test, the total estimated Vibration Dose Value (i.e. eVDV) will be determined based on the level and duration of the vibration event causing exceedance as detailed in Section 2.3.1 of the CNVS and Section 2.4 of the AVTG. * Impacts for hotels (sleeping areas) at night will be managed by the GBN NML.
Vibration – structural damage to buildings	British Standard BS 7385-2:1993 'Evaluation and measurement for vibration in buildings'[13] German Standard DIN 4150-3: 2016-12, Structural vibration - Effects of vibration on structures [14] CNVS [1]	A conservative vibration damage screening level (peak component particle velocity) per receiver type is detailed in Section 2.4 of the CNVS and outlined below: • Reinforced or framed structures: 25.0 mm/s • Unreinforced or light framed structures: 7.5 mm/s. Heritage buildings and structures found to be structurally unsound (following inspection) would adopt a more conservative vibration damage screening level (peak component particle velocity): • Heritage structures (structurally unsound): 2.5 mm/s (initial screening level). Where the predicted and/or measured vibration is greater than shown above, a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure will be completed to determine the applicable vibration limit.

Impact	Relevant guideline	Construction noise/ vibration objective
Sydney Water Assets – Threshold vibration limits	Sydney Water Procedure – Specialist Engineering Assessment (ref: D0081870, version 1, 19/02/2021) [18]	Masonry (Tank Stream and the Bennelong Stormwater Channels) • Maximum P.P.V. 3mm/s (initial screening level). If exceedance of vibration initial screening level, JCG JV shall review monitoring data to determine suitable frequency dependant vibration limits for the Sydney Water assets from the German Standard DIN 4150-3 guideline values for vibration velocity, vi, max, for evaluating the effects of short-term vibration on structures (Line 3).
Sensitive scientific and medical equipment	ASHRAE Applications Handbook (SI) [15] and AS 2834 Computer Accommodation [16]	Where vibration sensitive equipment is potentially affected by construction works, vibration limits for the operation of the equipment will be taken from manufacturer's data or provided by the equipment owner. Where this is not available, the following generic Vibration Criterion (VC) curves apply: • Computer Areas 0.7 mm/s, rms* 1.0 mm/s, peak • Medical 0.1 mm/s, rms* 0.14 mm/s, peak • Vibration criterion curve VC-A 0.05 mm/s, rms* 0.07 mm/s, peak • Vibration criterion curve VC-B 0.025 mm/s, rms* 0.03 mm/s, peak * Measured in one-third octave bands over the frequency range 8 to 100 Hz

5 Construction airborne noise impacts

ETP tunnelling excavation works will be underground works and will not generate airborne noise impacts. Airborne noise impacts from associated tunnelling excavation support works are addressed in the DNVISs prepared for surface works at The Bays, Pyrmont Station and Hunter Street Station worksites (ref: TM372-02-1-01F01 SMW-ETP_DNVIS-TBY; TM372-02-1-02F01 SMW-ETP_DNVIS-PYR; and TM372-02-1-03F01 SMW-ETP_DNVIS-HUN respectively).

There is no assessment of airborne noise impacts in this DNVIS.

6 Ground-borne noise impacts

6.1 Noise prediction methodology

Assessment of ground-borne noise impacts from the construction works were determined by predicting noise levels using a 3-dimensional model of the tunnels, caverns and adits developed for the Project. The model incorporates the ground-borne noise levels versus distance prediction curve algorithms for each plant item, developed from measurement data obtained from various Sydney tunnelling projects.

Key details regarding the construction work methodology, the likely plant and equipment, and hours of operation were informed by the JCG Design and Construction Teams.

The ground-borne noise predictions in this report represent a realistic worst-case scenario when excavation occurs at the closest location to residences and other sensitive receivers. At each receiver, noise levels will vary during the construction period based on:

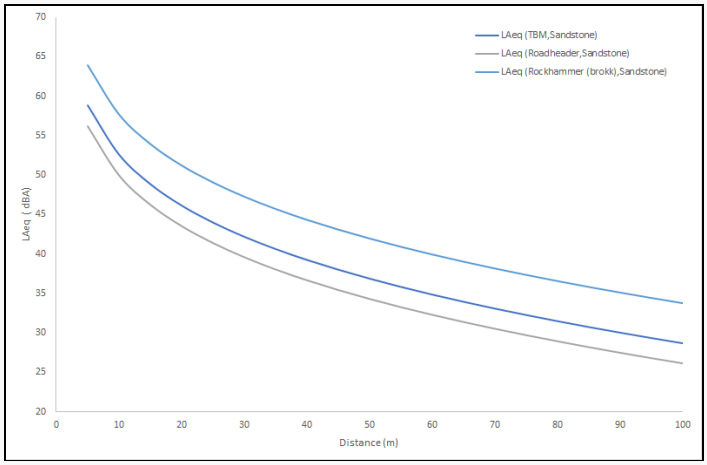
- the position of equipment within the tunnels/ caverns/ adits and distance to the receiver;
- construction methodology/ plant items and equipment in use.

Ground-borne noise impacts presented in Section 6.2 are based on the maximum predicted noise levels for each building at the ground floor level. Actual noise levels will often be less than the predicted levels presented in this report.

A summary of the noise model input parameters is detailed in Table 6.1.

Table 6.1: Summary of noise modelling parameters

Parameters	Inputs
Calculation method	Empirical model using ground-borne noise levels versus distance prediction curve algorithms. Distances between the excavation works and nearby buildings was calculated as the 3-dimensional slant distance from the closest edge of the buildings to: - Mainline tunnel crown - Cross passage crown - Station cavern and crossover cavern crown and bench - Stub tunnels and turnback tunnel crown and bench. - Pedestrian and services adit crown The tunnel excavation areas are clearly identified in Section 2.1.
Location of ground-borne noise sources	3D tunnel/ cavern/ adit information was provided by JCG based on SMWSTETP-JCG-SWD-SW000-GL-PKG-101001_C) with offset to crown provided in SMWSTEDS-SMD-PYR-SN150-TU~3; SMWSTETP-JCG-SWD-SW000-GL-M2D-101101; SMWSTETP-JCG-SWD-SW000-GL-M2D-101102.
Height of receivers	Ground-borne noise levels are calculated on the ground floor level within each building. The ground-height of each building was determined based on the ground surface height. Assumed 2 dB loss for every additional floor assessed.
Ground topography	1m digital ground contours obtained from ELVIS
Distance to receivers	Distances between the tunnel excavation works and nearby buildings is based on the 3-dimensional slant distance from the tunnel crown (TBM/cross passage/top-heading cavern excavation) to the closest edge of the buildings

Parameters	Inputs
Rock type	Sandstone
Ground-borne noise sources:	Algorithms based on measurement data obtained from Sydney Metro City & South-West (TSE), Sydney Metro North-West (NWRL), WestConnex Rozelle Interchange (WCX3B), WestConnex M8 (M5N), WestConnex M4East (M4E), Cross City Tunnel (CCT), Lane Cove Tunnel (LCT), Epping to Chatswood Rail Link (ECRL). See Figure 6.1. Tunnel/ cavern/ adit excavation method, number of plant and hours of operation detailed in Table C.1 in APPENDIX C. A 5 dB(A) penalty has been applied for rockhammer excavation works due to the annoying characteristic. **Figure 6.1: Indicative ground-borne noise levels from tunnelling**  Source: GBN from Sydney tunnel projects, including TSE, WCX3B, M5N, M4E, CCT, LCT, ECRL, and NWRL Extensive ground-borne noise and vibration verification monitoring on Sydney tunnelling projects has found that ground-borne noise from rock anchor drilling is typically below the ground-borne noise level for roadheading. Therefore, the roadheader curve above covers all roadheader tunnelling stages (i.e. including installation of support).
Engineering margin	The ground-borne noise predictions are based on typical geology for the area, comprising Sydney sandstone with a varying depth of shale above. However due to localised geological anomalies, foundation-to-footing interaction and the large range and variety of structures that exist (e.g. construction type, dimensions, materials, quality of construction, footing conditions etc) actual GBN levels may vary significantly to what has been predicted herein. The GBN empirical algorithms are derived from the 95th percentile of the measured GBN data. Verification measurements shall be undertaken at the first opportunity to verify the models.

6.2 Predicted noise levels

Ground-borne noise impacts during construction works have been predicted and compared to the noise management levels (NMLs). A receiver is considered construction noise affected when the predicted noise level is above the ground-borne NML (GNML).

Table 6.3 and Table 6.4 present a summary of the number of residential receivers and 'other sensitive receivers likely to be ground-borne noise affected by tunnelling excavation works. The tables are colour coded to indicate how much the predicted noise level is above the GNML, based on the CNVS, as noted in Table 6.2.

Table 6.2: Key to the predicted construction ground-noise results tables

Assessment	Time of day	Key		
$L_{Aeq(15min)}$	Standard hours[1] or Outside standard hours	0-10 dB(A) above NML (green)	11-20 dB(A) above NML (yellow)	>20 dB(A) above NML (orange)

Table 6.3 summarises the number of construction noise affected residential receivers (i.e. receivers where predicted L_{Aeq} noise levels construction works are above the GBNML) and the likely perceived noise impact. Table 6.4 presents the number of construction noise affected other sensitive receivers. Detailed predicted noise levels for nearby receivers are presented in APPENDIX E.

6.2.1 Standard construction hours

The ICNG and the CNVS do not provide NMLs for ground-borne noise during standard construction hours. The CNVS instructs that impacts during standard hours should be managed to meet the vibration guideline values for human disturbance. This assessment of GBN impacts during standard construction hours uses an initial screening level to provide an understanding of the likely perception of GBN generated by construction, especially for other noise sensitive receivers, such as recording studios.

No tunnelling activity is predicted to generate internal noise levels at any sensitive receiver greater than $L_{Aeq(15\ minute)}$ 60 dB(A), including during cross passage excavation. Some receivers will be ground-borne noise affected by different stages of tunnelling, as discussed below. Mitigation and management measures to reduce construction ground-borne noise impacts are summarised in Section 9. Consultation requirements are summarised in Section 9.1 and 9.2.

Mainline tunnel (TBM)

The results summarised in Table 6.3 show that no residential receivers are construction ground-borne noise affected by TBM tunnelling works during standard construction hours. The predicted ground-borne noise levels to other sensitive receivers presented in Table 6.4 are below the ground-borne NML during standard construction hours (or when in use), with the following exceptions:

- NOVA FM Radio Studios, Level 5, 33 Saunders Street, Pyrmont
- 2GB Radio, Level G Building C, 33-35 Saunders Street, Pyrmont Studios
- Channel 10 Television Studios, 1 Saunders Street, Pyrmont.

Ground-borne noise impacts are predicted to be up to 15 dB(A) above the NML at ground-floor level these receivers during the period when the TBM is directly below the studios. The impacts are likely to be short term, as the TBM passes by quickly, reducing the noise levels as it moves further away. Consultation is underway with these receivers (refer to APPENDIX G) to manage the impact of the works on the studio operations.

Cross passages (small rockbreaker)

The predicted ground-borne noise levels summarised in Table 6.3 are below the NML for residential receivers during standard construction hours. Table 6.4 shows that there are other sensitive receivers are construction ground-borne noise affected by cross passage excavation during standard construction hours (or when in use). The impacts are mostly within 10 dB of the NML. Receivers where impacts may be more than 10 dB above the NML include:

- NOVA FM Radio Studios, Level 5, 33 Saunders Street, Pyrmont (XP08 and XP09)
- 2GB Radio, Level G Building C, 33-35 Saunders Street, Pyrmont Studios (XP08 and XP09)
- Channel 10 Television Studios, 1 Saunders Street, Pyrmont (XP08 and XP09).

Caverns, turnback stub tunnels, nozzles and adits (roadheader)

Table 6.3 shows that no residential receivers are construction ground-borne noise affected by the roadheader excavation of the caverns, turnback stub tunnels, nozzles and adits at Pyrmont and Hunter Street during standard construction hours.

Predicted ground-borne noise levels in Table 6.4 from the roadheader tunnelling of the caverns, turnback stub tunnels, nozzles and adits at Pyrmont and Hunter Street are above the NML at the following other sensitive receivers during standard construction hours (or when in use):

- Otis Studios, 198 Harris Street, Pyrmont (Pyrmont station cavern)
- Electric Avenue Studios, 102 Pyrmont Street, Pyrmont (Pyrmont station cavern)
- The Grand Hotel, 30 Hunter Street, Sydney (Hunter Street station cavern)
- Comfort Hotel, 15-17 Hunter Street, Sydney (Hunter Street station cavern)
- The Tank Stream Hotel, 97-99 Pitt Street, Sydney (Hunter Street station cavern)
- Underground Auditorium (under construction) State Library of New South Wales, 1 Shakespeare Place, Sydney (Hunter Street turnback stub tunnels).

For the Hotels above the Hunter Street station cavern, the predicted ground-borne noise levels are within 1 dB of the NML during standard construction hours. The predicted impacts are at ground-floor level. It is assumed that there is 2 dB loss for every additional floor assessed, which would mean ground-borne noise levels NML at level 1 and above are likely to be below NML.

Ground-borne noise impacts are predicted to be up to 15 dB(A) above the NML at the recording studios in Pyrmont when the roadheader is directly below the studios. The impacts are likely to be short term, and the noise levels will reduce as the roadheader moves to other areas of the cavern further away the

studios. Consultation is underway with these receivers (refer to APPENDIX G) to manage the impact of the works on the studio operations.

The underground auditorium at the State Library of NSW is currently under refurbishment. Should the auditorium commence operation prior to the completion of Turnback tunnel TB5 (November 2024), ground-borne noise impacts are predicted to be up to 7 dB(A) above the NML. Consultation would be undertaken with the library to ensure GBN impacts during operation of the auditorium are managed.

6.2.2 Out of hours work

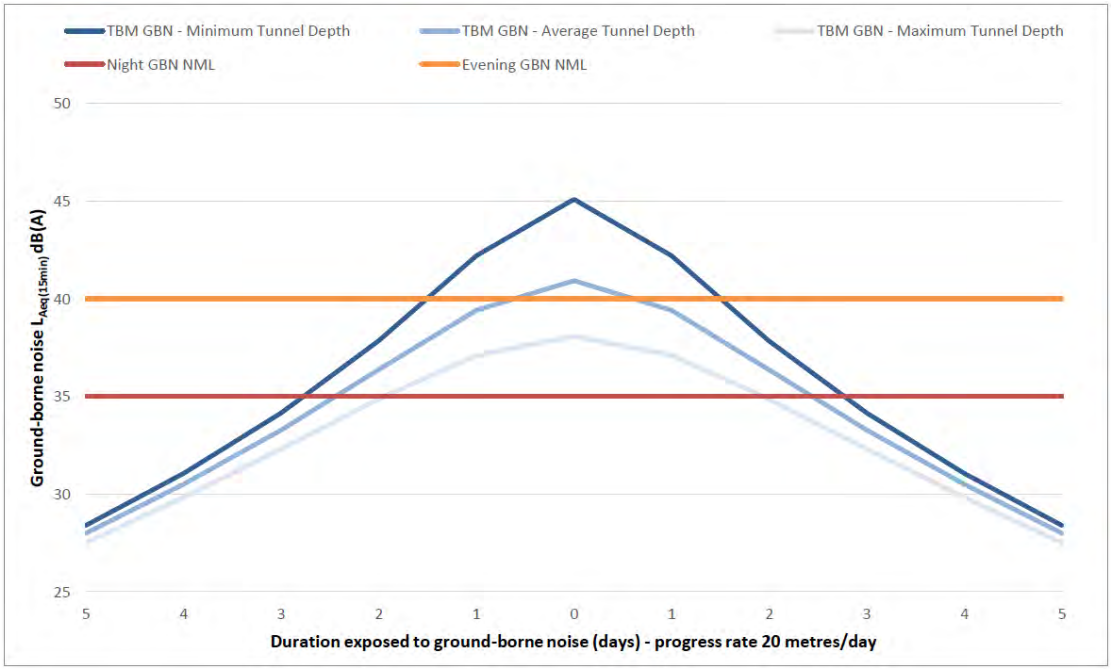
The results summarised in Table 6.3 and Table 6.4 show that there will be construction ground-borne noise affected receivers during the tunnelling works undertaken 24 hours a day.

Mainline tunnel (TBM)

The results summarised in Table 6.3 show that there will be residential receivers construction ground-borne noise affected (within 10 dB of the NML) by TBM tunnelling works during the OOH evening and night periods. Impacts to other sensitive receivers are discussed in Section 6.2.1.

Condition D23(d) allows tunnelling to occur 24 hours a day, provided the requirements of Condition D26 are met. As justified in Section 2.2.1, TBM tunnelling needs to be undertaken 24-hours per day. Predictions are based on a worst-case scenario that the tunnelling is occurring at the closest distance to the receiver. As the tunnelling works progress the activities will move further from the receivers. Figure 6.2, reproduced from the EIS [4] shows the anticipated number of nights residential receivers are likely to be construction ground-borne noise affected during TBM excavation, based on the tunnel depth. The ETP mainline tunnel depth varies from 26 metres to 48 metres, with an average depth of 38 metres. From the graph we can interpret that most residential receivers are unlikely to experience ground-borne noise levels from TBM excavation above 35 dB(A) for more than 4 consecutive nights. Impacts to noise affected residential receivers will be managed as outlined in Section 9.2, 9.3 and 9.4.

Figure 6.2: Estimated number of nights ground-borne noise from TBM tunnelling is above NMLs (Progress rate of 20 metres per day)



Cross passages (small rockbreaker)

The predicted ground-borne noise levels summarised in Table 6.3 show there are residential receivers that may be construction ground-borne noise affected by the excavation of cross passages outside standard construction hours. Table 6.4 shows that there are hotels, which would be in use outside standard construction hours, predicted to be ground-borne noise affected. The cross passages identified to not impact residential or Hotel receivers include XP05, XP11 and XP12 (evening and night), and XP10 (Evening only).

Caverns, turnback stub tunnels, nozzles and adits (roadheader)

The results summarised in Table 6.3 show that there will be residential receivers construction ground-borne noise affected (within 10 dB of the NML) by roadheader excavation of the Pyrmont caverns, nozzles and adits during the OOH evening and night periods. Residential receivers will be exposed to varying levels of GBN depending on the location of tunnel excavation.

There are no residential receivers construction ground-borne noise affected by roadheader excavation of the Hunter Street caverns and turnback stub tunnels. The results summarised in Table 6.4 and in APPENDIX D show hotels that may be construction ground-borne noise affected (within 11 dB of the NML) by roadheader excavation of the Hunter Street station cavern during the OOH night period, including:

- The Grand Hotel, 30 Hunter Street, Sydney (Hunter Street station cavern)
- Comfort Hotel, 15-17 Hunter Street, Sydney (Hunter Street station cavern)
- The Tank Stream Hotel, 97-99 Pitt Street, Sydney (Hunter Street station cavern)
- The Radisson Blu Hotel, 27 O'Connell Street, Sydney (Hunter Street station cavern)
- A by Adina Hotel, 2 Hunter Street, Sydney (Hunter Street station cavern).

Impacts to other sensitive receivers are discussed in Section 6.2.1.

Predictions are based on a worst-case scenario that the tunnelling activity is occurring at the closest distance to the receiver. Noise levels will reduce as the roadheader moves to other areas of the cavern further away the hotels. Consultation is underway with these receivers (refer to APPENDIX G) to manage the impact of the works on the hotels.

Mitigation and management measures to reduce construction noise levels towards the out-of-hours hours NML are summarised in Section 9.

Table 6.3: Number of receiver buildings over the ground-borne noise management level (all NCAs) – residential receivers

Work Area	Aspect/ Construction activity	Assessment reference[1]	Highly noise intensive activity (CoA D38)[2]	Day (standard hours/ outside standard hours)[3]					Evening[2]				Night[2]			
			$L_{Aeq(15min)}$	$L_{Aeq(15min)}$					$L_{Aeq(15min)}$				$L_{Aeq(15min)}$			
			> 60 dB(A)	45-50 dB(A)*	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)
The Bays to Pyrmont Station	Mainline Tunnel (TBM)	Crown - Eastbound	0	0	0	0	0	0	5	0	0	0	20	0	0	0
		Crown - Westbound	0	0	0	0	0	0	1	0	0	0	7	0	0	0
	Cross passages (rock hammer 5-15t)	Crown	0	25	3	0	0	0	44	3	0	0	78	22	0	0
Pyrmont Station to Hunter Street	Mainline Tunnel (TBM excavation)	Crown - Eastbound	0	0	0	0	0	0	8	0	0	0	65	0	0	0
		Crown - Westbound	0	0	0	0	0	0	2	0	0	0	9	0	0	0
	Cross passages (rock hammer 5-15t)	Crown	0	0	0	0	0	0	10	0	0	0	6	6	0	0
Pyrmont Station	Station Cavern (roadheader)	Heading	0	0	0	0	0	0	37	0	0	0	56	0	0	0
		Benching 1	0	0	0	0	0	0	1	0	0	0	53	0	0	0
		Benching 2	0	0	0	0	0	0	0	0	0	0	49	0	0	0
	Crossover Cavern (roadheader)	Heading	0	0	0	0	0	0	17	0	0	0	52	0	0	0
		Benching 1	0	0	0	0	0	0	0	0	0	0	44	0	0	0
	Pedestrian/ service adits (roadheader)	Service Adit SA2 Heading	0	0	0	0	0	0	17	0	0	0	50	0	0	0
		Service Adit SA1 Heading	0	0	0	0	0	0	17	0	0	0	36	0	0	0
		Service Adit SA1 Benching 1	0	0	0	0	0	0	0	0	0	0	29	0	0	0
		Service Adit SA1 Benching 2	0	0	0	0	0	0	0	0	0	0	27	0	0	0
		Pedestrian Adit PA1 Heading	0	0	0	0	0	0	15	0	0	0	26	0	0	0
		Pedestrian Adit PA2 Heading	0	0	0	0	0	0	9	0	0	0	24	0	0	0
		Pedestrian Adit PA2 Benching 1	0	0	0	0	0	0	0	0	0	0	18	0	0	0
		Pedestrian Adit PA2 Benching 2	0	0	0	0	0	0	0	0	0	0	15	0	0	0
	Nozzles/ stub tunnels (roadheader)	Heading	0	0	0	0	0	0	0	0	0	0	2	0	0	0
		Benching 1	0	0	0	0	0	0	0	0	0	0	2	0	0	0

Work Area	Aspect/ Construction activity	Assessment reference[1]	Highly noise intensive activity (CoA D38)[2]	Day (standard hours/ outside standard hours)[3]					Evening[2]				Night[2]			
			$L_{Aeq(15min)}$	$L_{Aeq(15min)}$					$L_{Aeq(15min)}$				$L_{Aeq(15min)}$			
			> 60 dB(A)	45-50 dB(A)*	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)
Hunter Street Station	Station Cavern (and adits) (roadheader)	Heading	0	0	0	0	0	0	0	0	0	0	1[4]	0	0	0
		Benching 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Benching 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Turnback stub tunnels (roadheader)	TB1-B Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TB1-S Heading	0	0	0	0	0	0	0	0	0	0	1[4]	0	0	0
		TB2 (North) Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TB2 (South) Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TB4 (East) Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TB4 (West) Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TB5 Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TB6 Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: Construction noise level cells are shaded based upon the predicted worst case NML exceedance in accordance with the key presented in Table 5.2

1. For detail, refer to Table C1 in APPENDIX C

2. Condition D38 requires identification of receivers at Pyrmont and Hunter Street Sydney CBD likely to experience internal noise levels greater than $L_{eq(15\ minute)}$ 60 dB(A) inclusive of a 5 dB penalty between 7am and 8pm. See Appendix E for detail.

3. The ICNG does not establish an applicable ground-borne NML for the day period. Human comfort vibration limit applies during the day. A ground-borne NML of 50 dB(A) used as screening guideline, applicable to Day (standard hours) and Day (outside standard hours), for the purpose of quantifying ground-borne noise impacts.

4. Based on prediction to ground floor level. Residential receiver is on Level 15. Predicted GBN to this floor level is < 35 dB(A)

* Number of receivers where predicted GBN level is above the EIS assessment NML of $L_{Aeq(15min)}$ 45 dB(A) and less than or equal to $L_{Aeq(15min)}$ 50 dB(A)

Table 6.4: Number of other sensitive receivers over the ground-borne noise management levels (all NCAs)

Work Area	Aspect/ Construction activity	Tunnelling location	Commercial[1]				Childcare[1]				Educational[1]				Recreational[1]				Places of worship[1]				Hotel/Motel/ Hostel[1]				Other[1]			
			1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 60 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 60 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 60 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 60 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 60 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	< 60 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 60 dB(A)
The Bays to Pyrmont Station	Mainline Tunnel (TBM)	Crown - Eastbound	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
		Crown - Westbound	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
	Cross passages (rock hammer 5-15t)	Crown	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0
Pyrmont Station to Hunter Street	Mainline Tunnel (TBM excavation)	Crown - Eastbound	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0
		Crown - Westbound	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cross passages (rock hammer 5-15t)	Crown	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	4	0	0	0
Pyrmont Station	Station Cavern (roadheader)	Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
		Benching 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Benching 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Crossover Cavern (roadheader)	Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Benching 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pedestrian/ service adits (roadheader)	Service Adit SA2 Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Service Adit SA1 Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Service Adit SA1 Benching 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Service Adit SA1 Benching 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
		Pedestrian Adit PA1 Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
		Pedestrian Adit PA2 Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
		Pedestrian Adit PA2 Benching 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
		Pedestrian Adit PA2 Benching 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
	Nozzles/ stub tunnels (roadheader)	Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Benching 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Work Area	Aspect/ Construction activity	Tunnelling location	Commercial[1]				Childcare[1]				Educational[1]				Recreational[1]				Places of worship[1]				Hotel/Motel/ Hostel[1]				Other[1]			
			1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 60 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 60 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 60 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 60 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 60 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	< 60 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 60 dB(A)
Hunter Street Station	Station Cavern (and adits) (roadheader)	Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0
		Benching 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0
		Benching 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0
	Turnback stub tunnels (roadheader)	TB1-B Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TB1-S Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TB2 (North) Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TB2 (South) Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TB4 (East) Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TB4 (West) Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		TB5 Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
		TB6 Heading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: Highly noise affected does not apply to OSRs, as per the ICNG.

1. Commercial, recreational and other sensitive receivers have been assessed against the respective NMLs (see Table B1 in APPENDIX B), and exceedances have been presented in the count table. 'Other' includes industrial receivers, television or recording studios. For more detail on specific impacts to receivers refer to Appendix D (Table D.1)

2. Impacts only applicable when facility is in use.

7 Construction vibration impacts

7.1 Vibration assessment methodology

7.1.1 Vibration intensive activities

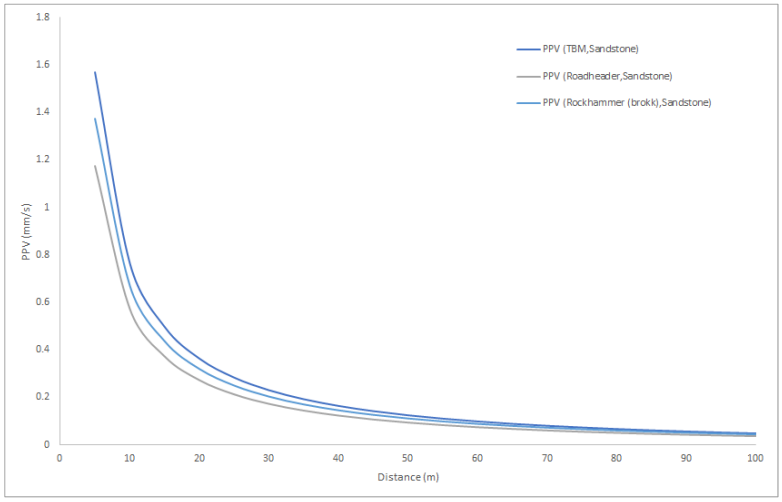
Tunnel/ cavern/ adit excavation method, number of plant and hours of operation detailed in Table C.1 in APPENDIX C. The dominant vibration generating plant and equipment include:

Table 7.1: The Bays vibration intensive activities and plant items

Work Area	Aspect/ Construction activity	Vibration intensive plant
The Bays to Hunter Street	Mainline Tunnel	TBM
	Cross passages	Brokk excavator 5-15t with rock hammer; Bolting rig Robodrill 525
Pyrmont Station	Station Cavern	Road Header 1,000V Electric; Bolting rig Robodrill 525
	Crossover Cavern	Road Header 1,000V Electric; Bolting rig Robodrill 525
	Pedestrian and Service Adits	Road Header 1,000V Electric; Bolting rig Robodrill 525
	Nozzles and Stub Tunnels	Road Header 1,000V Electric; Bolting rig Robodrill 525
Hunter Street Station	Station Cavern (and adits)	Road Header 1,000V Electric; Bolting rig Robodrill 525
	Turnback Stub Tunnels	Road Header 1,000V Electric; Bolting rig Robodrill 525

Potential vibration generated to receivers is dependent on separation distances, the intervening soil and rock strata, dominant frequencies of vibration, and the receiver structure. Based on the ground-borne vibration levels versus distance prediction curves for each vibration significant plant item, ground-borne vibration levels are calculated to the ground floor level of each building. The algorithms used in the modelling (Figure 7.1) have been developed from measurement data obtained from various Sydney projects, including the Sydney Metro City & South West (SM-TSE), Sydney Metro North West (NWRL), WestConnex M4-M5 Rozelle Interchange (WCX3B), WestConnex New M5 (WCX2), WestConnex M4 (WCX1B), Lane Cove Tunnel (LCT), Epping to Chatswood Rail Link (ECRL) and Cross City Tunnel (CCT).

Figure 7.1: Indicative ground-borne vibration levels from tunnelling



The geology of the tunnel alignment is predominantly sandstone. The predictions and subsequent assessment is based on this assumption. However due to localised geological anomalies, foundation-to-footing interaction and the large range and variety of structures that exist (e.g. construction type, dimensions, materials, quality of construction, footing conditions etc) actual vibration levels may vary significantly to what has been predicted herein, therefore verification measurements shall be undertaken at the first opportunity to check and verify the models (refer to Section 9.6).

7.1.2 Minimum working distances for vibration intensive plant

The recommended minimum working distances for vibration intensive plant in Table 7.2 are taken from a database of vibration levels measured at various sites or obtained from other sources (e.g. BS5228-2:2009). They are not specific to the Project works as final vibration levels are dependent on many factors including the actual plant used, its operation and the intervening geology between the activity and the receiver.

Potential impacts are identified by determining the buildings/ structures likely to be within the recommended minimum working distances, taking into consideration the vibration intensive plant in use, location of works and distance to nearest affected receiver buildings/ structures.

Site specific minimum working distances for vibration significant plant items must be measured on site where plant and equipment is likely to operate close to or within the recommended minimum working distances for cosmetic damage (Table 7.2).

Table 7.2: Recommended minimum working distances (m) for managing vibration impact based on screening criteria

	Minimum working distances for vibration intensive plant, m[3]		
Vibration sensitive receiver	**TBM**	**Roadheader and drill rig**	**Brokk 5-15t rockhammer**
Structural damage to buildings			
Reinforced or frame structures (Line 1)[1]	5	5	5
Unreinforced or light framed structures[1, 2]	5	5	5
Structurally unsound heritage structures[1, 2]	5	5	5
Sydney Water Assets threshold	5	5	5
Disturbance to building occupants			
Critical areas (when in use)[4]	25	20	20
Residences – Day	15	10	10
Residences – Night	20	15	15
Offices (when in use)[6,]	5	5	5
Workshops (when in use)	5	5	5

Notes: 1. Initial screening test criteria reduced by 50% due to potential dynamic magnification in accordance with BS7385.

2. In accordance with CNVMP, a building condition survey should determine whether a heritage structure is structurally unsound.

3. Minimum working distances are in 5m increments only to account for the intrinsic uncertainty of this screening method. Jackhammers/ plate compactors are likely to have minimum working distances smaller than 5 m.

4. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.

5. Daytime is 7 am to 10 pm; Night-time is 10 pm to 7am.

6. Examples include offices, schools, educational institutions, and place of worship.

7.2 Vibration assessment

The numbers of buildings which are close to or within the minimum working distances for vibration impact are shown in Table 7.3. More detailed results are presented in APPENDIX F. The figure in APPENDIX F identify the minimum working distances for vibration over aerial photographs that also show the work areas and the land uses.

7.2.1 Structural damage

There are no structures identified at risk of cosmetic damage from the tunnelling works.

7.2.2 Heritage structures

There are no heritage structures on the surface identified at risk of cosmetic damage from the tunnelling works.

Impacts to Sydney Water assets are discussed in Section 7.2.4.

Table 7.3: Number of buildings within minimum working distances for vibration impact

Work Area	Construction activity	Vibration intensive plant	Tunnelling Location	Buildings within Structural Damage MWD[1]				Buildings within human annoyance MWD[5]				
				Reinforced structures	Unreinforced structures	Heritage screening	Sydney Water Asset	Critical areas[2]	Residence Day[3]	Residence Night[3]	Offices[4]	Workshop
The Bays to Pyrmont Station	Mainline Tunnel	TBM	Crown - Eastbound	0	0	0	0	0	0	0	0	0
			Crown - Westbound	0	0	0	0	0	0	0	0	0
	Cross passages	Brokk rock hammer 5-15t and bolting rig Robodrill 525	Crown	0	0	0	0	0	0	0	0	0
Pyrmont Station to Hunter Street	Mainline Tunnel	TBM	Crown - Eastbound	0	0	0	0	0	0	0	0	0
			Crown - Westbound	0	0	0	0	0	0	0	0	0
	Cross passages	Brokk rock hammer 5-15t and bolting rig Robodrill 525	Crown	0	0	0	0	0	0	0	0	0
Pyrmont Station	Station Cavern	Roadheader and bolting rig Robodrill 525	Heading	0	0	0	0	0	0	0	0	0
			Benching 1	0	0	0	0	0	0	0	0	0
			Benching 2	0	0	0	0	0	0	0	0	0
	Crossover Cavern	Roadheader and bolting rig Robodrill 525	Heading	0	0	0	0	0	0	0	0	0
			Benching 1	0	0	0	0	0	0	0	0	0
	Pedestrian/ service adits	Roadheader and bolting rig Robodrill 525	Service Adit SA2 Heading	0	0	0	0	0	0	0	0	0
			Service Adit SA1 Heading	0	0	0	0	0	0	0	0	0
			Service Adit SA1 Benching 1	0	0	0	0	0	0	0	0	0
			Service Adit SA1 Benching 2	0	0	0	0	0	0	0	0	0
			Pedestrian Adit PA1 Heading	0	0	0	0	0	0	0	0	0
			Pedestrian Adit PA2 Heading	0	0	0	0	0	0	0	0	0
			Pedestrian Adit PA2 Benching 1	0	0	0	0	0	0	0	0	0
			Pedestrian Adit PA2 Benching 2	0	0	0	0	0	0	0	0	0
	Nozzles/ stub tunnels	Roadheader and bolting rig Robodrill 525	Heading	0	0	0	0	0	0	0	0	0
			Benching 1	0	0	0	0	0	0	0	0	0
Hunter Street Station	Station Cavern, nozzles and adits	Roadheader and bolting rig Robodrill 525	Heading	0	0	0	1	0	0	0	0	0
			Benching 1	0	0	0	1	0	0	0	0	0
			Benching 2	0	0	0	0	0	0	0	0	0

Work Area	Construction activity	Vibration intensive plant	Tunnelling Location	Buildings within Structural Damage MWD[1]				Buildings within human annoyance MWD[5]				
				Reinforced structures	Unreinforced structures	Heritage screening	Sydney Water Asset	Critical areas[2]	Residence Day[3]	Residence Night[3]	Offices[4]	Workshop
	Turnback stub tunnels	Roadheader and bolting rig Robodrill 525	TB1-B Heading	0	0	0	0	0	0	0	0	0
			TB1-S Heading	0	0	0	0	0	0	0	0	0
			TB2 (North) Heading	0	0	0	0	0	0	0	0	0
			TB2 (South) Heading	0	0	0	0	0	0	0	0	0
			TB4 (East) Heading	0	0	0	0	0	0	0	0	0
			TB4 (West) Heading	0	0	0	0	0	0	0	0	0
			TB5 Heading	0	0	0	0	0	0	0	0	0
			TB6 Heading	0	0	0	0	0	0	0	0	0

Notes: 1. Site inspection should determine structural conditions of all potentially vibration impacted buildings

2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.

3. Daytime is 7 am to 10 pm; Night-time is 10 pm to 7am.

4. Examples include offices, schools, educational institutions, and place of worship.

5. Applicable when in use.

7.2.3 Human annoyance

The assessing vibration guideline [7] notes that inside dwellings, adverse comments often arise when occupants can perceive (feel) vibration, particularly when the vibration arises from a source located outside their home (or outside their control) and assume that the vibration has the potential to damage their building or contents.

However, it is noted that vibration levels required to cause minor cosmetic damage are typically 10 x higher than levels that will cause disturbance to building occupants. Many building occupants assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures.

At properties near the worksite, it is possible that the nearest receivers will be able to feel vibration levels when vibration-generating equipment is being utilised. Properties where vibration levels may be above the vibration disturbance goals in Table 4.1 and there is a probability of adverse comment are shown in Table 7.3. It is important to note that human comfort levels are much lower than vibration levels likely to result in property damage and people therefore may be disturbed by vibration with no potential to result in property damage. More detailed results are presented in APPENDIX E.

As can be noted from Table 7.3, there are no properties likely to be exposed to vibration above the screening limit for human annoyance. The above assessment is based on the tunnelling works at the closest location to nearby receivers. When vibration-generating equipment operates further from the closest point, the predicted vibration levels will reduce along with the probability of adverse comment.

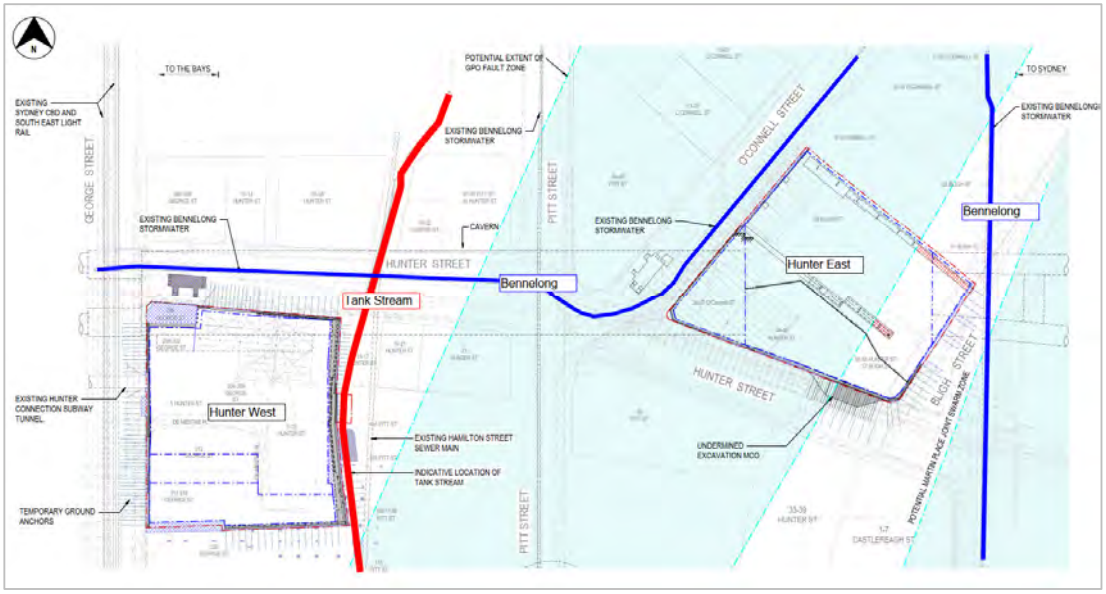
Attended vibration measurements are proposed to be carried out in accordance with the CNVMP Appendix A and in response to vibration complaints. If measurement results indicate events above the vibration objectives for human annoyance, vibration control and management measures will be provided to reduce vibration impact (see Section 9).

After applying all feasible and reasonable vibration mitigation measures, if vibration monitoring still identifies that measured vibration levels are above the relevant vibration criteria for human annoyance, appropriate additional management measures should be considered (see Section 9).

7.2.4 Sydney Water Assets

There are two Sydney Water assets with 5 metres of the Hunter Street Station caverns and stub tunnel excavation works. These are the Tank Stream and the Bennelong Stormwater Channels, which are identified on Figure 7.2.

Figure 7.2: Sydney Water Assets near the Hunter Street Station cavern and stub tunnels



Review of the construction design has identified that the shortest distances for each worksite to the Sydney Water Assets are provided in Table 7.4.

Table 7.4: Shortest distance between construction works and Sydney Water Assets

Worksite	Sydney Water Asset	Distance to closest excavation face	Distance to ground anchors
Hunter Street Station cavern, nozzles and adits	Tank Stream	8,000 mm	4,700 mm
	Bennelong Sewer	3,800 mm	1,000 mm
Hunter Street turnback stub tunnels	Bennelong Sewer	30,000 mm	22,500 mm

The P.P.V. vibration levels vibration intensive plant is likely to generate on Sydney Water assets has been predicted, based on a database of vibration levels measured at various sites or obtained from other sources (e.g. BS5228-2:2009). The predicted vibration levels are presented in Table 7.5 and compared against the Sydney Water Assets initial screening threshold vibration of 3 mm/s p.p.v for masonry pipelines (refer to Table 4.1). Bold text indicates the predicted vibration is above the initial screening threshold limit.

Table 7.5: Predicted P.P.V. vibration levels from construction on Sydney Water Assets

Worksite	Sydney Water Asset	Construction activity	Distance to asset, m	Predicted P.P.V. vibration, mm/s	Recommended MWD, m
Hunter Street station cavern, nozzles and adits	Tank Stream	Roadheader tunnelling	8.0	<2	5
	Bennelong Sewer	Roadheader tunnelling	3.8	<2	5
Hunter Street turnback stub tunnels	Bennelong Sewer	Roadheader tunnelling	30.0	<2	5

The results presented in Table 7.5 indicate that vibration from roadheader tunnelling works at Hunter Street station cavern and turnback stub tunnels are likely to be below Sydney Water Assets threshold

vibration limit. Roadheader tunnelling, including ground anchor drilling of the Hunter Street Station cavern may occur within the 5 metre MWD noted in Table 7.5 to the Bennelong sewer. There is a low risk that vibration may be above the initial screening threshold vibration of 3 mm/s p.p.v for masonry pipelines.

Vibration monitoring would be undertaken when the cavern ground anchor drilling is within a 5 metre MWD of the Bennelong sewer to confirm determine site specific vibration levels for Hunter Street and confirm whether vibration is likely to be below German Standard DIN 4150-3 guideline values for vibration velocity, vi, max, for evaluating the effects of short-term vibration on structures (Line 3)(refer to G.2). Where roadheader tunnelling is required to operate within site specific minimum working distances, the construction methodology will be revised to ensure the vibration impact is managed to within the DIN 4150-3 guideline values .

Recommendations for managing construction vibration impacts are presented in Section 9.3.

7.2.5 Sensitive scientific and medical equipment (SME)

Receivers with potentially sensitive scientific and medical equipment (SME) have been identified along the alignment and are summarised in Table 7.6

Table 7.6: Shortest distance between construction works and sensitive SME receivers

Worksite	Sensitive SME receiver	Distance to closest excavation face
Pyrmont Station cavern	Pyrmont Data Centre, 13A-29 Union Street, Pyrmont NSW 2009	19 m (ground floor) 16 m (basement)
Hunter Street turnback stub tunnels	State Library of New South Wales, 1 Shakespeare Pl, Sydney NSW 2000	40 m (ground floor) 36 m (basement)
	Sydney and Sydney Eye Hospital, 8 Macquarie Street, Sydney NSW 2000	>150 m

The P.P.V. vibration levels vibration intensive plant is likely to generate on sensitive SME receivers has been predicted, based on a database of vibration levels measured at various sites or obtained from other sources (e.g. BS5228-2:2009). The predicted vibration levels are presented in Table 7.5 and compared against the generic Vibration Criterion (VC) curve screening level (refer to Table 4.1). Bold text indicates the predicted vibration is above the initial screening threshold limit.

Table 7.7: Shortest distance between construction works and sensitive SME receivers

Worksite	Sensitive SME receiver	Applicable VC-curve - screening limit PPV	Distance to closest excavation face	Predicted P.P.V. vibration, mm/s
Pyrmont Station cavern	Pyrmont Data Centre	Computer Areas 1.0 mm/s	19 m (ground floor) 16 m (basement	0.289 0.348
Hunter Street turnback stub tunnels	State Library of New South Wales	Computer Areas 1.0 mm/s	40 m (ground floor) 36 m (basement)	0.123 0.140
	Sydney and Sydney Eye Hospital	VC-B 0.03 mm/s	>150 m	0.019

The results presented in Table 7.5 indicate that vibration from roadheader tunnelling works at Pyrmont Station Cavern and Hunter Street turnback stub tunnels are likely to be below vibration limits for sensitive SME receivers.

8 Construction traffic noise assessment

There is no assessment of construction traffic noise impacts in this DNVIS.

9 Mitigation and management measures

9.1 High noise impact activities

9.1.1 Conditional respite periods (CoA D38, D39 and D40)

Under condition D38 JCG JV must identify all receivers at Hunter Street likely to experience internal noise levels greater than $L_{eq(15\ minute)}$ 60 dB(A) inclusive of a 5 dB penalty, if rock breaking or any other highly noise intensive activity likely to result in regenerated (ground-borne) noise or a perceptible level of vibration is planned (including works associated with utility adjustments), between 7am and 8pm. APPENDIX E identifies receivers where predicted internal ground-borne noise levels are above 60 dB(A).

JCG JV will consult with the receivers identified above with the objective of determining appropriate hours of respite so that construction noise (including ground-borne noise) from rock breaking or any other highly noise intensive activity, does not exceed internal noise levels of:

a) $L_{eq(15\ minute)}$ 60 dB(A) inclusive of a 5 dB penalty if rock breaking or any other highly noise intensive activity likely to result in ground-borne noise or a perceptible level of vibration is planned between 7am – 8pm for more than 50 percent of the time; and

b) $L_{eq(15\ minute)}$ 55 dB(A) inclusive of a 5 dB penalty if rock breaking or any other highly noise intensive activity likely to result in ground-borne noise or a perceptible level of vibration is planned between 7am – 8pm for more than 25 percent of the time,

unless an agreement is reached with those receivers. This does not apply to noise associated with the cutting surface of a TBM as it passes under receivers.

The results presented in Section 6.2 and Section 7.2 show that no tunnelling activity is predicted to generate internal noise levels greater than $L_{Aeq(15\ minute)}$ 60 dB(A) or a perceptible level of vibration at any sensitive receiver.

9.2 Consultation with affected receivers

CoA D29 and D30 require consultation with noise and/ or vibration affected sensitive land users to assist in determining site-specific mitigation measures.

JCG has commenced consultation and will continue to consult with potentially affected stakeholders including Councils, businesses, and residential receivers. The consultation is focused on specific mitigation and management measures applicable to tunnelling works. These measures include managing noise impact and appropriate respite periods for out-of-hours works; scheduling high noise impact works around sensitive periods where feasible and reasonable; alternative methods of tunnelling excavation to reduce ground-borne noise and/or vibration, substitution of plant and equipment to ones with a lower sound power level, offers of movie or dinner vouchers; alternative accommodation offers.

Details of completed consultation is recorded in the Sydney Metro Stakeholder Management System, Consultation Manager. A detailed outline of the receiver specific consultation undertaken to date and the consultation respite program derived through consultation is provided in APPENDIX G. A summary of the consultation program is provided below:

- Consultation with relevant community members on construction works, including site establishment, demolition, acoustic shed construction, stub tunnel excavation and TBM tunnelling support works.
- A Project wide community information session to discuss site establishment, utility and TBM support works. These sessions will occur every quarter as the Project continues.
- Residents and businesses within the 50m of the tunnel alignment will receive advise of likelihood of ground-borne noise and vibration impact during tunnel excavation, a property condition survey offer letter, and other information on tunnelling.
- Consultation with noise affected receivers identified in APPENDIX D to ensure additional management measures are provided (if required, refer to Section 9.4).
- Consultation with potentially noise and/ or vibration affected community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, studios, laboratories and operating theatres) to satisfy CoA D27 and ensure events resulting in noise levels above the NMLs are not timetabled within sensitive periods, or make alternative arrangements where this cannot be avoided.
- Consultation with community that are construction noise and/or vibration affected on a regular basis on respite during out-of-hours work. To satisfy CoA D37, this consultation will include:
    - a progressive schedule for periods no less than three (3) months of likely out-of-hours work;
    - a description of the potential work, location and duration of the out-of-hours work;
    - the noise characteristics and likely noise levels of the work; and
    - likely mitigation and management measures which aim to achieve the relevant NMLs under CoA D26, including the circumstances of when respite or relocation offers will be available and details about how the affected community can access these offers (see Section 9.4 and 9.3).

Evidence of the receiver specific consultation program and site-specific mitigation and management measures that have been adopted to date to reduce impacts to receivers is included in APPENDIX G. Consultation will continue and mitigation measures implemented as applicable to the stage of work. APPENDIX G will be updated progressively to reflect consultation completed as tunnelling progresses . The ongoing consultation record will be entered into the Sydney Metro Consultation Manager system and included in future updates of this DNVIS.

9.3 Noise and vibration control and management measures

Noise and vibration control and management measures to reduce potential noise impacts will be implemented during the construction works, where reasonable and feasible. In accordance with the ICNG and consistent with the CNVS, feasible noise mitigation measures are those work practices or measures to reduce noise that are capable of being put into practice or of being engineered and are practical to build given project constraints such as safety and maintenance requirements. Reasonable noise mitigation measures are those feasible noise mitigation measures that are considered reasonable in the circumstances, based on a judgement that the overall noise benefits outweigh the overall adverse social economic and environmental effects, including the cost of implementing the measure. To make such a judgement, consideration is to be given to noise level impacts, duration of impacts, noise mitigation benefits, cost effectiveness of noise mitigation and community views.

Table 9.1 outlines the noise and vibration control measures that will be implemented on site during the construction works, where feasible and reasonable.

Table 9.1 Site noise control measures

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
At source control measures							
Timing of equipment in use	Where practicable, activities and plant will be scheduled/limited as outlined Section 6.2.2 and Section 9.5, including: - Cross passage excavation will be limited to standard construction hours only, with the exception of XP05, XP11 and XP12 (evening and night excavation meets Condition D26), and XP10 (evening excavation meets Condition D26). - Excavation of the caverns, stub tunnels and adits at Pyrmont and Hunter Street will be managed to satisfy Condition D26 and Hotels (OOH), where feasible and reasonable. Additional mitigation measures (see Section 9.4) would be implemented as required.	This measure could be feasibly implemented. To be determined on a case-by-case basis, through consultation with the impacted receiver (see APPENDIX G).	May not be feasible for all works	- Sufficient noise reduction could be achieved at enough receivers and cost effective etc, - Deemed to be cost effective. - Outweighs the identified social, economic, and environmental effects.	May not be reasonable for all works	May not be adopted for all works. To be determined on a case-by-case basis.	Where practicable, the timing of works will be managed to reduce noise levels during more sensitive periods (i.e. after 10pm and before 7am). Noisy plant that does not require OOH operation (e.g. small excavator with rockbreaker) will be limited to standard standard construction hours, where is feasible and reasonable.
Alternative construction methods to reduce GBN and vibration	Alternative, less vibration generating construction methods will be reviewed where vibration significant works found to be within the site-specific minimum working distance of a structure, as determined by site vibration monitoring. For example, the use of roadheading to reduce vibration transmission instead of rockbreaking to excavate the cavern benches.	This measure could be feasibly implemented. To be determined on a case-by-case basis.	Yes	- Sufficient GBN and/ or vibration reduction could be achieved at identified structure to reduce the risk of structural damage from vibration significant works.	Yes	Yes	The use of alternative methods to reduce GBN and vibration transmission will be considered where site specific vibration assessments indicate that minimum working distances for cosmetic damage cannot be met.
Review cross passage design to relocate cross passages	Extensive review of cross passage design has been undertaken. The design review considered extending the distance between XPs from 250 metres to 500 metres, which would reduce the number of receivers impacted by GBN&V impacts from XP excavation. The location of cross passages, notably for XP04, XP07, XP08 and XP09, was also reviewed to maximise distance to sensitive receivers. XP04 and XP07 were moved away from residential/ hotel receivers and closer to a commercial premise. XP08 and XP09 were slightly relocated to site underneath the public road, to maximise distance to residential and other sensitive receivers (hotels, recording studios).	Extending distance between XPs not feasible due to operational safety issues. XP04, XP07, XP08 and XP09 were located to maximise distance to sensitive receivers.	No for extending distance between XPs Yes, for relocation of XPs	GBN and vibration reduction could be achieved at sensitive receivers by relocating XPs to maximise distance to sensitive receivers.	Yes	No for extending distance between XPs Yes, for relocation of XPs	Extending the distance between XPs from 250 metres to 500 metres was not feasible due to operational safety issues. It was feasible and reasonable to ensure the locations of XP04, XP07, XP08 and XP09 were able to maximise distance to sensitive receivers.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
Building condition surveys	Undertake building dilapidation surveys on all buildings located within the minimum working distances established for cosmetic damage prior to commencement of activities with the potential to cause property damage (see Section 7.2.1).	This measure could be feasibly implemented.	Yes	Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	No	No buildings are identified to be within cosmetic damage MWD. Tank Stream and Bennelong Sewer identified as potentially at risk. Condition survey, subject to consultation with Sydney Water.
Noise management measures							
3D construction noise and vibration management tool	Tunnel excavation planning will be used to minimise the ground-borne noise impacts on sensitive receivers, including residential and Hotels during the evening and night period. Works will be planned to minimise the ground-borne noise and vibration impacts during the evening and night.	This measure could be feasibly implemented.	Yes	- Potential benefit of 10-20 dB(A) at the affected sensitive receivers. - Sufficient noise reduction could be achieved at enough receivers. - Could be cost effective	Yes	Yes	A Gatewave will be developed for the tunnel excavation (namely caverns, turnback stub tunnels and cross passages) to manage OOHW excavation of the tunnels to meet Condition D26 and Hotels and/ or implement additional mitigation measures (see Section 9.4) as required.
Site inductions & Toolbox Talks	All employees, contractors and subcontractors will receive a Project induction. The environmental component may be covered in toolboxes and should include (but is not limited to): • location of nearest sensitive receivers • relevant project specific and standard noise and vibration mitigation measures; • permitted hours of work; • OOHW Procedure and Form • construction employee parking areas.	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Inductions and toolbox talks will continue to be conducted for the project.
Community consultation - disseminating information	Provide information to community of construction activity and potential impacts (see Section 9.2).	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Updates will be distributed regularly for the duration of the project.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
Community consultation - active communication with nearby sensitive receivers	Seek feedback from community to identify more sensitive times of the day, or particularly sensitive days (see Section 9.2). An example is identifying when student exams (such as Higher School Certificate exams, end of semester exams) will take place.	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Project team shall proactively contact nearby sensitive receivers, particularly those which may have special requirements (e.g. hotels with sleeping areas, recording studios).
Noise/ vibration monitoring and on-site checks	Noise/ vibration monitoring to be conducted at key locations to verify or quantify impacts at sensitive receivers, as outlined in Section 9.6. Check whether feasible and reasonable mitigation and work practices are in place, as outlined in APPENDIX C.	This measure could be feasibly implemented.	Yes	Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	Yes	Noise / vibration monitoring and site checks shall be carried out as detailed in this assessment.
Update DNVIS	Regular updates of the DNVIS to account for changes in noise and vibration management strategies.	This measure could be feasibly implemented.	Yes	Can be reasonably undertaken by project team where required.	Yes	Yes	Updates to the DNVIS will be carried out where required and will be reviewed regularly.
Implement additional management measures	Identify and implement additional management measures outlined in this assessment.	This measure could be feasibly implemented.	Yes	Consistency with CNVS	Yes	Yes	Additional management measures to be identified on a case-by-case basis and with consideration of the standard mitigation and management measures outlined in this report (see Section 9.4).
Gatewave GBNV management tool	A 3D GBNV vibration management tool (Gatewave, www.gatewave.com.au) developed specifically for the excavation of the Pyrmont station and Crossover Cavern and Adits to allow specific tunnelling areas and activities to be assessed and managed as construction works progress.	This measure could be feasibly implemented.	Yes	Deemed to be cost effective. Outweighs the identified social, economic and environmental effects. Allows for timely consultation with affected receivers and management of tunnelling work areas as works progress.	Yes	Yes	Gatewave GBNV management tool will be implemented to manage GBNV impacts and coordinate effective community consultation.

9.4 Additional management measures

Section 5 of the CNVS directs that in instances where, after the application of all reasonable and feasible mitigation and management measures (refer to Section 9.3), the $L_{Aeq(15minute)}$ airborne construction noise and/ or $L_{Aeq(15minute)}$ ground-borne noise levels are still predicted to exceed the relevant NMLs, or if vibration monitoring at representative locations still exceeds relevant vibration objectives for human annoyance, additional management measures can be applied to further limit the risk of annoyance from construction noise and vibration. The CNVS suggests the Project should consider implementing additional management measures such as:

- **Alternative accommodation** (**AA**) options may be provided for residents living close to construction works that are likely to incur unreasonably high impacts over an extended period of time (more than 2 consecutive days). Alternative accommodation will be determined on a case-by-case basis.
- **Monitoring** (**M**) of noise or vibration may be conducted at the affected receiver(s) or a nominated representative location where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration objectives. 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.
- **Individual briefings** (**IB**) are used to inform stakeholders about the impacts of high noise activities and mitigation and management 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.
- **Letter box drops** (**LB**) in the form of a newsletter produced and distributed to the local community via letterbox drop or email via the project mailing list. The newsletter will provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage, 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.
- **Project specific respite offers** (**RO**) provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
- **Phone calls and emails** (**PC**) detailing relevant information about construction works would be made to identified noise or vibration affected stakeholders within 7 days of proposed work to provide tailored advice and the opportunity for stakeholders to provide comments on the proposed work and specific needs etc.
- **Specific notifications** (**SN**) 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.

In addition, all potentially impacted receivers will be kept informed of the nature of works to be carried out, the expected noise levels and duration, as well as be given appropriate enquiries and complaints contact details (see Section 9.6.4).

9.4.1 Additional ground-borne noise management measures

The steps to be carried out to determine the additional ground-borne noise management measures to be implemented are identified in Figure 9.1.

Figure 9.1: Additional ground-borne noise management measures

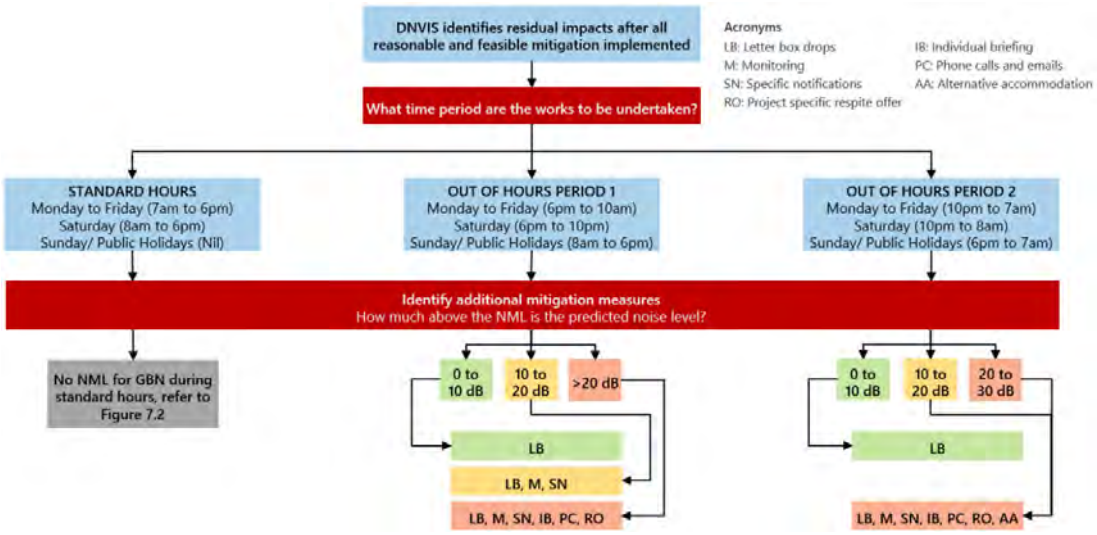


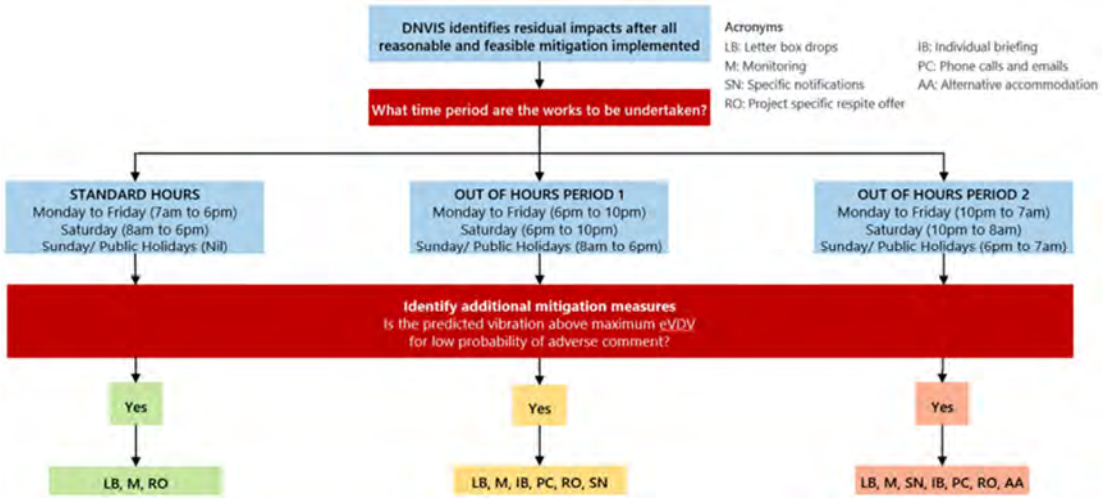
Figure 9.1 presents a summary of the additional ground-borne noise management measures applicable for construction activities where, after application of all reasonable and feasible mitigation options, ground-borne noise levels are still above the NMLs.

Prior to the commencement of works, receivers identified in APPENDIX E will be notified to advise that ground-borne noise from the works may at times be audible.

9.4.2 Additional vibration management measures

If vibration monitoring at representative locations still exceeds relevant vibration objectives for human annoyance, the appropriate additional management measures [1], presented in Figure 9.2, should be provided.

Figure 9.2: Additional vibration management measures



9.5 Managing site specific activities and cumulative noise impacts

9.5.1 Construction noise and vibration management tool (Gatewave)

This DNVIS has established the overall impacts associated with the proposed works. A 3D construction noise and vibration management tool (Gatewave, www.gatewave.com.au) is being developed specifically for the ETP Works to allow specific work areas and activities to be assessed as construction works progress. It also allows cumulative noise impact from other aspects of the Project or, where relevant noise from other construction projects, to be assessed and managed in accordance with relevant conditions of approval.

Gatewave will be used regularly to plan, assess and manage works progressively.

Gatewave incorporates ground elevation contours, building heights, the built environment and atmospheric conditions to predict construction noise in accordance with the International Standard ISO 9613-2:1996 implementing quality standard ISO 17534-1:2015. All sensitive receivers identified by the land use survey are integrated into the Gatewave tool.

9.5.2 Managing duration of impact and cumulative noise impacts (Gatewave)

The extent of mitigation and management required to manage potential GBN impacts at the nearest noise sensitive receivers is determined by not only considering the level of noise impact, but also the duration that receivers are likely to be exposed to noise levels above the relevant GNMLs.

The duration of potential GBN impacts depends on potentially concurrent and non-concurrent excavation works and the excavation advance rate. Due to the dynamic nature of the tunnel excavation, excavation programs often change and therefore it is not possible to determine in this DNVIS an overall duration of GBN impacts at each receiver. However, in order to properly address and assess the potential variability in excavation staging, a construction noise and vibration management tool

(Gatewave) is being developed in conjunction with JCG to assist in the prediction of GBN&V impacts and the identification of appropriate mitigation and management measures. The predicted values are compared against the relevant ground-borne noise and vibration criteria and are used to select the specific management measures to be applied to individual properties during construction.

GBN affected receivers will be notified prior to commencement of shaft and tunnel excavation activities.

9.6 Attended or unattended noise monitoring

Noise and vibration monitoring should follow the procedures outlined in the Noise and Vibration Monitoring Program required by condition C14 and the CNVS. Monitoring would be undertaken by trained personnel, familiar with the relevant standards and should follow the procedures outlined in the Noise and Vibration Monitoring Program and the CNVS.

9.6.1 Airborne noise

Not required

9.6.2 Ground-borne noise (and vibration)

Attended or unattended noise monitoring is to be undertaken to validate the GBN model and to verify that ground-borne noise and vibration resulting from tunnelling works are consistent with the levels predicted in this DNVIS and any EPL Conditions.

Noise (and vibration) monitoring would be conducted during tunnelling excavation works at the first available locations identified in Table 9-2, subject to landowner and tenant consent. These monitoring locations are considered the most suitable locations near the tunnel alignment to collect a representative sample of measurements required to validate the noise model. Monitoring is not required at every one of the locations and for all potential excavation activities listed in the table below. Once a representative sample of measurements has been completed and the model has been validated, no further monitoring is required for model validation. However, additional monitoring would be conducted in response to noise complaints or community consultation. Where, following community consultation, specific sensitive receivers are identified for additional monitoring, access to the property will be sought through the Stakeholder and Community Relations team.

Subject to obtaining the property owner/occupier's consent to access the property, noise measurements would be undertaken in rooms that are the most shielded from existing ambient noise to allow a higher signal to noise ratio to be obtained. Where noise monitoring is undertaken on or within heritage structures, advice of a heritage specialist on methods and locations for installing equipment used for noise monitoring is required where it is likely to interfere with the building (i.e. if attachment to the building in some form is required).

In addition, vibration monitoring at the receivers identified in the table above should be considered to provide assurance to the residents that vibration levels are not potentially causing any cosmetic

damages to the buildings.

Table 9-2: Nominated verification monitoring locations – ground-borne noise[1]

Work area	Construction activity	Address	Nominated receiver location
The Bays to Pyrmont Station	Mainline Tunnel (TBM)	102 MILLER STREET PYRMONT 120-122 SAUNDERS STREET PYRMONT	Internal, within ground floor rooms when TBM is closest to the receiver
	Cross passages (rock hammer 5-15t)	102 MILLER STREET PYRMONT 120-122 SAUNDERS STREET PYRMONT	Internal, within ground floor rooms when the rockbreaker is closest to the receiver at XP07 and XP09
Pyrmont Station to Hunter Street	Mainline Tunnel (TBM)	1-9 PYRMONT BRIDGE ROAD 2 HUNTER STREET (Hotel)	Internal, within lowest floor level with sleeping area rooms when the TBM is closest to the receiver
	Cross passages (rock hammer 5-15t)	73 UNION STREET PYRMONT 21-23 SHELLY STREET SYDNEY	Internal, within lowest floor sleeping area when the rockbreaker is closest to the receiver at XP04 and XP06
Pyrmont Station	Station and Crossover Cavern (roadheader)	102 PYRMONT STREET PYRMONT 21-23 SHELLY STREET SYDNEY	Internal, within ground floor rooms when roadheader is closest to the receiver
	Pedestrian/ service adits (roadheader)	28 PATERNOSTER ROW PYRMONT 115 PYRMONT STREET PYRMONT	Internal, within ground floor rooms when roadheader is closest to the receiver
	Nozzles/ stub tunnels (roadheader)	1-9 PYRMONT BRIDGE ROAD	Internal, within lowest floor level with sleeping area rooms when the roadheader is closest to the receiver
Hunter Street Station	Station Cavern (roadheader)	2 HUNTER STREET SYDNEY 27 O'CONNEL STREET SYDNEY	Internal, within lowest floor level with sleeping area rooms when the roadheader is closest to the receiver
	Turnback stub tunnels (roadheader)	101 PHILLIP STREET SYDNEY	Internal, within lowest floor level with sleeping area rooms when the roadheader is closest to the receiver

Note: Suitable alternative locations will be identified if access to nominated receiver locations is not available.

9.6.3 Vibration monitoring

Attended vibration monitoring is to be undertaken to determine and verify site specific minimum working distances for cosmetic damage and human annoyance. Attended vibration monitoring will be undertaken during works at the locations identified in Section 7 whenever vibration significant plant items are operating within the recommended minimum working distances in Table 7.2.

Table 9-3: Nominated verification monitoring locations - vibration

Work area	Construction activity	Address	Nominated receiver location
The Bays to Pyrmont Station	Mainline Tunnel (TBM)	102 MILLER STREET PYRMONT 120-122 SAUNDERS STREET PYRMONT	Internal, within ground floor rooms when TBM is closest to the receiver
	Cross passages (rock hammer 5-15t)	102 MILLER STREET PYRMONT 120-122 SAUNDERS STREET PYRMONT	Internal, within ground floor rooms when the rockbreaker is closest to the receiver at XP07 and XP09
Pyrmont Station to Hunter Street	Mainline Tunnel (TBM)	1-9 PYRMONT BRIDGE ROAD 2 HUNTER STREET (Hotel)	Internal, within lowest floor level with sleeping area rooms when the TBM is closest to the receiver
	Cross passages (rock hammer 5-15t)	73 UNION STREET PYRMONT 21-23 SHELLY STREET SYDNEY	Internal, within lowest floor sleeping area when the rockbreaker is closest to the receiver at XP04 and XP06
Pyrmont Station	Station and Crossover Cavern (roadheader)	102 PYRMONT STREET PYRMONT 21-23 SHELLY STREET SYDNEY	Internal, within ground floor rooms when roadheader is closest to the receiver
	Pedestrian/ service adits (roadheader)	28 PATERNOSTER ROW PYRMONT 115 PYRMONT STREET PYRMONT	Internal, within ground floor rooms when roadheader is closest to the receiver
	Nozzles/ stub tunnels (roadheader)	1-9 PYRMONT BRIDGE ROAD	Internal, within lowest floor level with sleeping area rooms when the roadheader is closest to the receiver
Hunter Street Station	Station Cavern (roadheader)	2 HUNTER STREET SYDNEY 27 O'CONNELL STREET SYDNEY	Internal, within lowest floor level with sleeping area rooms when the roadheader is closest to the receiver
		TANK STREAM BENNELONG SEWER	Monitoring location equivalent to the asset location or on the asset, subject to consultation with Sydney Water
	Turnback stub tunnels (roadheader)	101 PHILLIP STREET SYDNEY	Internal, within lowest floor level with sleeping area rooms when the roadheader is closest to the receiver

9.6.4 Complaints handling

Noise and/ or vibration complaints received and responded to will be managed in accordance with the JCG Community Communication Strategy prepared under Condition D52 and the Overarching Community Communications Strategy.

All noise and vibration related complaints received and responded to will be managed in accordance with the CEMP, the JCG Community Communication Strategy prepared under Condition D52 and the Overarching Community Communications Strategy. Each complaint shall be investigated and where noise and/or vibration levels are established as exceeding the set limits, appropriate amelioration measures shall be put in place to mitigate future occurrences. Management measures may include modification of construction methods such as using smaller equipment and establishment of minimum working distances as mentioned above and/or use of additional temporary screening.

Sydney Metro operate a 24-hour construction complaints line. Enquiries/ complaints may also be received through the project email mailbox (sydneymetrowest@transport.nsw.gov.au) or through the complaints hotline (1800 612 173).

10 Impact classification

The CNVS requires that on completion of a DNVIS, the subjective classification of the noise (and vibration) impact is to be evaluated and documented as:

- Low Impact
- Moderate Impact
- High Impact.

The classifications are to be determined on a case-by-case basis with consideration of the items addressed in the table below and the requirements of SSI 19238057 Condition D23 (b) which defines Low impact.

Table 10.1: Impact classification for the works – Tunnelling

No.	Impact item description	Analysis	Classification
1	The location of the works in relation to noise sensitive receivers (NSRs) with consideration of noise attenuation features such as noise barriers including topographical features (earth-mounds), buildings, dividing fences etc (distance of works from sensitive receiver(s)).	Majority of the NSRs close to Pyrmont cavern worksite are residential receivers. Majority of the NSRs close to Hunter Street cavern worksite are commercial receivers with some hotels.	Low to Moderate
2	The type and sensitivity of the NSRs: - Low Impact: e.g. Commercial buildings/ Scattered Residential (low density) - Moderate Impact: e.g. Standard residential (typical density) - High Impact: e.g. Residential home for the elderly/high density unit blocks/ persistent complainers/ residents deemed to have "construction noise fatigue".	Radio and television studios are located above the main alignment and XP08 and XP09. Recording studios are located near the tunnel alignment and cavern by the Pyrmont station site. A theatre and hotels are located near the tunnel alignment near the Hunter Street site.	Moderate
3	Land use zoning and planning amenity objectives for the area.	Residential, commercial and industrial use in the immediate vicinity between the Bays and Pyrmont, Commercial and hotels and residential use in the immediate vicinity between Pyrmont and Hunter Street.	Low to moderate
4	Construction and architectural design of impacted building, particularly the presence of any existing noise mitigation including that provided under a Noise Abatement Program or required by the ISEPP, Council DCP or other planning instrument.	Along the alignment at Pyrmont there is a mix of commercial and single and multi-storey residential and mixed-use residential receivers with additional façade attenuation. Single occupancy residential or older multi-storey residential are assumed to be standard construction with no extra noise mitigation, with the exception of buildings identified for at-property treatment under the SSI 7485. Along the alignment near Hunter Street there is mostly commercial buildings and some hotels with good façade attenuation.	Low to moderate
5	Existing ambient levels.	Moderate existing ambient noise levels during daytime ($L_{Aeq(15min)}$ 54-59 dB(A)); evening ($L_{Aeq(15min)}$ 51-58 dB(A)); and night ($L_{Aeq(15min)}$ 48-58 dB(A)) at The Bays.	Low
6	The extent of noise exceedance above Noise Management Level.	The tunnelling works will cause noise impacts to receivers located above the tunnel alignment and caverns. Typically impacts will be within 10dB(A) of NMLs but may at times be more than 10dB(A) above NML during the worst-case scenario cross passage and cavern excavation. The predicted levels are calculated at the closest distance to the receiver and the works will move further away with time reducing the actual level.	Low to moderate

No.	Impact item description	Analysis	Classification
7	The likelihood for potential sleep disturbance (as described in the NPfI).	NPfI is not applicable for GBN. Where GBN is above the GBNML at night, impacts will be managed as outlined in Section 9.4.	Low to Moderate
8	The type of and intensity of noise emitted from works (i.e. tonal or impulsive): - Lower Impact: No high noise and/or vibration intensive activities - Moderate Impact: Short/intermittent high noise and/or vibration intensive activities - High Impact: Prolonged high noise and/or vibration intensive activities.	The proposed works consist of 'typical impact', with high noise impact equipment in the form of a rock breaker being used for cross passage excavation. All reasonable and feasible measures will be applied to minimise noise and vibration impacts. Respite periods will be provided for highly noise intensive works as per Section 9.1.	Low to Moderate
9	The duration of any OOHW required.	The 24 hours a day tunnelling works will continue for 16 months across the project. Note that the tunnelling works will not impact the same sensitive receiver for the duration of the work.	Moderate
10	The time frames for any OOHW: - Lower Impact: 6.00 pm till 10.00 pm weekdays 1.00 pm till 10.00pm Saturdays 8.00 am till 6.00 pm Sundays or Public Holidays. - Moderate Impact: 10.00 pm to 7.00 am Weekday Nights 10.00 pm to 8.00 am Saturdays. - High Impact: 6.00 pm to 7.00 am Sundays and Public Holidays.	The tunnelling works are a prescribed activity under condition D23(d) and will be undertaken 24 hours a day. High impact plants such rock breakers will not be used except where required such as cross passages and will not be used outside standard construction hours unless the requirements of Condition D26 are met.	Low to Moderate
11	As a result of noise classification and/or the noise level exceedances at sensitive receivers provided by the DNVIS report, appropriate reasonable and feasible noise mitigation is to be adopted and implemented. For sites where works are predicted to significantly exceed noise goals and impact on receivers for a significant period of time, additional reasonable and feasible noise mitigation measures such as those outlined in Section 5 of the CNVS would be considered if practical to reduce the noise levels and impact on sensitive receivers.	Mitigation measures outlined in Section 9 will be implemented to manage and reduce impacts from the works.	Low

Review of the overall noise impact of the tunnelling works is considered **low to moderate**. The works outside standard construction hours were found to, at times, exceed the GNMLs. This impact will be managed through the mitigation and management measures outlined in Section 9, including suitable community notification regarding potential impacts from the works. Mitigation measures will be implemented to reduce noise levels with the aim of achieving the NMLs and limit the overall noise impact to **low**. Where this is not feasible or reasonable, residual impacts will be managed as outlined in Section 9.4.

Properties at risk of vibration impact have been identified through the conservative screening process set out in the CNVS [1]. Vibration significant works will be managed in accordance with Section 9. The overall vibration impact of the tunnelling works is considered **low**.

11 Conclusion

In conclusion, construction works associated with the Project-wide tunnelling excavation have been described in this DNVIS to identify potential environmental risks associated with construction noise (ground-borne) and vibration. Construction ground-borne noise and vibration objectives have been established consistent with the conditions of approval for the Project and the EIS.

Construction airborne noise

Airborne noise impacts have been assessed as negligible.

Construction ground-borne noise

No tunnelling activity is predicted to generate internal noise levels at any sensitive receiver greater than $L_{Aeq(15\ minute)}$ 60 dB(A), including during cross passage excavation. Some receivers will be ground-borne noise affected by different stages of tunnelling.

The mainline tunnel excavation by TBM will be undertaken 24 hours a day as prescribed tunnelling works for the duration of the works. The predicted levels indicate that there will be construction ground-borne noise affected residential receivers during the out-of-hours tunnelling. The predicted levels are calculated at the closest distance to the receivers from the works. As the tunnelling progresses the works will move further away from the receivers and impacts will not be sustained. Residential receivers are unlikely to experience ground-borne noise levels from TBM excavation above 35 dB(A) for more than 2 consecutive nights.

Residential receivers and hotels are predicted to be construction ground-borne noise affected by the excavation of cross passages outside standard construction hours. Cross passage excavation will be limited to standard construction hours, except for XP05, XP11 and XP12 where excavation may occur during the evening and night period, and XP10 where excavation may occur during the evening period.

Residential receivers will be construction ground-borne noise affected (within 10 dB of the NML) by roadheader excavation of the Pyrmont caverns, nozzles and adits during the OOH evening and night periods.

There are no residential receivers construction ground-borne noise affected by roadheader excavation of the Hunter Street caverns and turnback stub tunnels, however there are five hotels that will experience ground-borne noise levels above the night NMLs. 24 hour excavation of the caverns, turnback stub tunnels, nozzles and adits by roadheader will be managed to satisfy the requirement of Condition D23(d).

Noise mitigation and management measures, including noise monitoring requirements, have been presented in Section 9 to aid in providing additional noise reduction benefits where noise levels are above the NMLs.

Construction vibration

No building/structures have been identified as within the recommended minimum working distance for cosmetic damage during the works. No residential receivers have been identified as within the minimum working distance for human comfort during the works.

Potential vibration impacts to Sydney Water assets have been assessed in Section 7.2.4. Monitoring will be undertaken when roadheader tunnelling is within the (conservative) recommended minimum working distance of 5 metres, to determine site specific conditions. Where plant roadheader tunnelling is required to operate within site specific minimum working distances, the construction methodology and/ or the vibration monitoring regime will be revised to ensure the vibration impact is managed to within the DIN 4150-3 guideline values threshold vibration limit.

Vibration mitigation and management measures have been presented in Section 9 to reduce the risk of damage to buildings near the worksites and to manage annoyance from construction vibration.

Construction traffic

There is no assessment of construction traffic noise in this DNVIS. Construction generated traffic related to the public road network, is addressed in the separate DNVISs prepared for surface works at The Bays, Pyrmont Station and Hunter Street Station worksites (ref: TM372-02-1-01F01 SMW-ETP_DNVIS-TBY; TM372-02-1-02F01 SMW-ETP_DNVIS-PYR; and TM372-02-1-03F01 SMW-ETP_DNVIS-HUN respectively).

Impact classification

The overall noise and vibration impact of The Bays works is considered **low to moderate**.

Careful management of noise and vibration generating activities will reduce the impact of the works.

References

[1] Sydney Metro Construction Noise and Vibration Standard Version 4.3 (SM-20-00098866) – 4 November 2020

[2] Transport for NSW Construction Noise and Vibration Strategy (ref: ST-157/4.1) April 2019

[3] Sydney Metro West Out-of-hours Work Protocol (in progress)

[4] SLR Consulting Australia Pty Ltd 2021 Sydney Metro West - Major civil construction between The Bays and Sydney CBD - Technical Paper 2: Noise and Vibration October 2020

[5] Sydney Metro 2022 Sydney Metro West – Submissions Report - Major civil construction between The Bays and Sydney CBD

[6] Department of Environment and Climate Change 2009 NSW Interim Construction Noise Guideline (ICNG)

[7] Environment Protection Authority 2017 NSW Noise Policy for Industry (NPfI)

[8] Department of Environment, Climate Change and Water 2011 NSW Road Noise Policy (RNP)

[9] Department of Environment Conservation NSW 2006 Assessing Vibration; a technical guideline

[10] Environment Protection Authority 2000 NSW Industrial Noise Policy (INP)

[11] British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)

[12] Australian Standard AS 2187.2-2006 Explosives - Storage and Use - Use of Explosives

[13] British Standard BS 7385 Part2-1993, Evaluation and measurements for vibration in buildings Part 2

[14] German Standard DIN 4150-3: 2016-12, Structural vibration - Effects of vibration on structures, December 2016

[15] ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control, pp47.39-47.40

[16] Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration, p16

[17] Australian Standard AS/NZS 2107:2000 *Acoustics - Recommended design sound levels and reverberation times for building interiors*

[18] Sydney Water 2021 Procedure - Specialist Engineering Assessment, Doc no. D0001870, Version 1, Issue date 19/02/2021

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

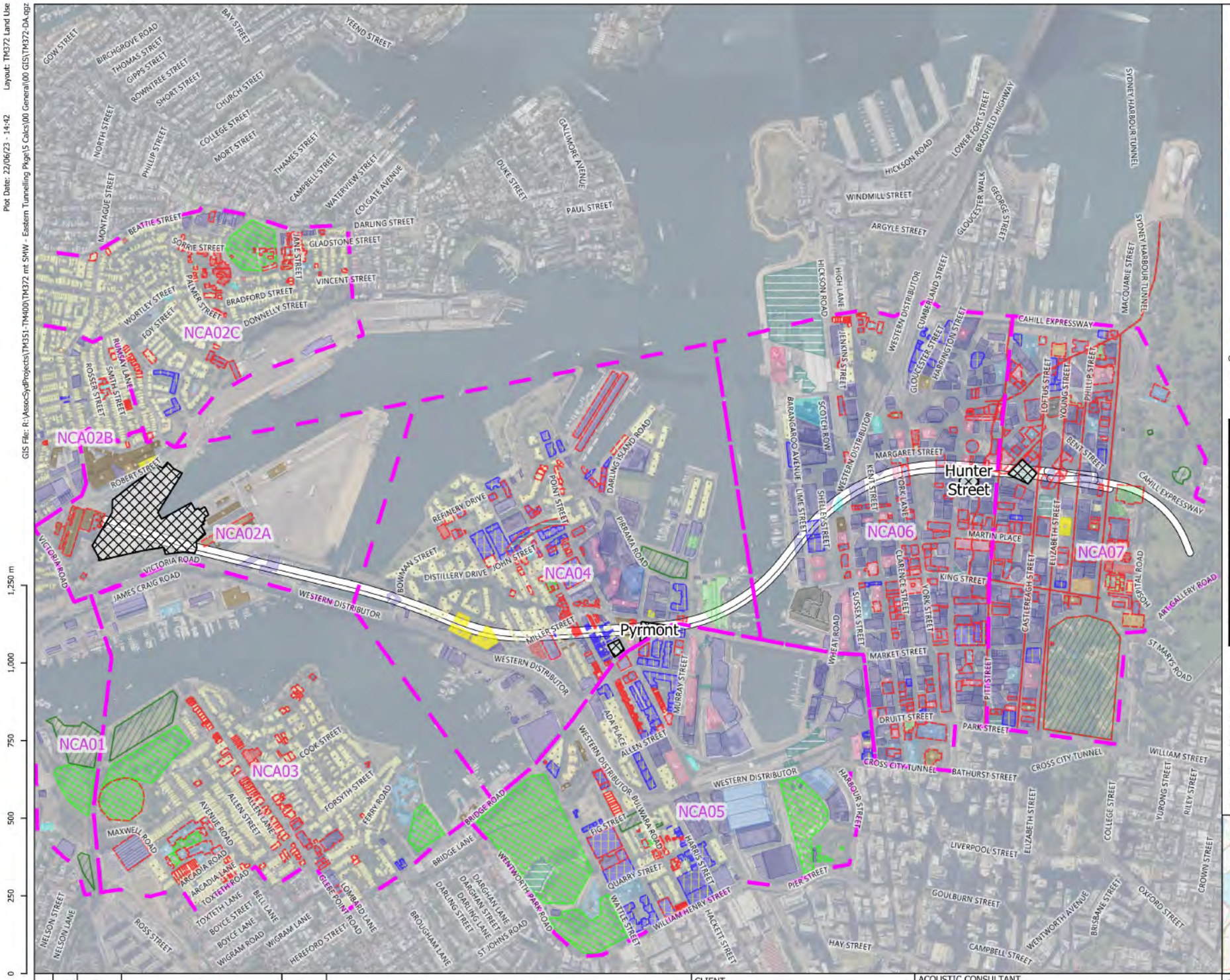
ABN	Airborne Noise
Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Attenuation	The reduction in the level of sound or vibration.
AVTG	Assessing Vibration – a technical guideline (DEC 2006)
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
CEMP	Construction Environmental Management Plan
CNVS	Construction Noise and Vibration Standard (Sydney Metro 2021)
CoA	Condition of Approval (SSI 19238057)
Condition	Condition of Approval (SSI 19238057)
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
DEC	Department of Environment and Conservation (now EPA)

DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)
DNVIS	Detailed Noise and Vibration Impact Statement
DP&E	NSW Department of Planning and Environment
ECRTN	Environmental Criteria for Road Traffic Noise (EPA 1999)
EIS	Environmental Impacts Statement
EPA	NSW Environment Protection Authority
ETP	Sydney Metro West – Eastern Tunnelling Package
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
GBN	Ground-borne noise
GNML	Ground-borne Noise Management Level
GIS	Geographic Information System
ICNG	Interim Construction Noise Guideline (DECC, 2009)
INP	NSW Industrial Noise Policy (EPA, 2000)
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
JCG	John Holland CPB Contractors Ghella Joint Venture
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
MWD	Minimum Working Distance
NCA	Noise Catchment Area
NML	Noise management level
NPfI	Noise Policy for Industry
NSR	Noise Sensitive Receiver
OEH	Office of Environment and Heritage
OOHW	Out-of-Hours Works – work completed outside of standard construction hours

OSR	Other Sensitive Receiver
PPV	Peak Particle Velocity
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
REMM	Revised Environmental Mitigation Measure
RNP	NSW Road Noise Policy (DECCW 2011)
ROL	Road Occupancy Licence
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level (SPL)	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level (SWP)	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
SSI	State Significant Infrastructure
Standard construction hours	Hours during which construction work is permitted by the conditions of approval and the EPL.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Sensitive receivers and noise management levels

B.1 NCAs and sensitive receiver identification



LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library/Museum
- Childcare
- Educational
- Theatre/Auditorium
- Cinema
- Laboratory
- Flight simulator
- Horse Stable
- Recreational - Passive
- Recreational - Active
- Other
- Heritage

- NCAs
- Tunnel alignment
- Worksites

NCA	NML DS	NML DO	NML E	NML N
NCA02C	59	54	54	51
NCA01	61	56	56	50
NCA03	58	53	52	44
NCA04	60	55	52	50
NCA05	62	57	54	51
NCA06	71	66	61	57
NCA07	71	66	61	57
NCA02A	53	48	48	40
NCA02B	52	47	47	43

NCA: Noise Catchment Area
NML: Noise Management Level
D(S): Standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday
D(O): Out-of-hours day period from 8 am to 6 pm Sunday and Public holidays - OOHW P1
E: Evening period from 7 pm to 10 pm Monday to Sundy - OOHW P1
N: Night-time period from 10 pm to 7am Monday to Friday, from 10 pm to 8 am Saturday, Sunday and Public holidays - OOHW P1

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	22/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 150 300 450 600 750 m
1:12,000
FULL SIZE A3
NOTE: Do not scale from this drawing.

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Land Use, Worksites and NCAs

Sheet 0 of 0

Land-Use file revision_date: rX_dd/mm/yy
Plot Date: 22/06/23 - 14:42 Layout: TM372 Land Use
GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-DA.qgz

B.2 NCAs and noise management levels

Table B1: Noise Sensitive Receivers and Construction Noise Management Levels (groundborne noise) **TUNNELLING**

NCA	Receiver Type	Groundborne NMLs based on ICNG (internal) NMLDS	NMLDO	NMLE	NMLN			Comments
Residential receivers								
All	All residential receivers	(50)*	(50)*	40	35			Source: ICNG, CNVS (NMLE and NMLN only)
		** Daytime ground-borne noise NMLs are not specified in the ICNG or Sydney Metro CNVS. Human comfort vibration limit applies during the day. 50 dB(A) used as screening guideline as this correlates to human comfort vibration limit.* ***EIS Daytime ground-borne NML 45 dB(A)****, which were based on preceding Sydney Metro planning applications, also considered for consistency.*						
ICNG 'Other sensitive' receivers (NML applicable when in use)								
Classrooms at schools and other educational institutions		45	45	45	45	-	-	Source: ICNG
Hospital wards and operating theatres		45	45	45	45	-	-	Source: ICNG
Places of worship		45	45	45	45	-	-	Source: ICNG
Commercial premises (including offices and retail outlets)		50	50	50	50	-	-	Source: ICNG, assuming a conservative façade loss of 20 dB(A)
Industrial premises		55	55	55	55	-	-	Source: ICNG, assuming a conservative façade loss of 20 dB(A)
Non-ICNG 'Other sensitive' receivers (GBNML applicable when in use)								
Hotel - daytime and evening (non-sleeping areas)		50	50	50	50	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Hotel - night-time (sleeping areas)		40	40	40	40	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Café/ Bar/ Restaurant		50	50	50	50	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Childcare centre (indoor sleeping areas)		45	45	45	45	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Childcare centre (play areas)		55	55	55	55	-	-	Source: CNVS Section 2.2.1, assuming a conservative façade loss of 10 dB(A)
Public Building		50	50	50	50	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Studio building (music recording studio)		25	25	25	25	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Studio building (film or television studio)		30	30	30	30	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Theatre/ Auditorium		30	30	30	30	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'

Notes: D(S): standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday
D(O): out-of-hours day period from 8 am to 6 pm Sunday and Public holidays - OOHW P1
E: evening period from 6 pm to 10 pm Monday to Sunday - OOHW P1
N: night period from 22:00 to 07:00 Monday to Friday, and from 22:00 to 08:00 Saturday, Sunday and Public holidays - OOHW P2

APPENDIX C Construction timetable/ activities/ management

C.1 Construction timetable/activities/equipment

Table C1-1: Construction timetable/ activities/ equipment **TUNNELLING**

Activity/ Work Area	Aspect	Plant/ Equipment (as provided by client)	Day	Evening	Night	Timing of Activity		Notes
			7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	Duration	
Project wide	Mainline tunnel	Earth Pressure Balance Tunnel Boring Machine	2	2	2	Apr-24	Jan-25	Assumed advance rate of 20m per day per TBM
								Tunnel crown RL based on 3.5 m above tunnel control line (SOP)(see Figure C1-1)
	Cross passages	Brokk robotic excavator 5-15t with rock hammer	1	(1)	(1)	Oct-24	Jul-25	Advance at an assumed rate of 0.5m per day (approx. 12 days for a standard cross passage).
		Bolting rig Robodrill 525	1	(1)	(1)	Mar-24	4 weeks	Ten cross passages in total, located approx. every 200 to 250 metres
		Shotcrete rig (Potenza)	1	1	1			Cross passage crown RL based mainline tunnel crown at cross passage location
		-						
Pyrmont Station	Station Cavern	Road Header 1,000V Electric	3	3	3	Nov-23	Oct-24	Assumed advance rate: Heading 20m per week; Bench 40m per week.
		Bolting rig Robodrill 525	2	2	2			Heading RL based on tunnel crown 12.5 m above tunnel Working Point (WP) line (see Figure C1-2)
		Shotcrete rig (Potenza)	2	2	2			Bench 1 RL based on 8.5 m below tunnel crown
								Bench 2 RL based on 11.5 m below tunnel crown
	Crossover cavern	Road Header 1,000V Electric	3	3	3	Jan-23	Oct-24	Assumed advance rate: Heading 20m per week; Bench 40m per week.
		Bolting rig Robodrill 525	2	2	2			Heading RL based on tunnel crown 12.9 m above tunnel Working Point (WP) line (see Figure C1-2)
		Shotcrete rig (Potenza)	2	2	2			Bench 1 RL based on 8.5 m below tunnel crown
	Pedestrian and Service Adits	Road Header 1,000V Electric	1	1	1	Nov-23	Oct-24	Assumed 1 roadheader per tunnel
		Bolting rig Robodrill 525	1	1	1			Assumed advance rate: Heading 20m per week.
		Shotcrete rig (Potenza)	1	1	1			Nozzle - Heading RL based on tunnel crown 9.7 m above SOP (see Figure C1-2)
								Stub - Heading RL based on tunnel crown 4.0 m above SOP (see Figure C1-2)
	Nozzles and Stub Tunnels	Road Header 1,000V Electric	1	1	1	Nov-23	Oct-24	Assumed 1 roadheader per tunnel
		Bolting rig Robodrill 525	1	1	1			Assumed advance rate: Heading 20m per week.
		Shotcrete rig (Potenza)	1	1	1			Nozzle - Heading RL based on tunnel crown 9.7 m above SOP (see Figure C1-2)
								Stub - Heading RL based on tunnel crown 4.0 m above SOP (see Figure C1-2)
Hunter Street Station	Station Cavern (and adits)	Road Header 1,000V Electric	2	2	2	Jul-23	Oct-24	Assumed advance rate: Heading 20m per week; Bench 40m per week.
		Bolting rig Robodrill 525	2	2	2			Heading RL based on tunnel crown 12.5 m above tunnel Working Point (WP) line (see Figure C1-2)
		Shotcrete rig (Potenza)	2	2	2			Bench 1 RL based on 8.5 m below tunnel crown
								Bench 2 RL based on 11.5 m below tunnel crown
	Turnback Stub Tunnels	Road Header 1,000V Electric	2	2	2	Jul-23	Oct-24	Assumed 1 roadheader per tunnel
	TB1	Bolting rig Robodrill 525	2	2	2			Assumed advance rate: Heading 20m per week; Bench 40m per week.
	TB2	Shotcrete rig (Potenza)	2	2	2			TB1 Heading RL based on tunnel crown 3.25 m above running tunnel axis. No bench.
	TB4							TB2 Heading RL based on tunnel crown 4.58 m above running tunnel axis. No bench.
								TB4 Heading RL based on tunnel crown 8.51 m above running tunnel axis.
	TB5							TB4 Bench 1 RL based on running tunnel axis
								TB5 Heading RL based on tunnel crown 5.93 m above running tunnel axis. No Bench.
	TB6							TB5 Bench 1 RL based on running tunnel axis
								TB6 Heading RL based on tunnel crown 8.16 m above running tunnel axis. No Bench.
								TB6 Bench 1 RL based on running tunnel axis

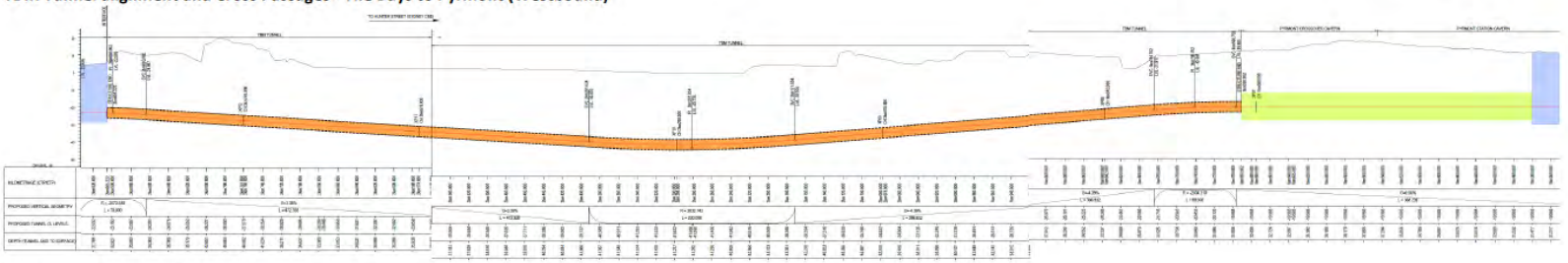
Table C1-3: Construction timetable (indicative)

TUNNELLING - MAINLINE TUNNEL AND CROSS PASSAGES

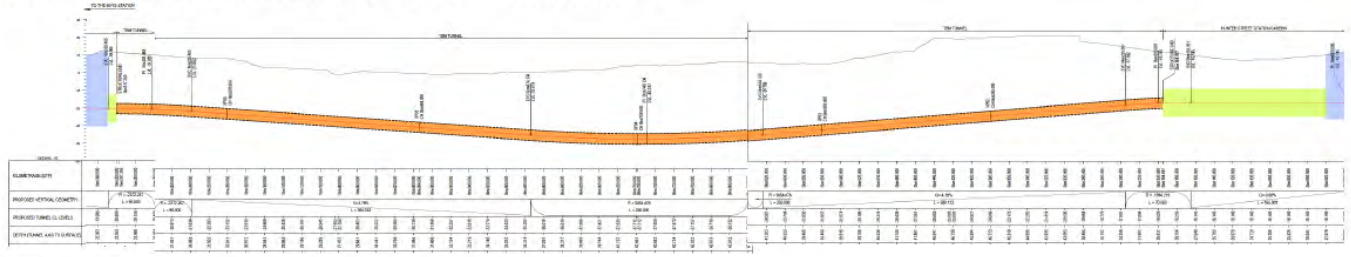
Activity/ Work Area	Aspect	2023								2024												2025											
		May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December
Project wide	Mainline tunnel (TBM)																																
	The Bays to Pyrmont																																
	Pyrmont to Hunter Street																																
	Cross passages																																
	The Bays to Pyrmont																																
	Pyrmont to Hunter Street																																
Pyrmont Station	Station Cavern																																
	Crossover cavern																																
	Pedestrian and Service Adits																																
	Nozzles and Stub Tunnels																																
Hunter Street Station	Station Cavern (and adits)																																
	Turnback Stub Tunnels																																

Figure C1-1: Tunnel Profiles

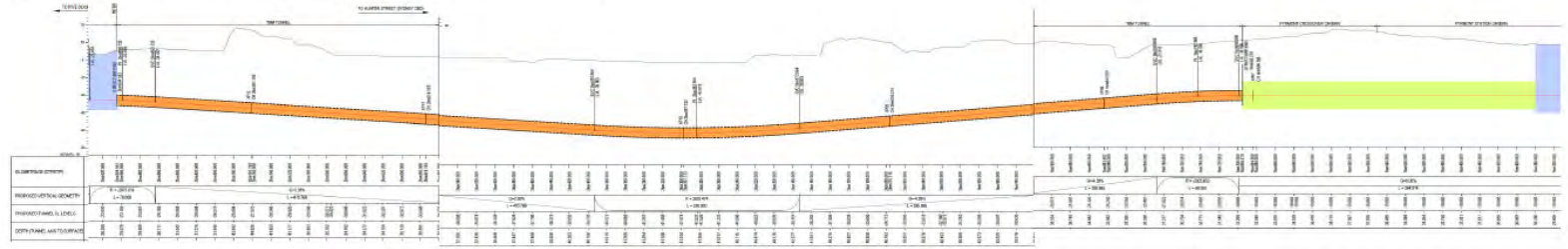
TBM Tunnel alignment and Cross Passages - The Bays to Pyrmont (Westbound)



TBM Tunnel alignment and Cross Passages - Pyrmont to Hunter Street (Westbound)



TBM Tunnel alignment and Cross Passages - The Bays to Pyrmont (Eastbound)



TBM Tunnel alignment and Cross Passages - Pyrmont to Hunter Street (Eastbound)

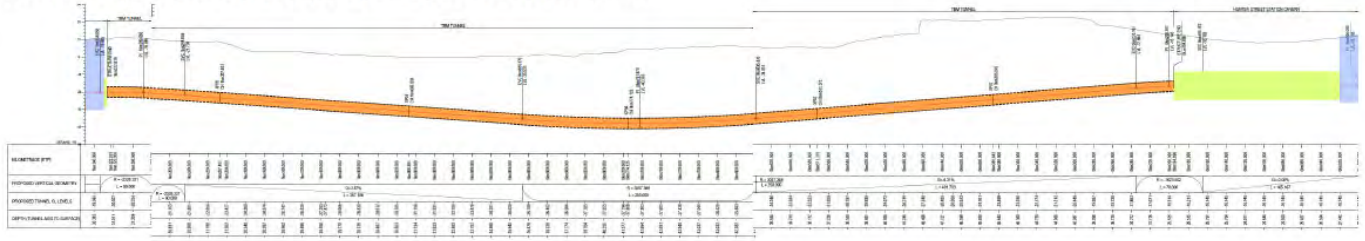
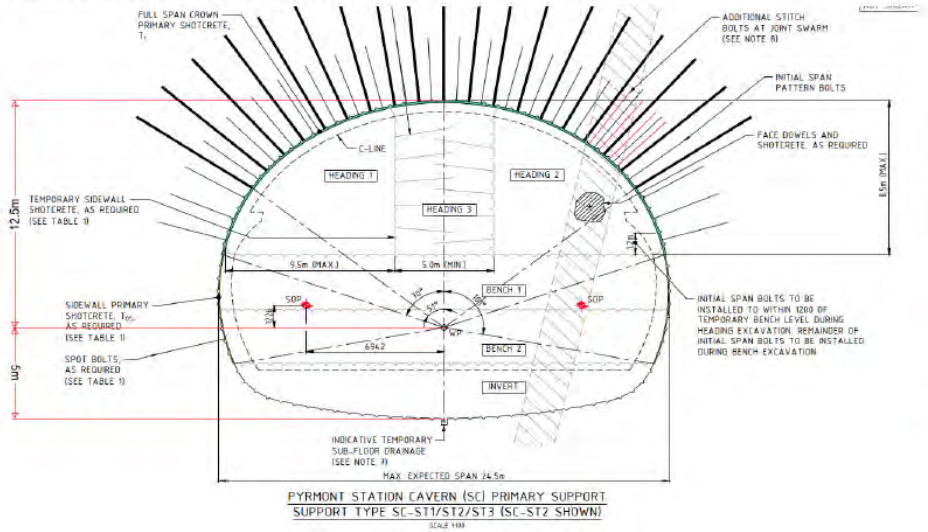
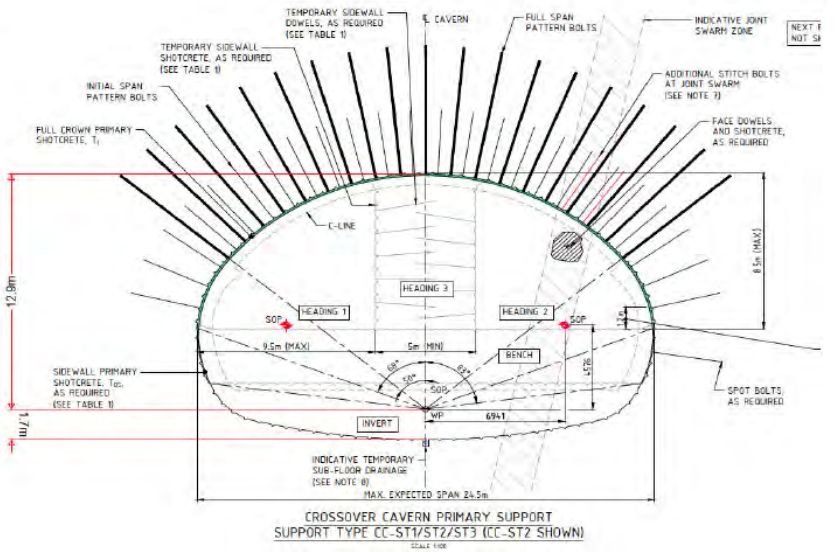


Figure C1-2: Tunnel Profiles

Pyrmont Station Cavern and Crossover Cavern

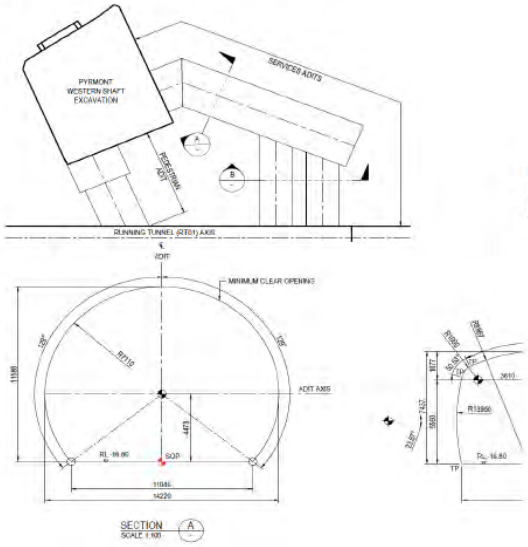


PYRMONT STATION CAVERN (SC) PRIMARY SUPPORT
SUPPORT TYPE SC-ST1/ST2/ST3 (SC-ST2 SHOWN)

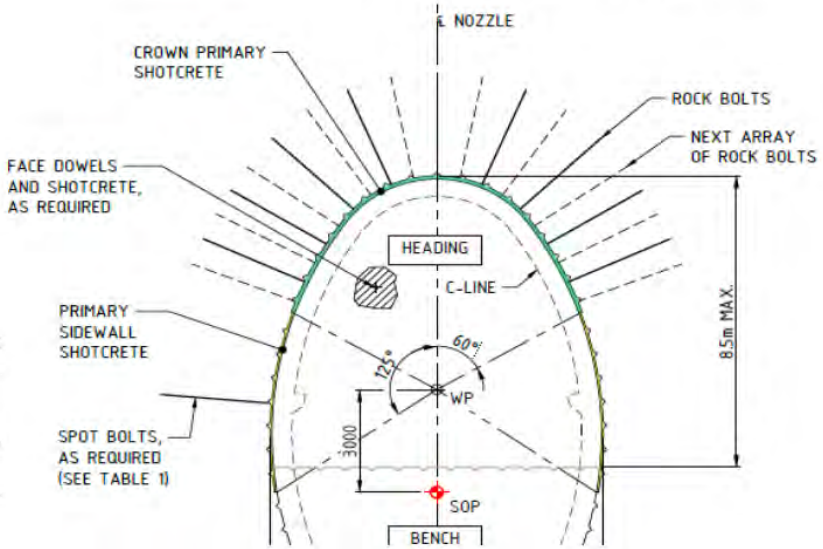


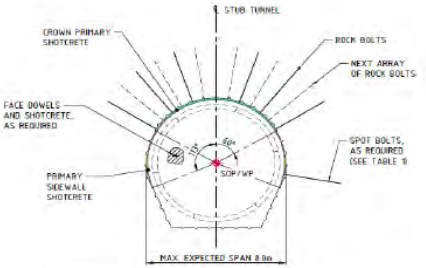
CROSSOVER CAVERN PRIMARY SUPPORT
SUPPORT TYPE CC-ST1/ST2/ST3 (CC-ST2 SHOWN)

Pyrmont Station Pedestrian and Service Adits



Pyrmont Station Nozzle and Stub Tunnels

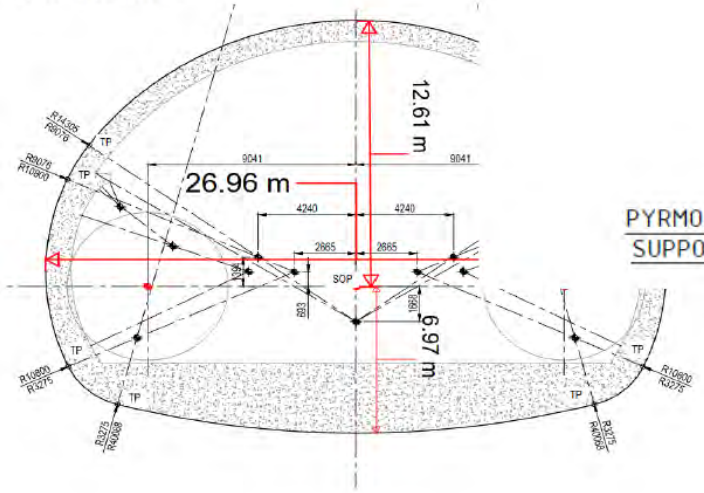




PYRMONT STATION STUB TUNNEL (ST) PRIMARY SUPPORT
SUPPORT TYPE ST-ST1/ST2/ST3 (ST-ST2 SHOWN)

Figure C1-3: Tunnel Profiles

Hunter Street Station Cavern



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PROFILE SCB1 - TYPE 3
A-LINE SETOUT
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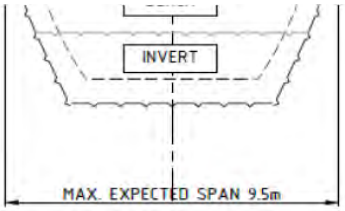

PYRMONT STATION NOZZLE (NZ) PRIMARY SUPPORT
SUPPORT TYPE NZ-ST1/ST2/ST3 (NZ-ST2 SHOWN)
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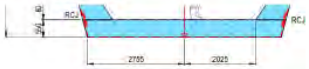
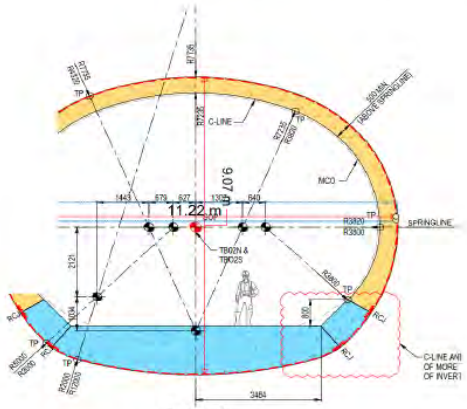


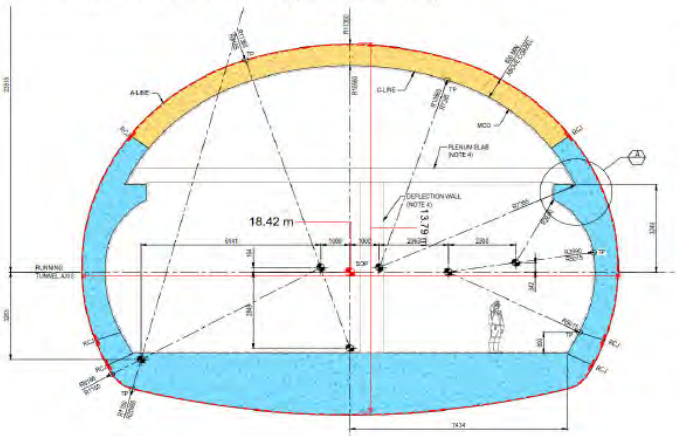
TUNNEL TB1-S
C-LINE AND A-LINE SETOUT
SCALE 1:50

TUNNELLING - HUNTER STREET STATION

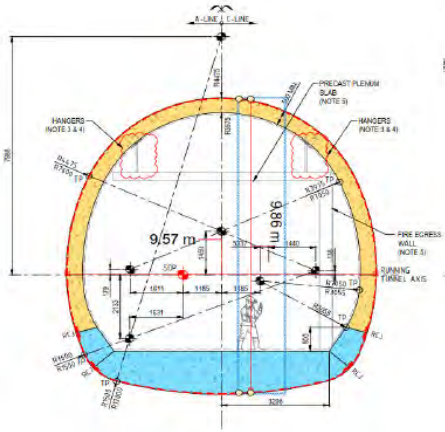


TUNNEL TB2
C-LINE AND A-LINE SETOUT
SCALE 1:50

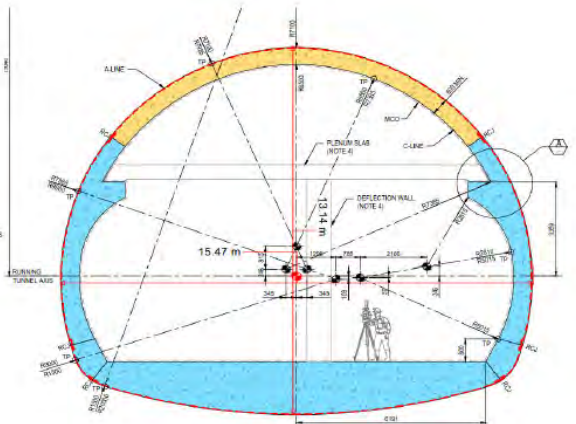
Hunter Street Turnback Stub Tunnels (TB4, TB5 and TB6)



CAVERN TB4 (WEST)
C-LINE AND A-LINE SETOUT
SCALE 1:100



TUNNEL TB5
C-LINE & A-LINE SETOUT
SCALE 1:50



CAVERN TB6
C-LINE & A-LINE SETOUT
SCALE 1:50

APPENDIX D Construction airborne noise impacts

Airborne noise impacts not applicable to this DNVIS.

APPENDIX E Construction ground-borne noise impacts

E.1 Predicted ground-borne noise levels

The detailed predicted levels have been provided to JCG in a spreadsheet table to more adequately mitigate and manage potential noise impacts.

E.2 Number of receivers above NMLs

The number of exceedances has been provided to JCG in a spreadsheet table.

E.3 Additional management measures

The additional management measures have been provided to JCG in a spreadsheet table to more adequately mitigate and manage potential noise impacts.

E.4 Project-wide – GBN from tunnelling works

Plot Date: 18/08/23 - 09:52 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Eastbound Tunnel
- Station Shaft Footprint

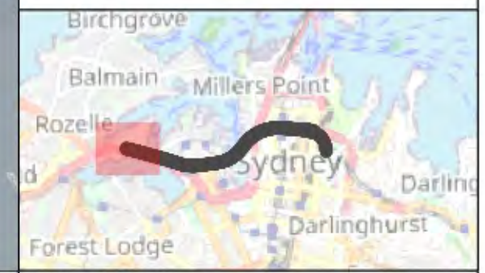
Maximum GBN levels ppv(mm/s) during TBM operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.



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r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Crown excavation (TBM)

Plot Date: 18/08/23 - 09:52 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Eastbound Tunnel
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during TBM operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
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r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Crown excavation (TBM)

Plot Date: 18/08/23 - 09:52 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Eastbound Tunnel
- Station Shaft Footprint

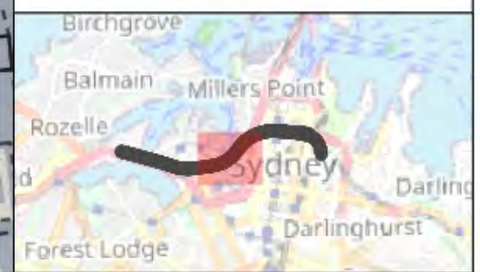
Maximum GBN levels ppv(mm/s) during TBM operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.



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r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

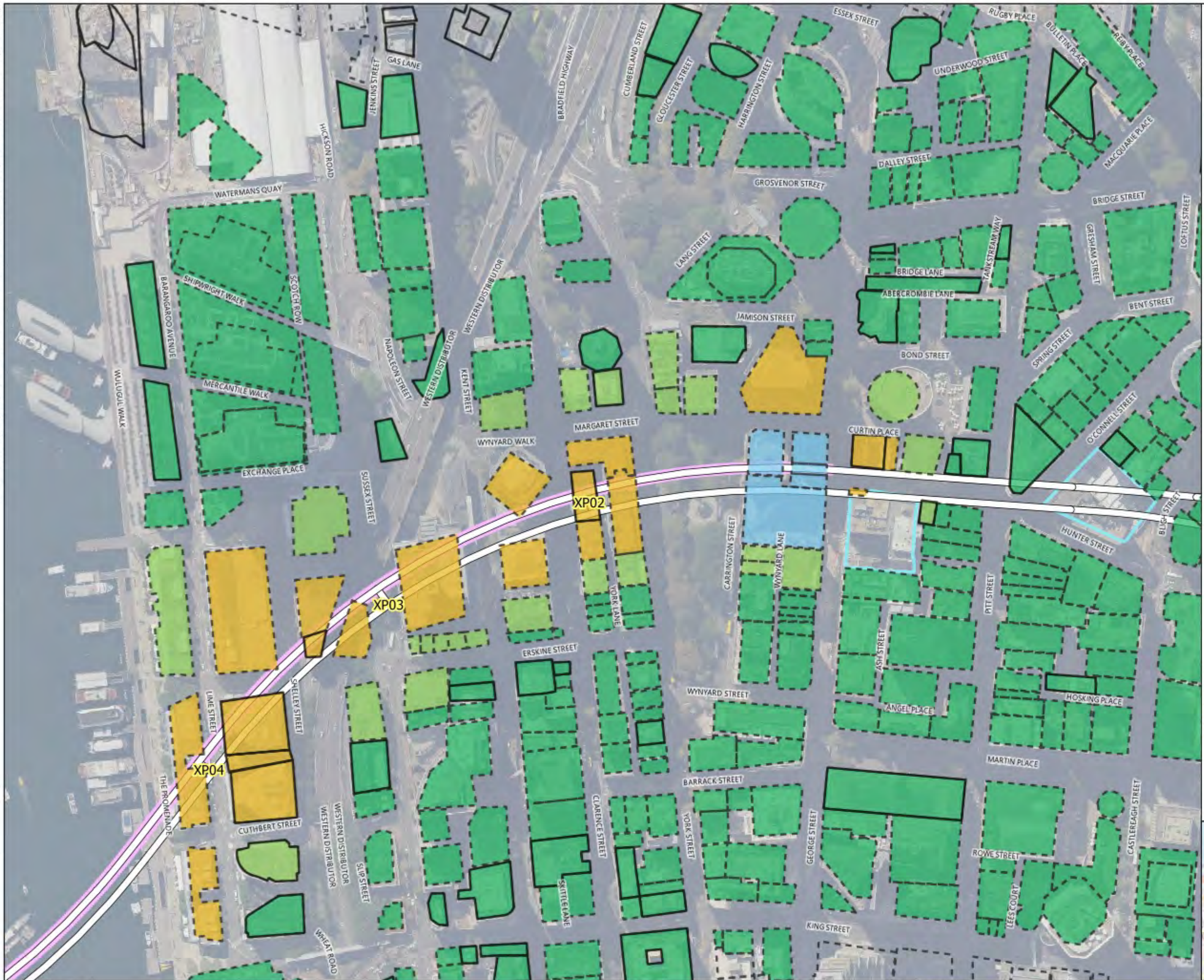
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Crown excavation (TBM)

Plot Date: 18/08/23 - 09:52 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Eastbound Tunnel
- Station Shaft Footprint

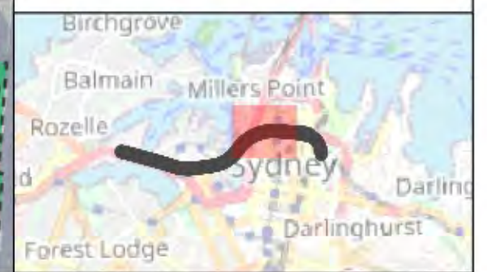
Maximum GBN levels ppv(mm/s) during TBM operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.



REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Crown excavation (TBM)

Plot Date: 18/08/23 - 09:52 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Westbound Tunnel
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during TBM operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
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..	..	..	..	..
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

JOHN HOLLAND CPB Ghella

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Crown excavation (TBM)

Plot Date: 18/08/23 - 09:53 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Westbound Tunnel
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during TBM operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Crown excavation (TBM)

Plot Date: 18/08/23 - 09:53 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Westbound Tunnel
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during TBM operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
..	..	..	..	..
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

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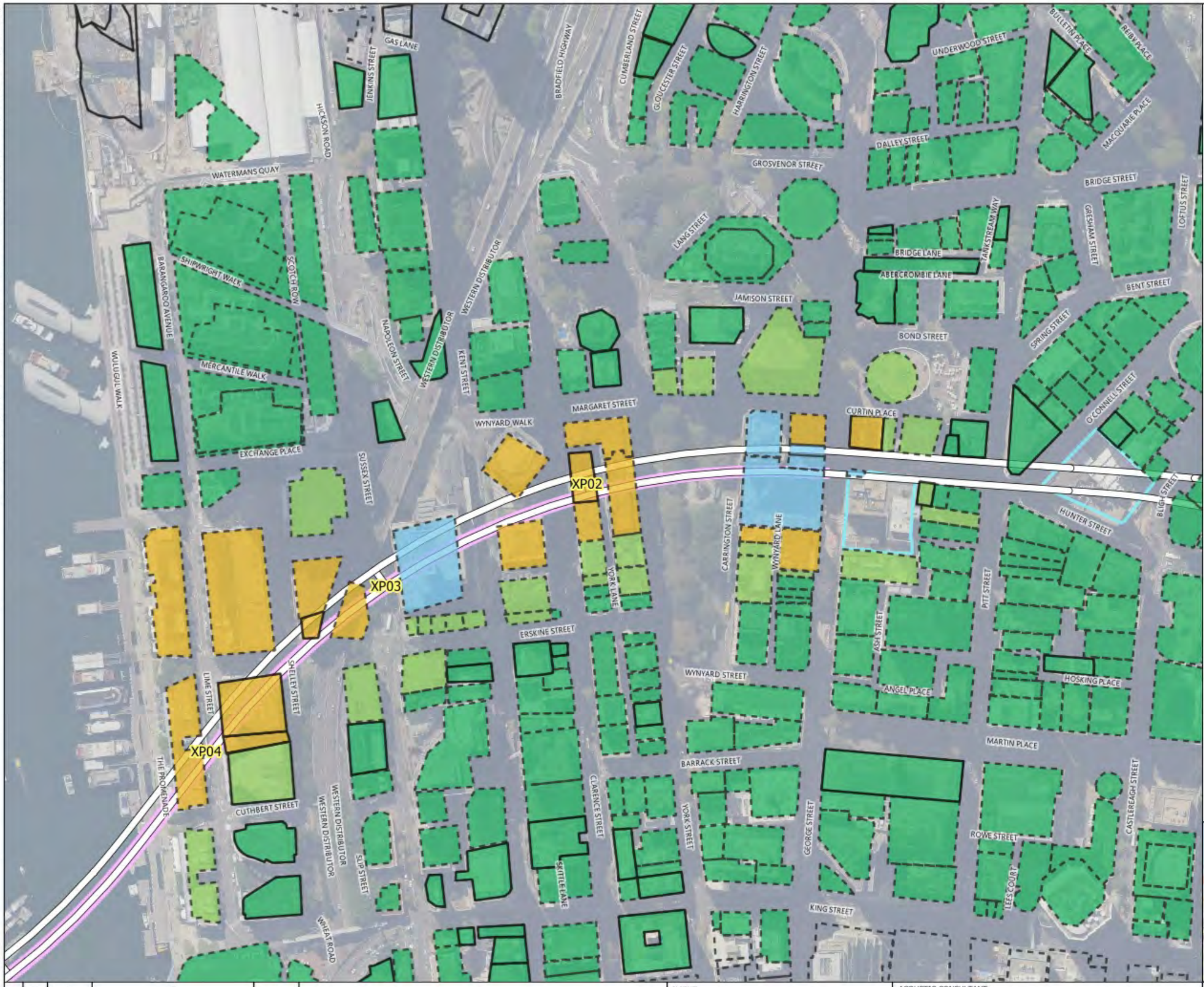
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Crown excavation (TBM)

Plot Date: 18/08/23 - 09:53 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Westbound Tunnel
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during TBM operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
..	..	..	..	..
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
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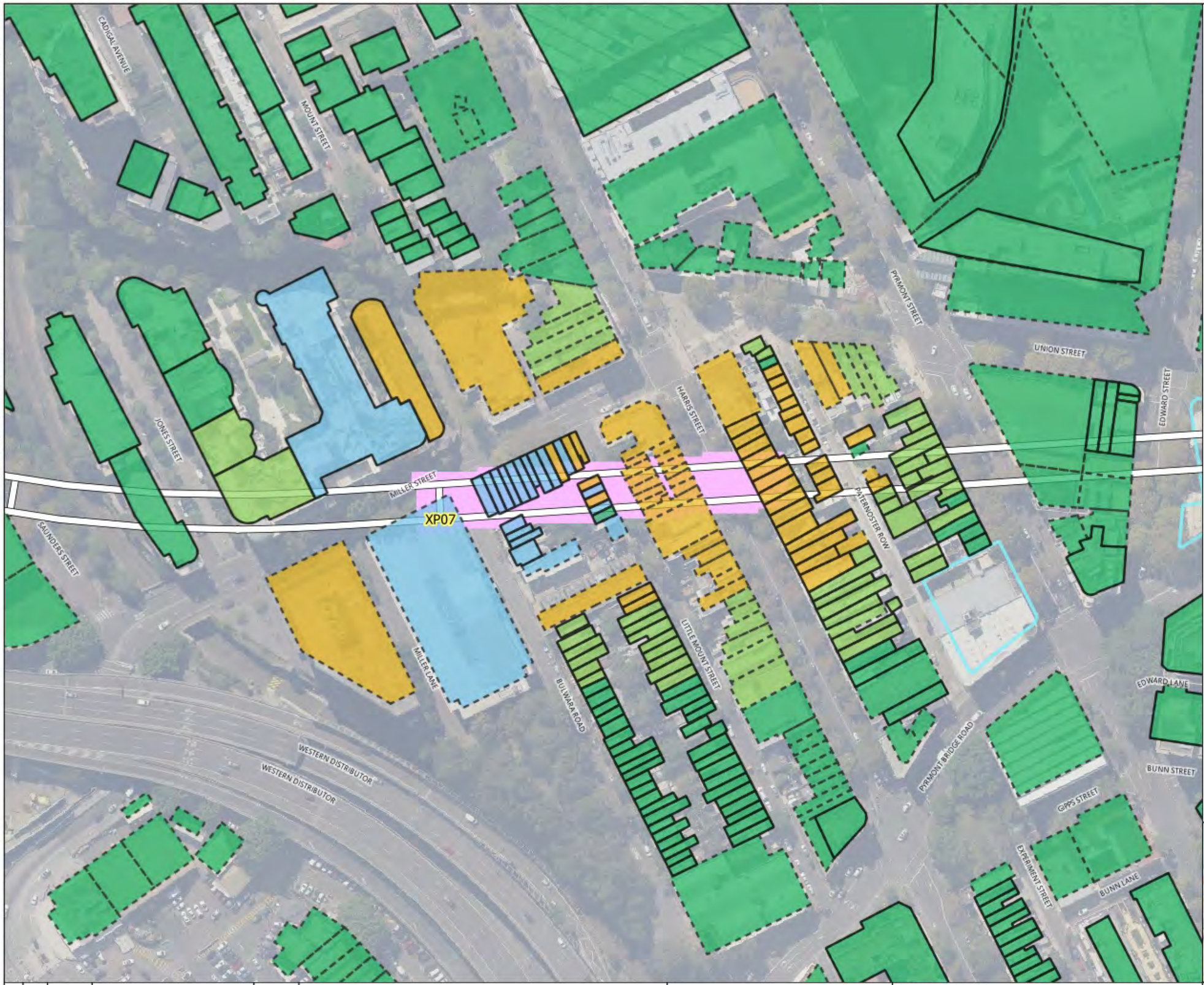
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Crown excavation (TBM)

Plot Date: 18/08/23 - 09:53 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Crossover Cavern
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

A3 Original

Co-ordinate System: MGA Zone 56

NOTE: Do not scale from this drawing.

CLIENT

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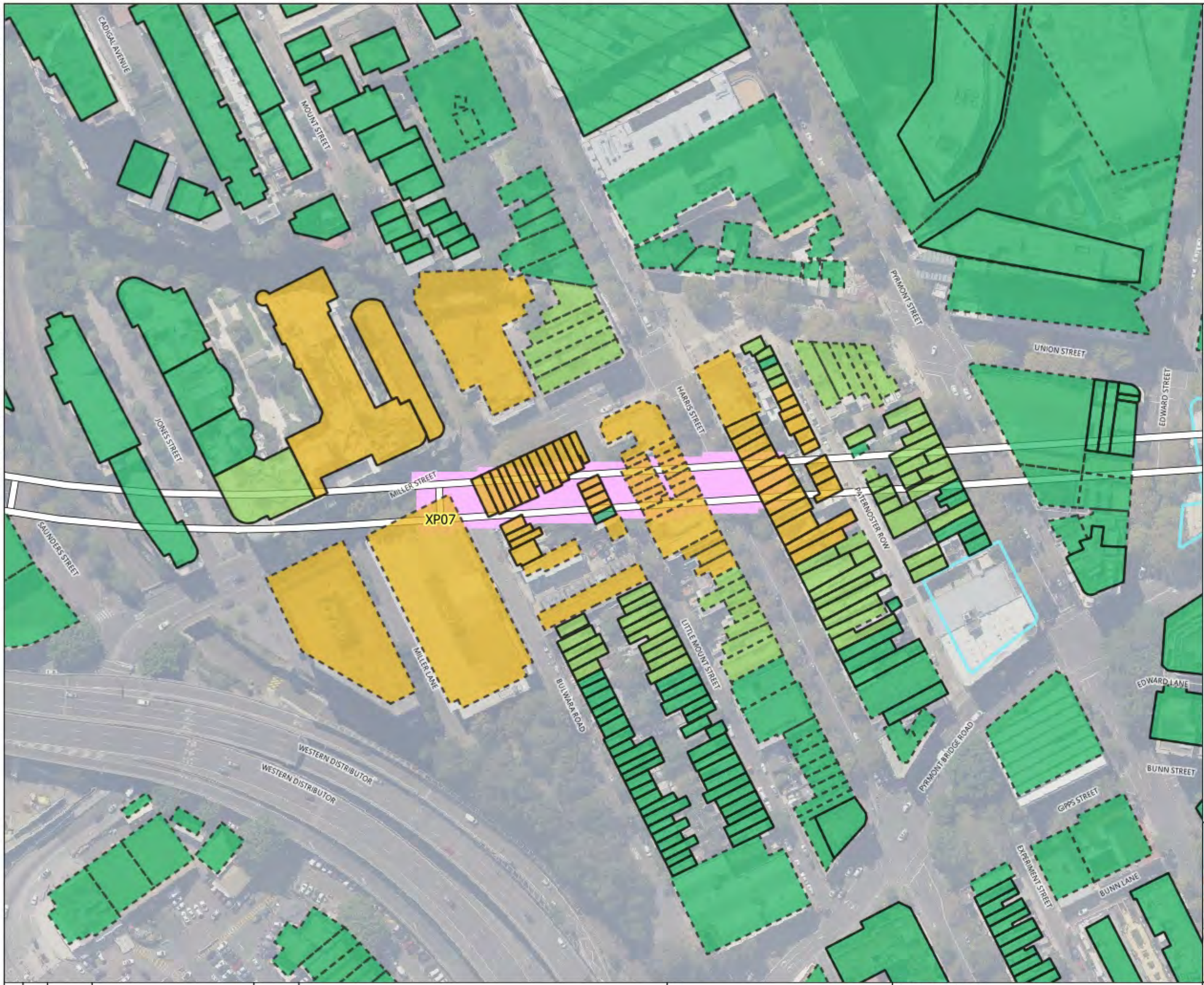
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:53 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Crossover Cavern
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

A3 Original

Co-ordinate System: MGA Zone 56

NOTE: Do not scale from this drawing.

CLIENT

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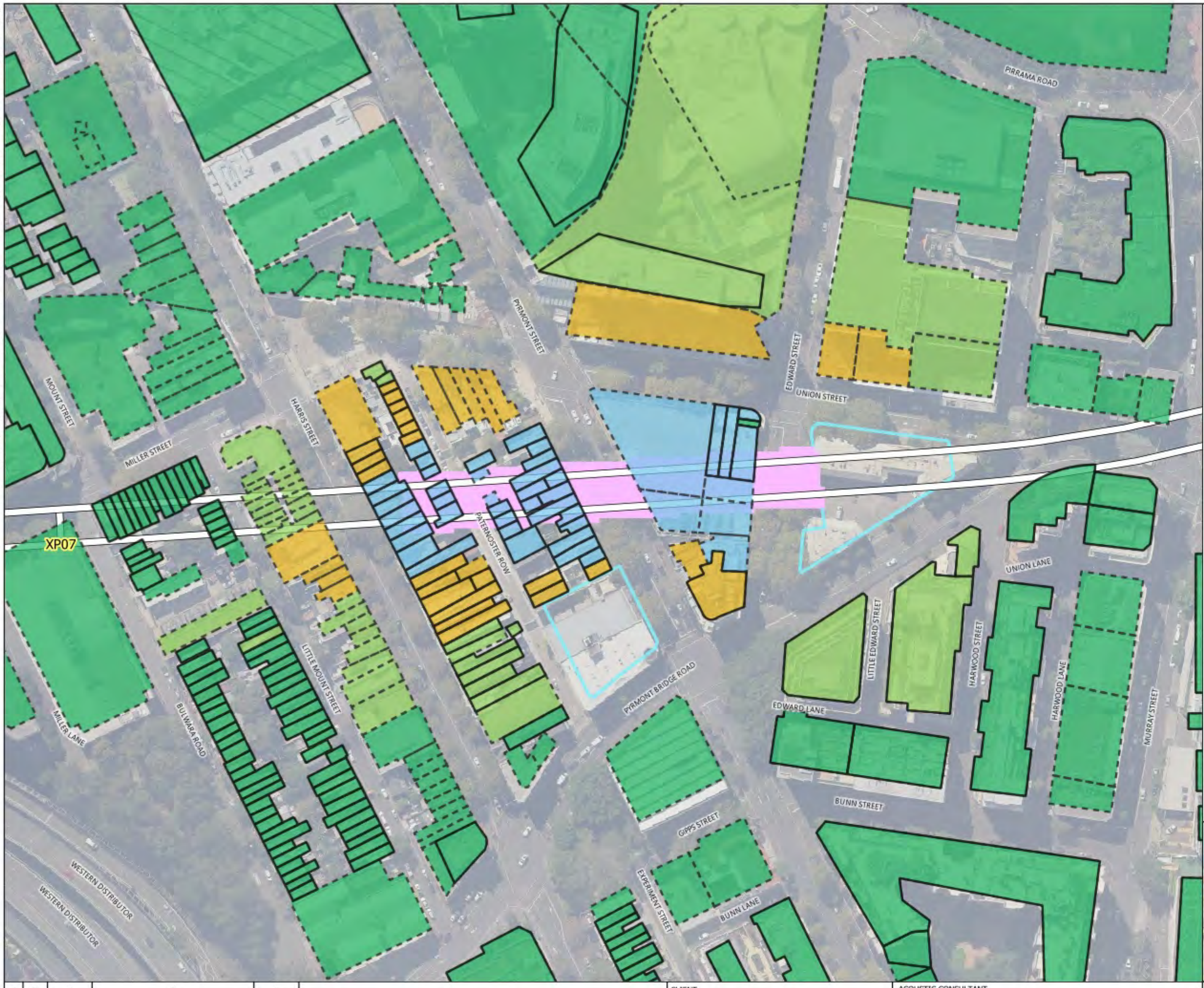
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Bencing 1 excavation (Roadheader)

Plot Date: 18/08/23 - 09:53 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Station Cavern
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

0 50 100 150 m

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

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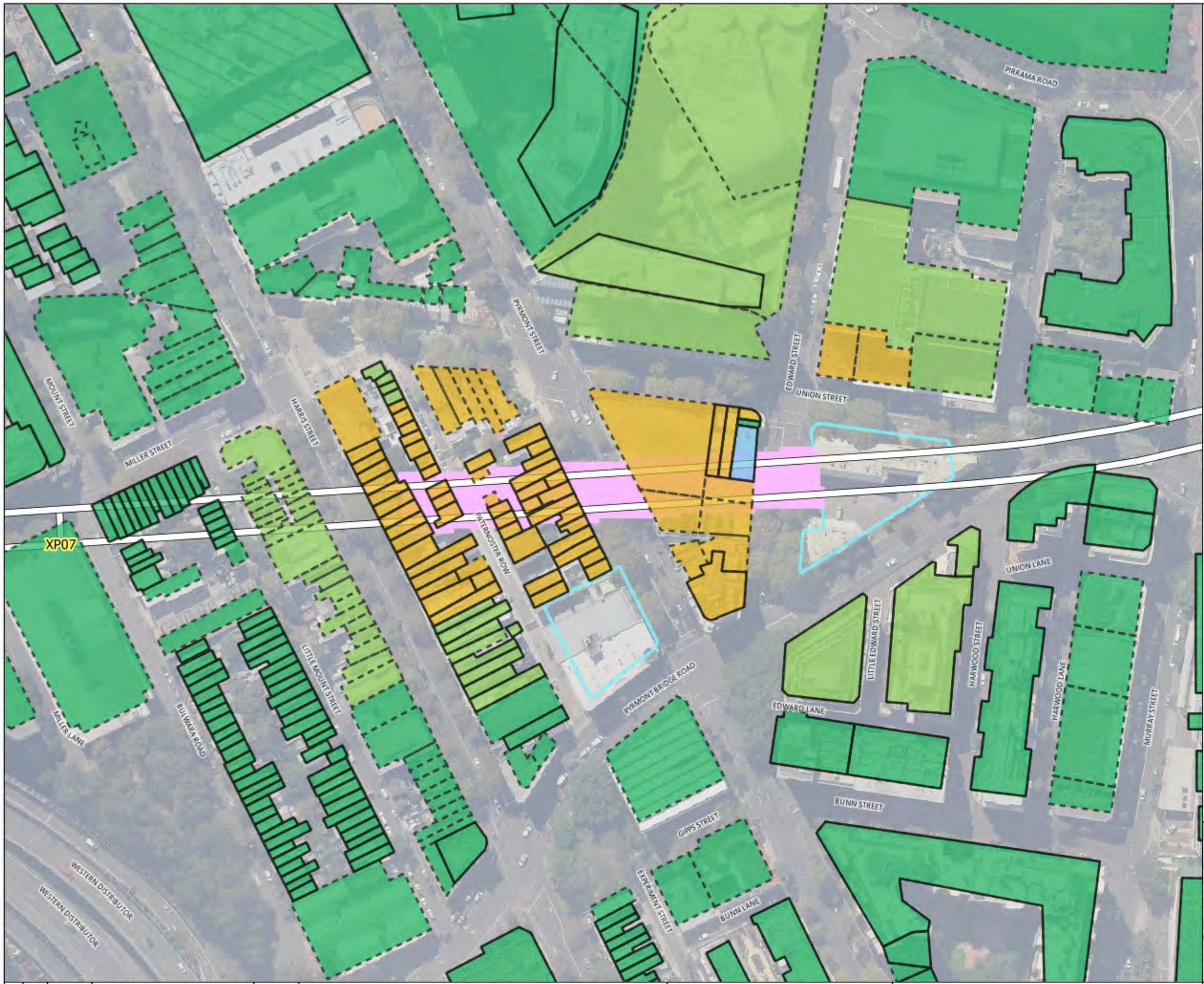
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:53 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Station Cavern
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Benching 1 excavation (Roadheader)

Plot Date: 18/08/23 - 09:53 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Station Cavern
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
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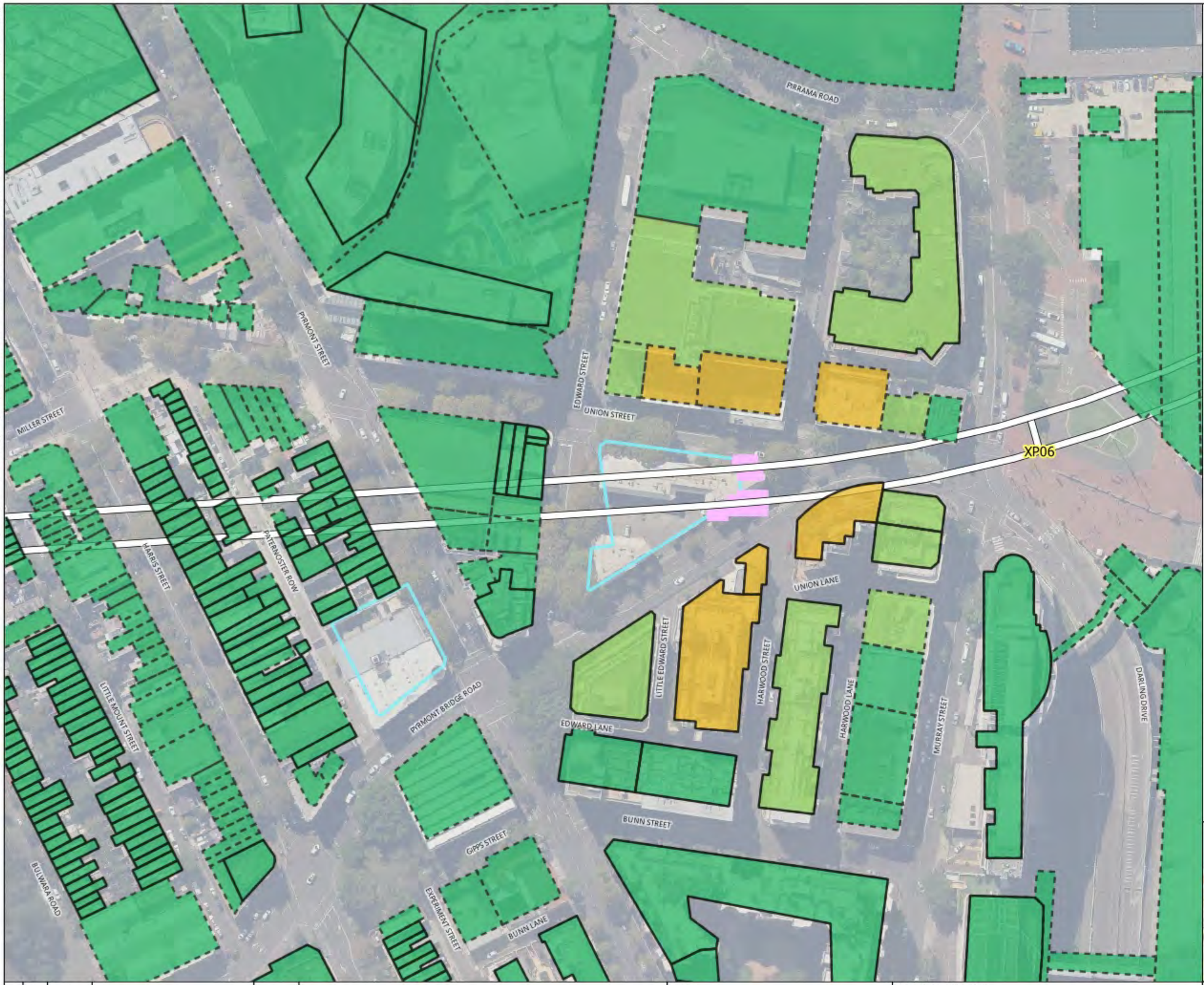
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Benching 2 excavation (Roadheader)

Plot Date: 18/08/23 - 09:54 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Nozzle
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

150 m
100
50
0

REV	BY	DATE	DESCRIPTION	APPROVER
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..	..	..	..	..
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

JOHN HOLLAND CPB Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve

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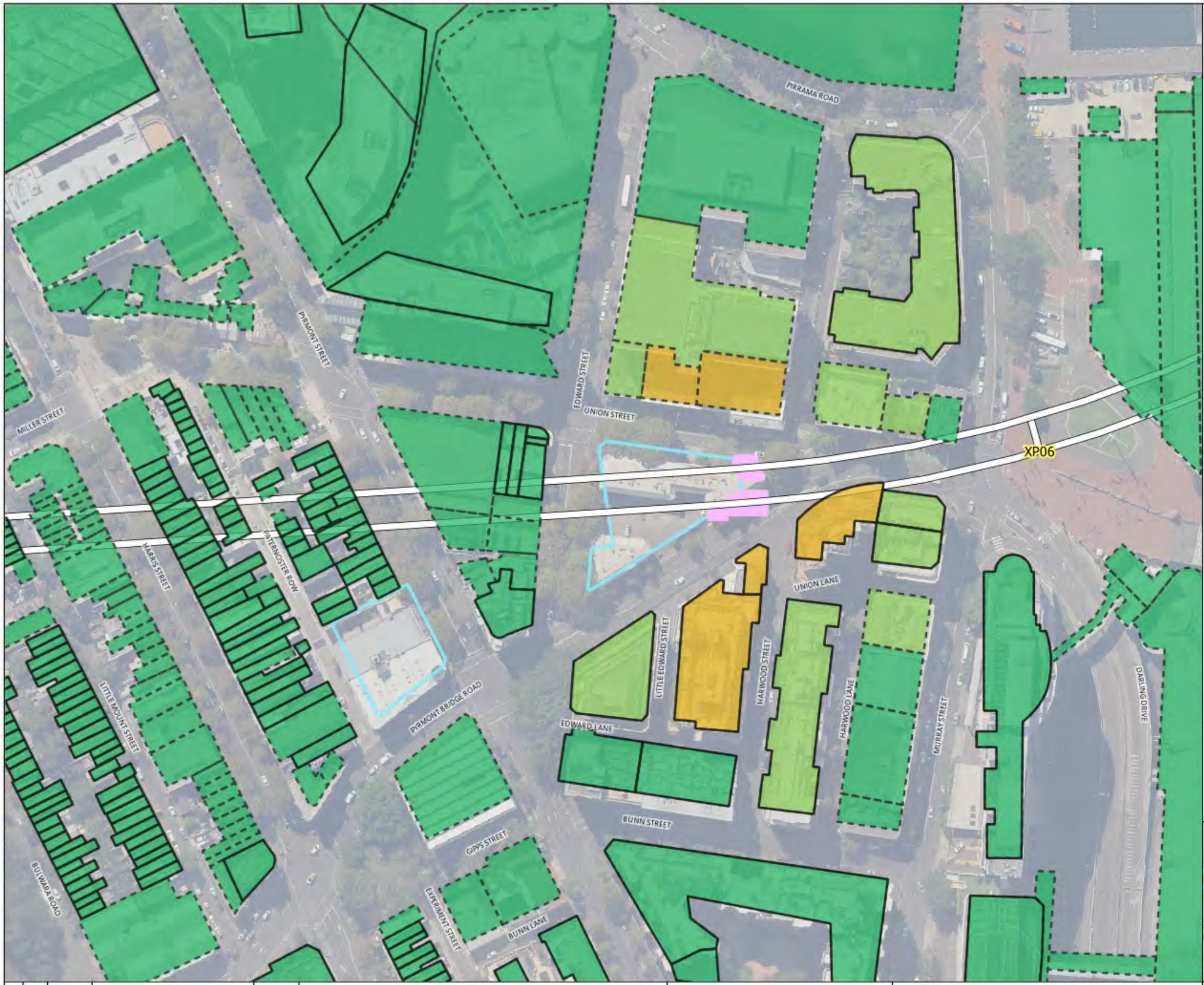
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:54 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Nozzle
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

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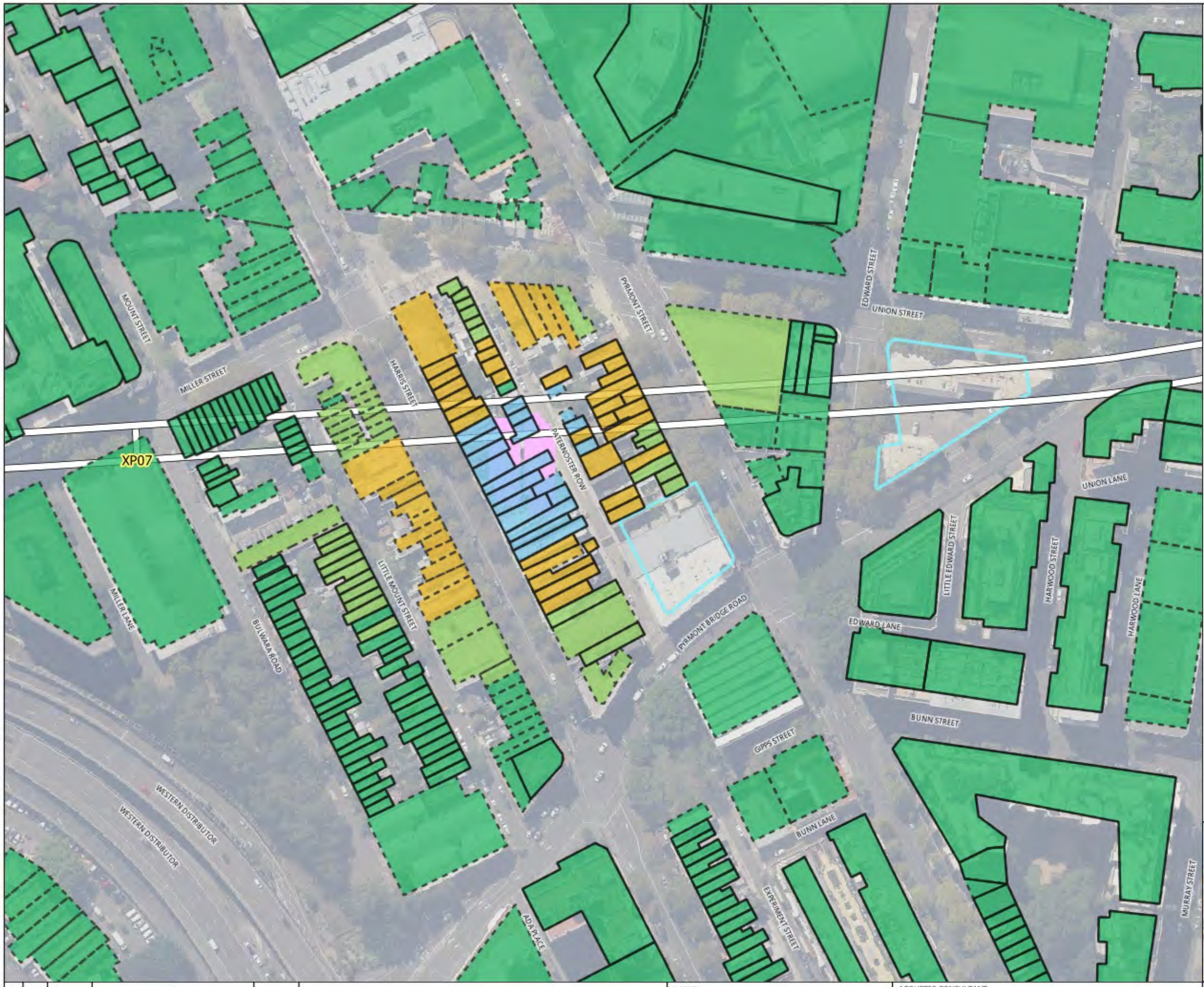
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Benching 1 excavation (Roadheader)

Plot Date: 18/08/23 - 09:54 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Service Adit SA2
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
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..	..	..	..	..
..	..	..	..	..
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

JOHN HOLLAND | CPB | Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:54 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Service Adit SA1
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

JOHN HOLLAND CPB Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve

Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:54 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Service Adit SA1
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
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..	..	..	..	..
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

JOHN HOLLAND | CPB | Ghella

ACOUSTIC CONSULTANT

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Benching 1 excavation (Roadheader)

Plot Date: 18/08/23 - 09:55 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Service Adit SA1
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Benching 2 excavation (Roadheader)

Plot Date: 18/08/23 - 09:55 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Pedestrian Adit PA1
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
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..	..	..	..	..
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:55 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Pedestrian Adit PA2
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
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..	..	..	..	..
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:55 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

0 50 100 150 m

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Pedestrian Adit PA2
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Benching 1 excavation (Roadheader)

Plot Date: 18/08/23 - 09:55 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Pedestrian Adit PA2
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Benching 2 excavation (Roadheader)

Plot Date: 18/08/23 - 09:55 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

150 m
100
50
0

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Hunter Street Nozzle
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:55 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Hunter Street Nozzle
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

150 m
100
50
0

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

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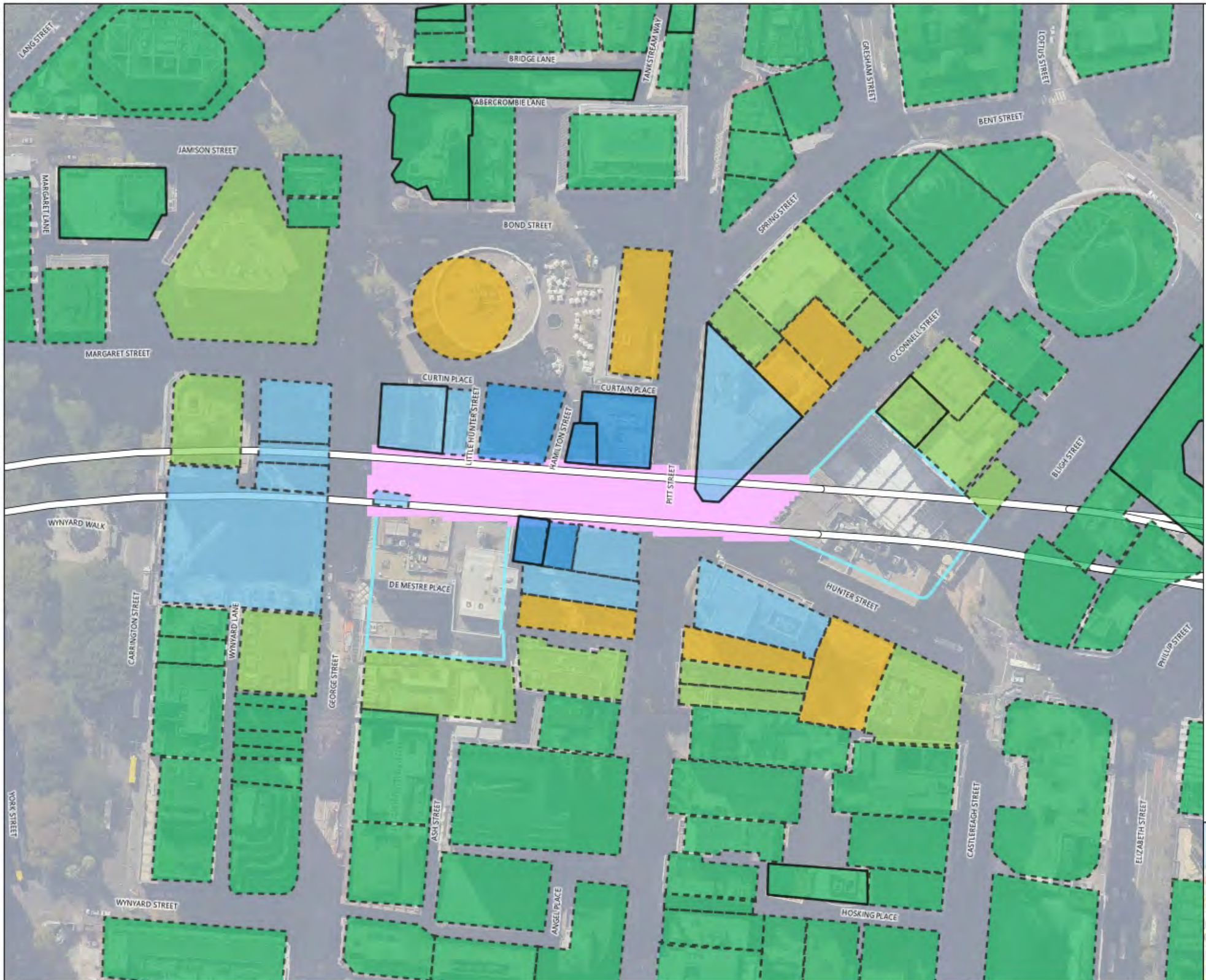
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Benching 1 excavation (Roadheader)

Plot Date: 18/08/23 - 09:55 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Hunter Street Station Cavern
- Station Shaft Footprint

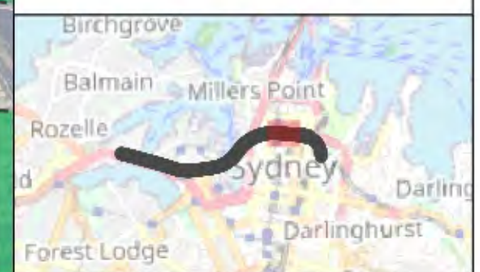
Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.



REV	BY	DATE	DESCRIPTION	APPROVER
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..	..	..	..	..
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
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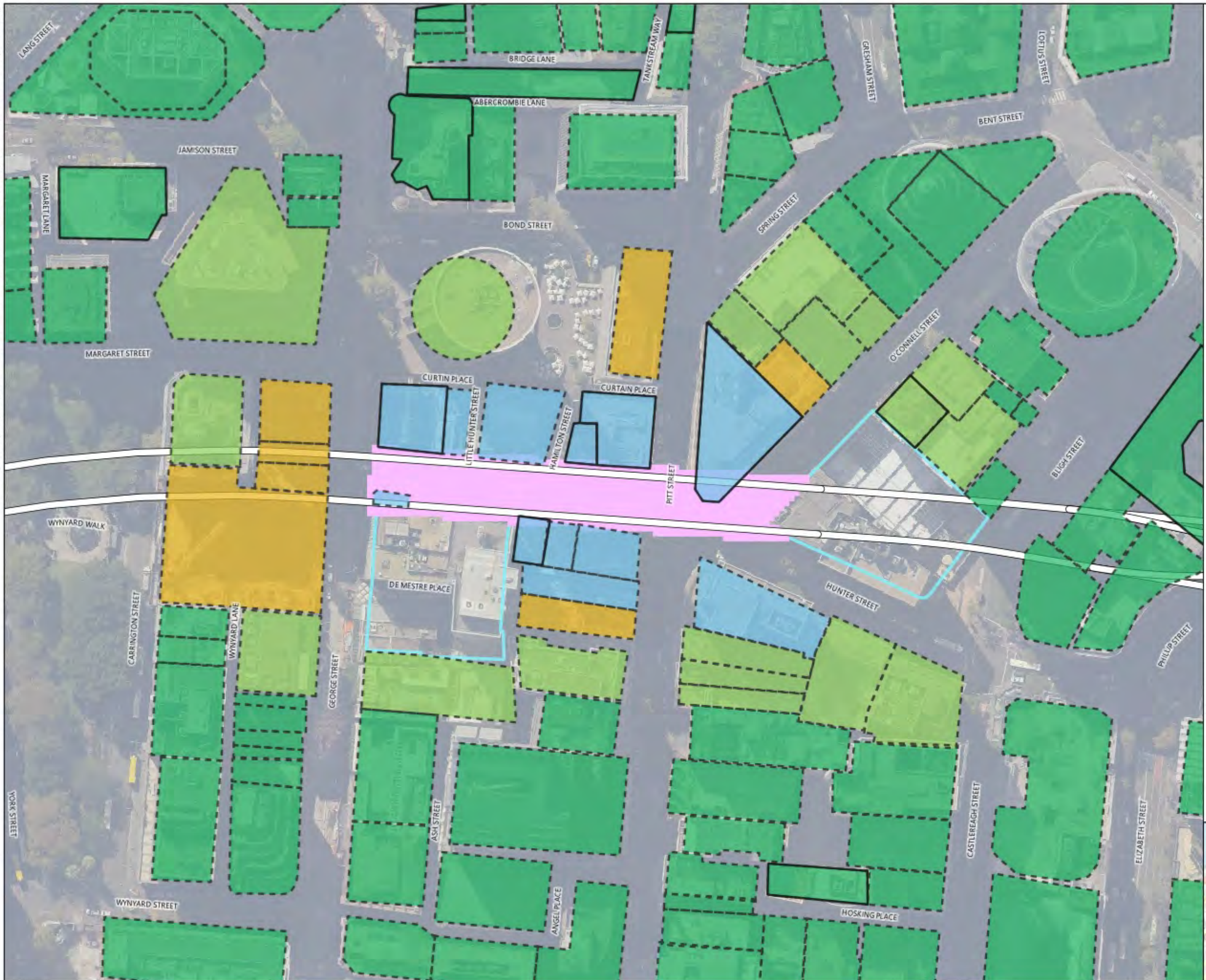
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:56 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Hunter Street Station Cavern
- Station Shaft Footprint

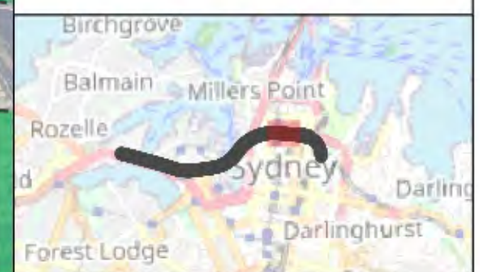
Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.



REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

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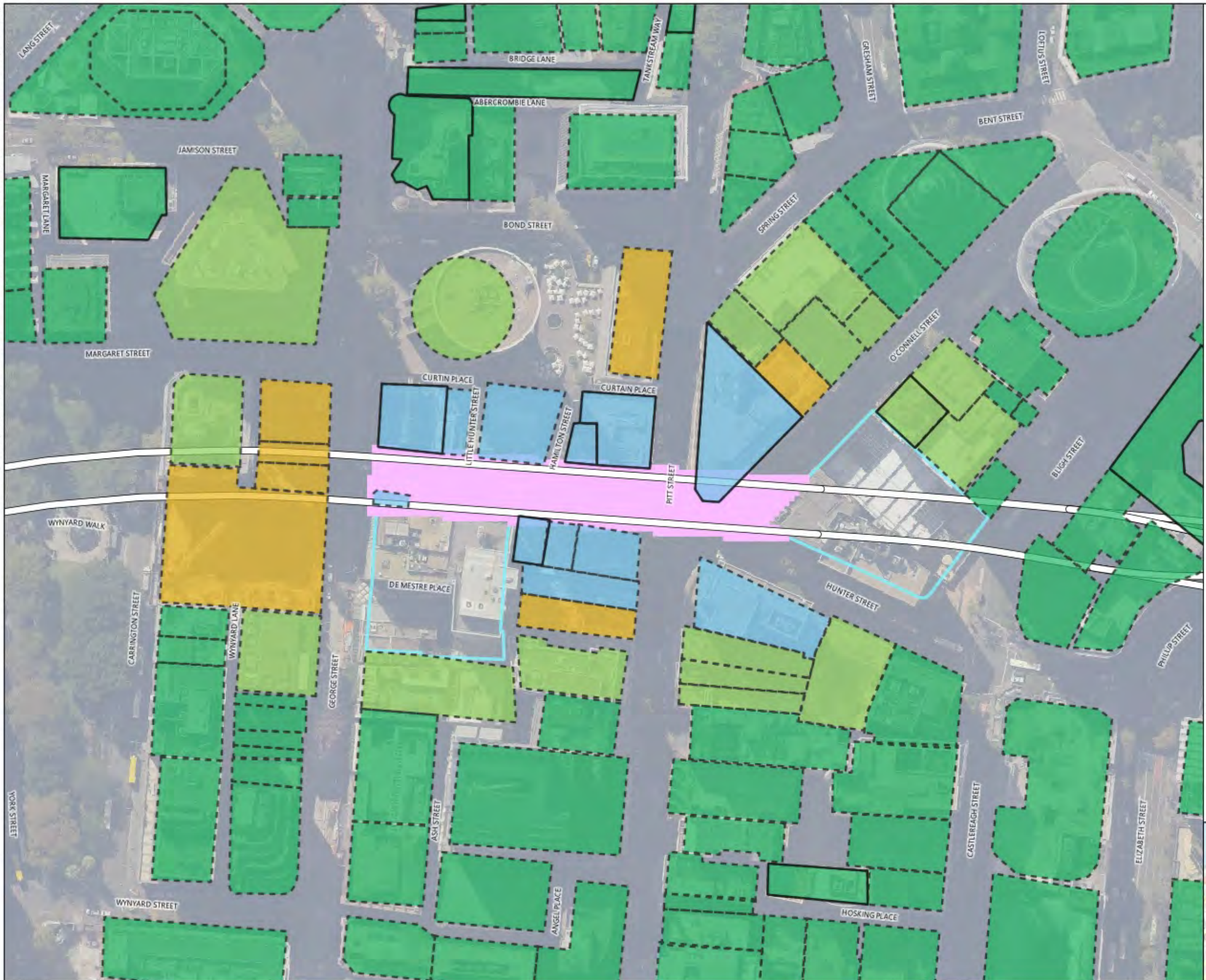
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Benching 1 excavation (Roadheader)

Plot Date: 18/08/23 - 09:56 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Hunter Street Station Cavern
- Station Shaft Footprint

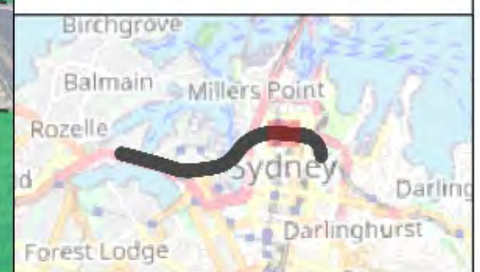
Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.



REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

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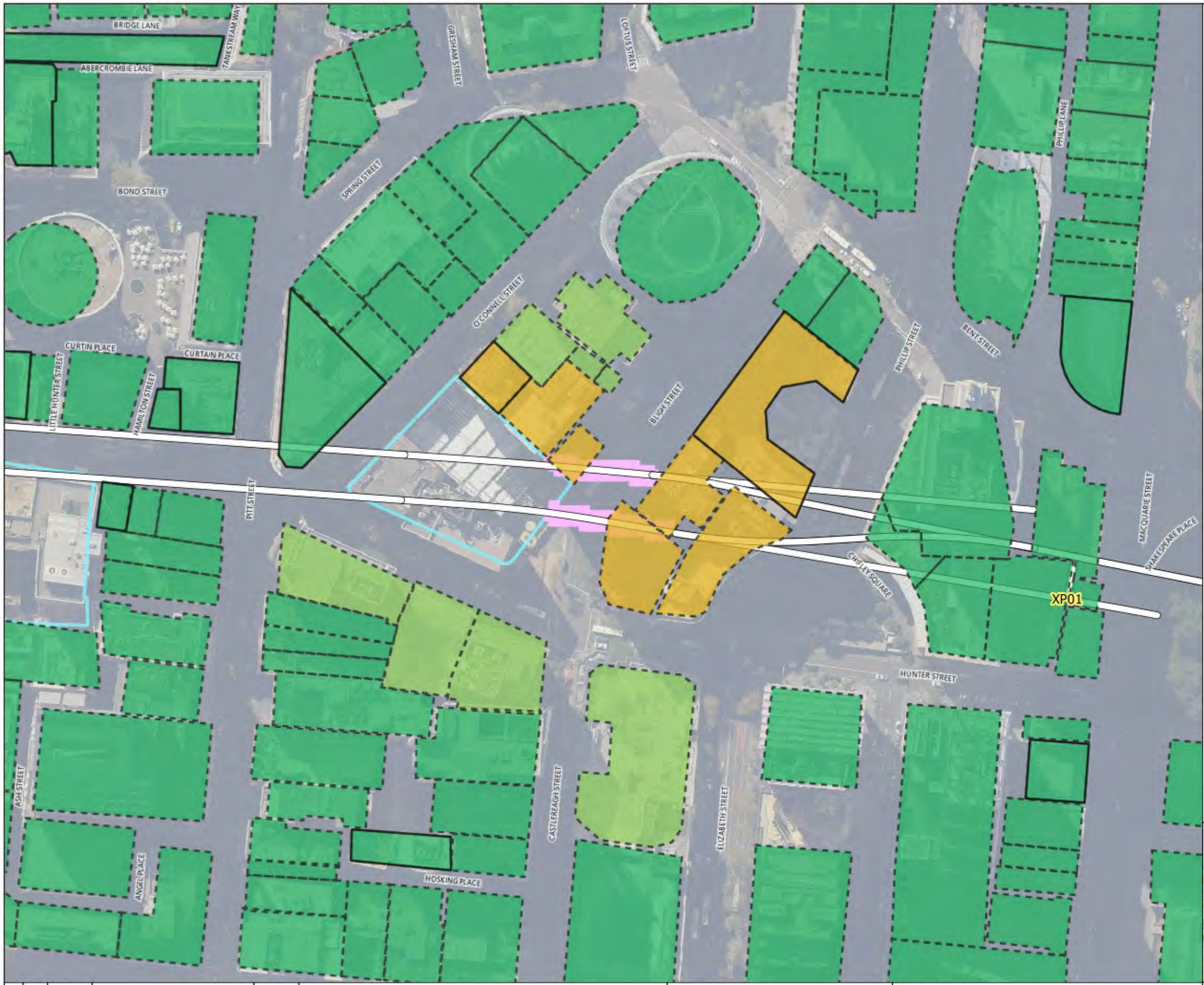
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Benching 2 excavation (Roadheader)

Plot Date: 18/08/23 - 09:56 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB1-S
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:56 Layout: TM372 GBN&V Tunnel Template
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB2 (North)
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m
1:1,500
FULL SIZE A3, REDUCED TO A4
NOTE: Do not scale from this drawing.

CLIENT
EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:56 Layout: TM372 GBN&V Tunnel Template
GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB2 (South)
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
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..	..	..	..	..
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:56 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB4 (West)
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:56 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB6
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:56 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB1-B
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:57 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB4 (East)
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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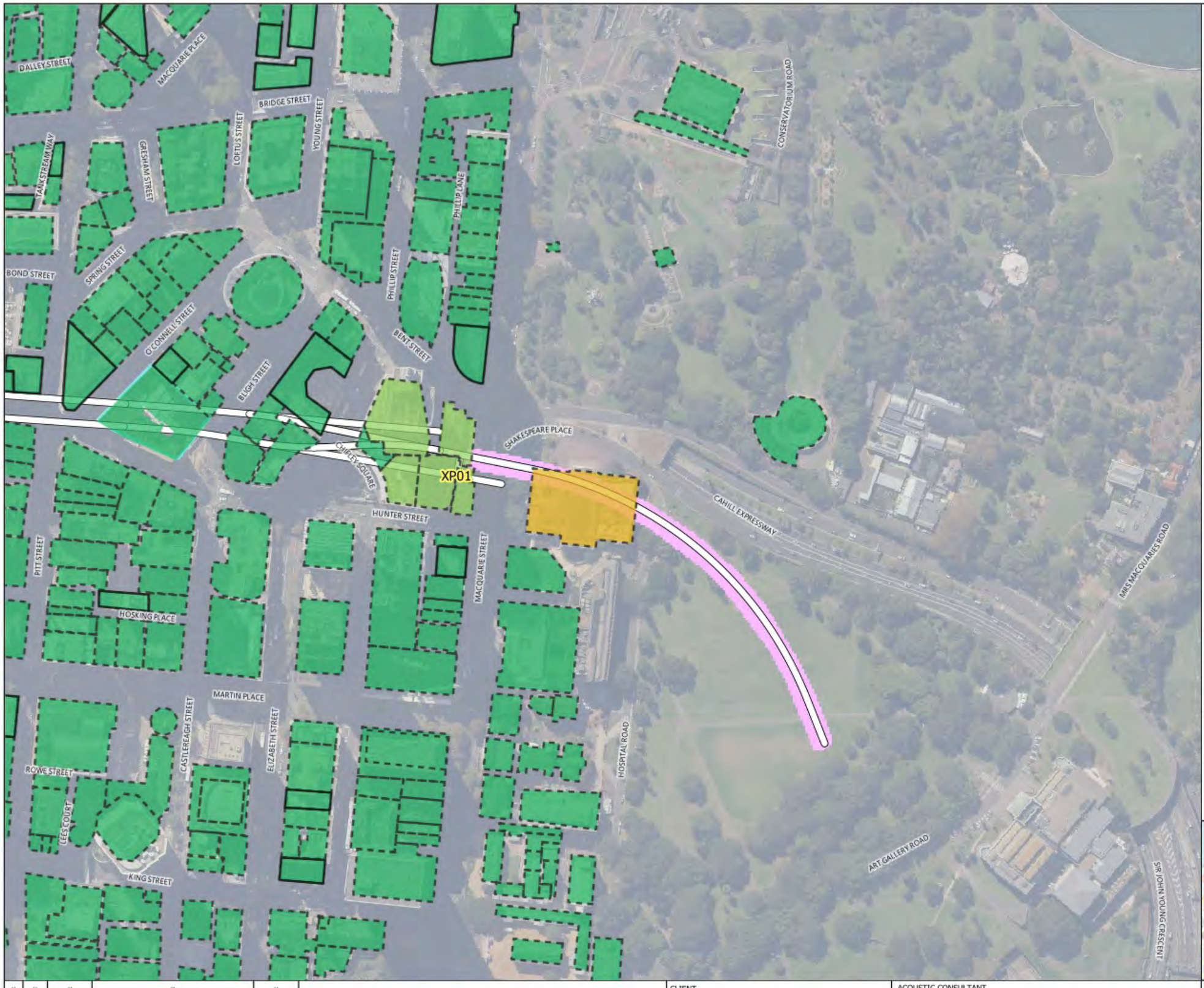
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBN level during Heading excavation (Roadheader)

Plot Date: 18/08/23 - 09:57 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB5
- Station Shaft Footprint

Maximum GBN levels ppv(mm/s) during Roadheader operation

- ≤ 30
- ≤ 35
- ≤ 40
- ≤ 50
- ≤ 55
- ≤60
- > 60

Notes:

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
..	..	..	..	..
r1	SS	18/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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EASTERN TUNNELLING PACKAGE
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JOHN HOLLAND CPB Ghella

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SYDNEY METRO WEST
Eastern Tunneling Package

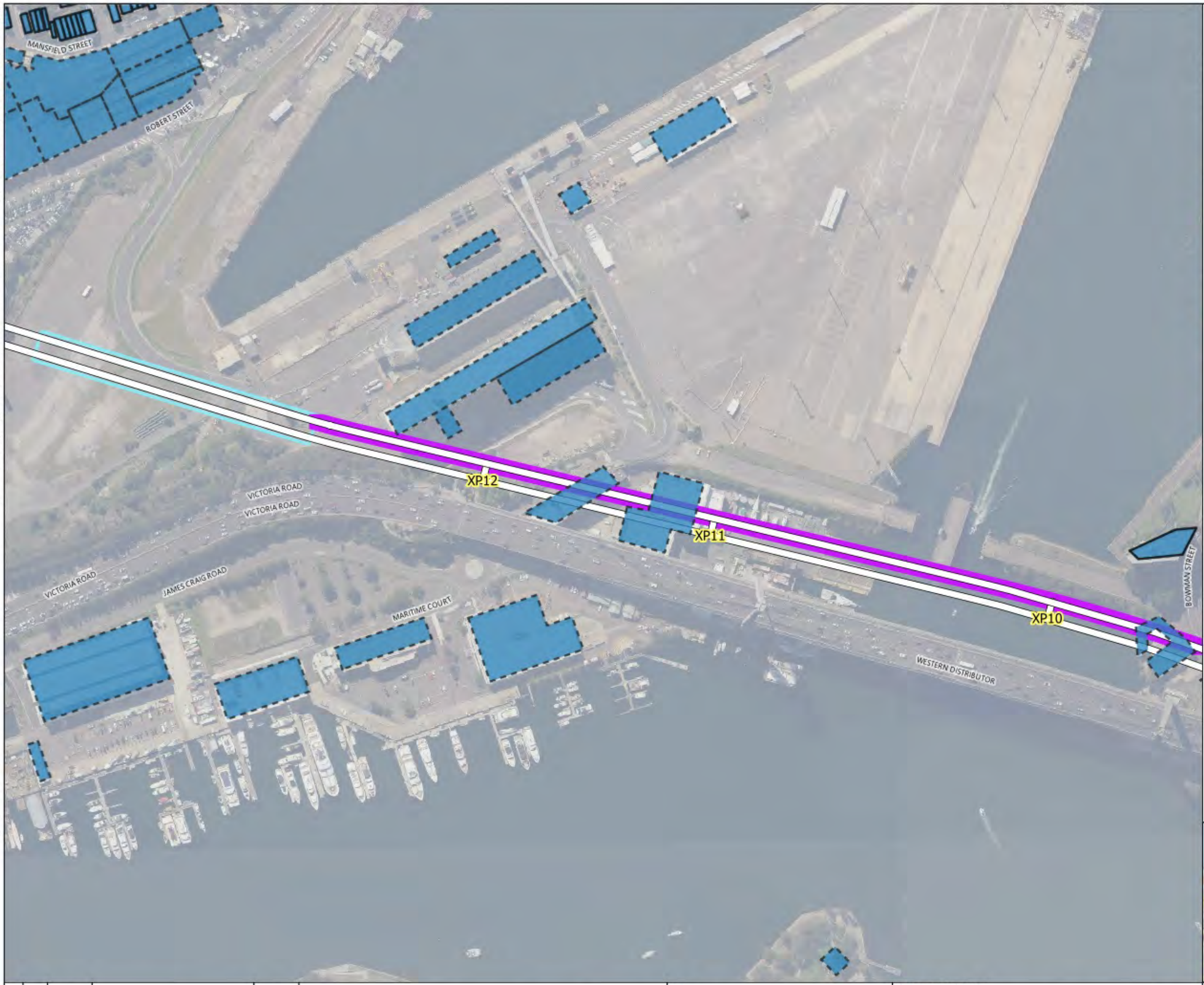
Predicted Maximum GBN level during Heading excavation (Roadheader)

APPENDIX F Construction vibration impacts

F.1 Project-wide – GBV from tunnelling works

Plot Date: 04/08/23 - 14:23 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Eastbound Tunnel
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during TBM operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Crown excavation (TBM)

Plot Date: 04/08/23 - 14:24 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Eastbound Tunnel
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during TBM operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Crown excavation (TBM)

Plot Date: 04/08/23 - 14:24 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Eastbound Tunnel
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during TBM operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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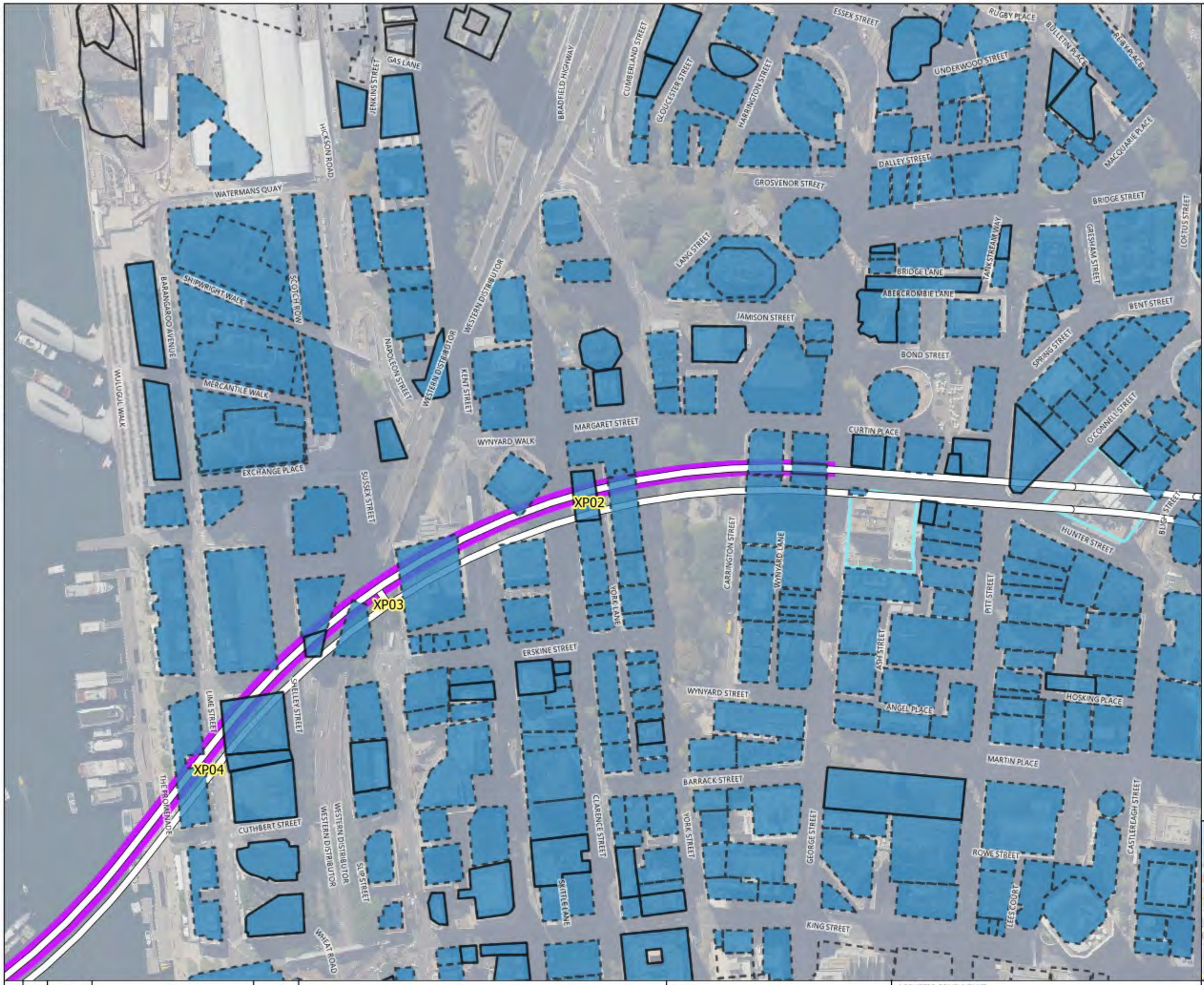
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Crown excavation (TBM)

Plot Date: 04/08/23 - 14:24 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Eastbound Tunnel
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during TBM operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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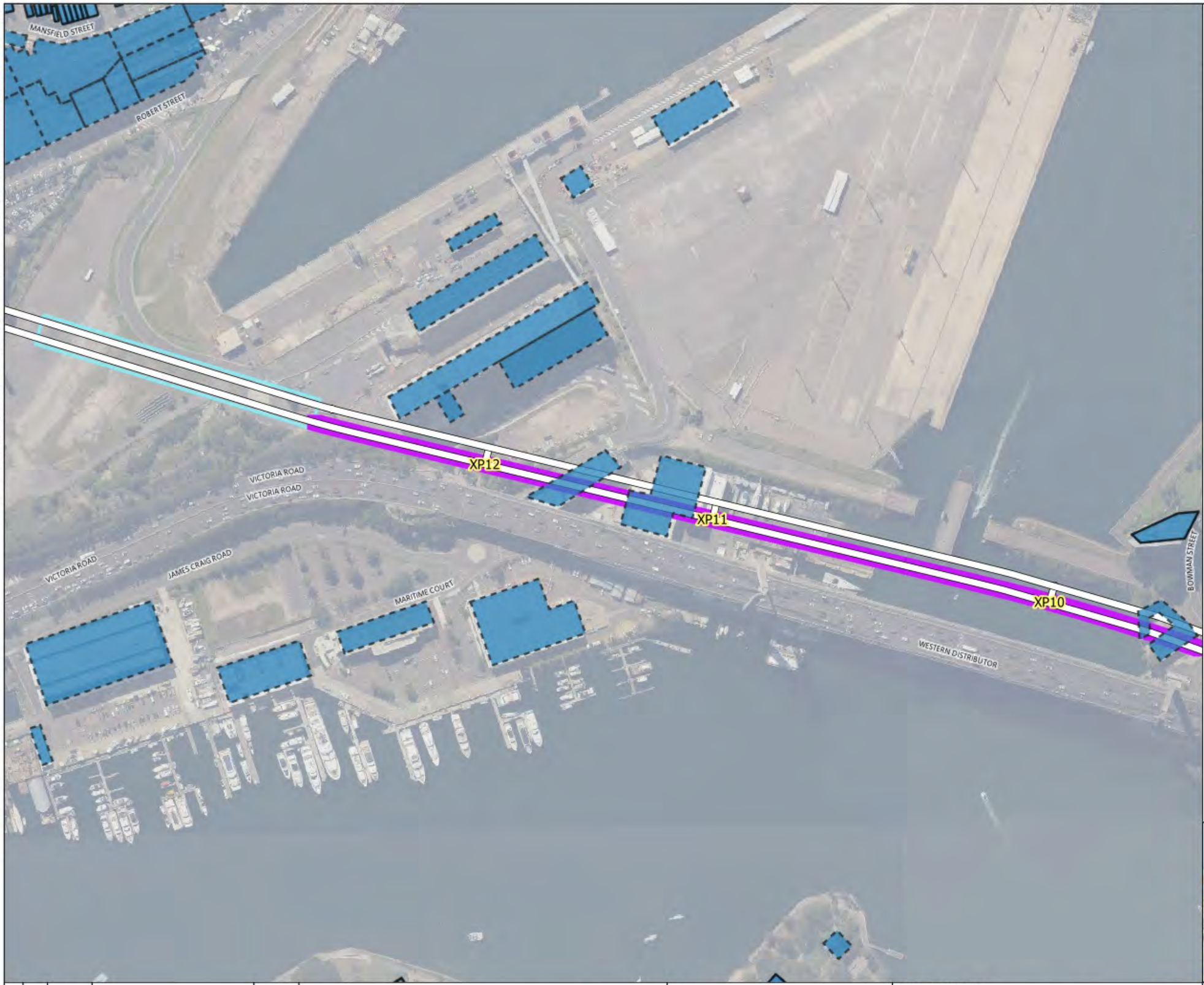
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Crown excavation (TBM)

Plot Date: 04/08/23 - 14:24 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Westbound Tunnel
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during TBM operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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REV	BY	DATE	DESCRIPTION	APPROVER
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..	..	..	..	..
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

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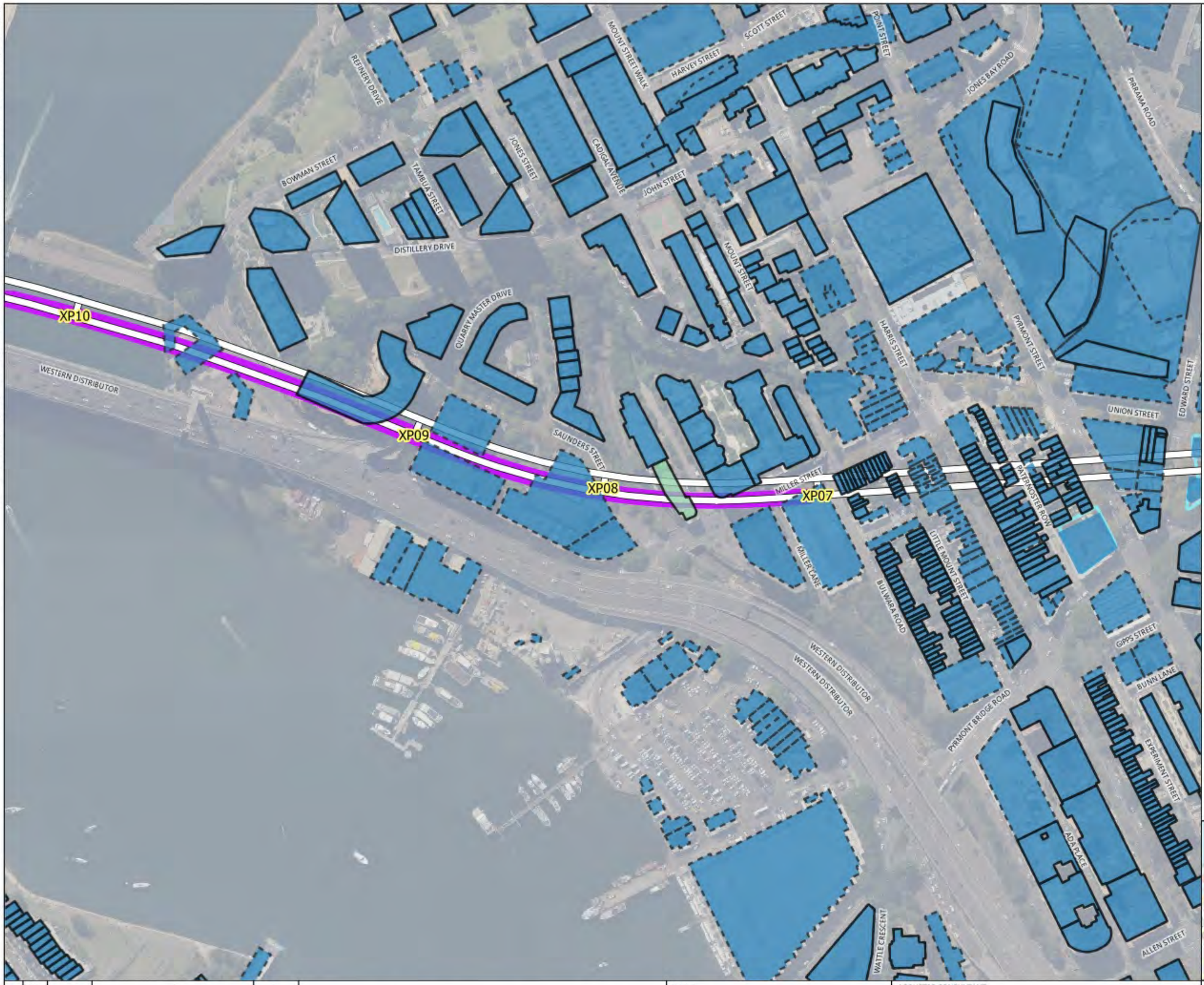
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Crown excavation (TBM)

Plot Date: 04/08/23 - 14:24 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Westbound Tunnel
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during TBM operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

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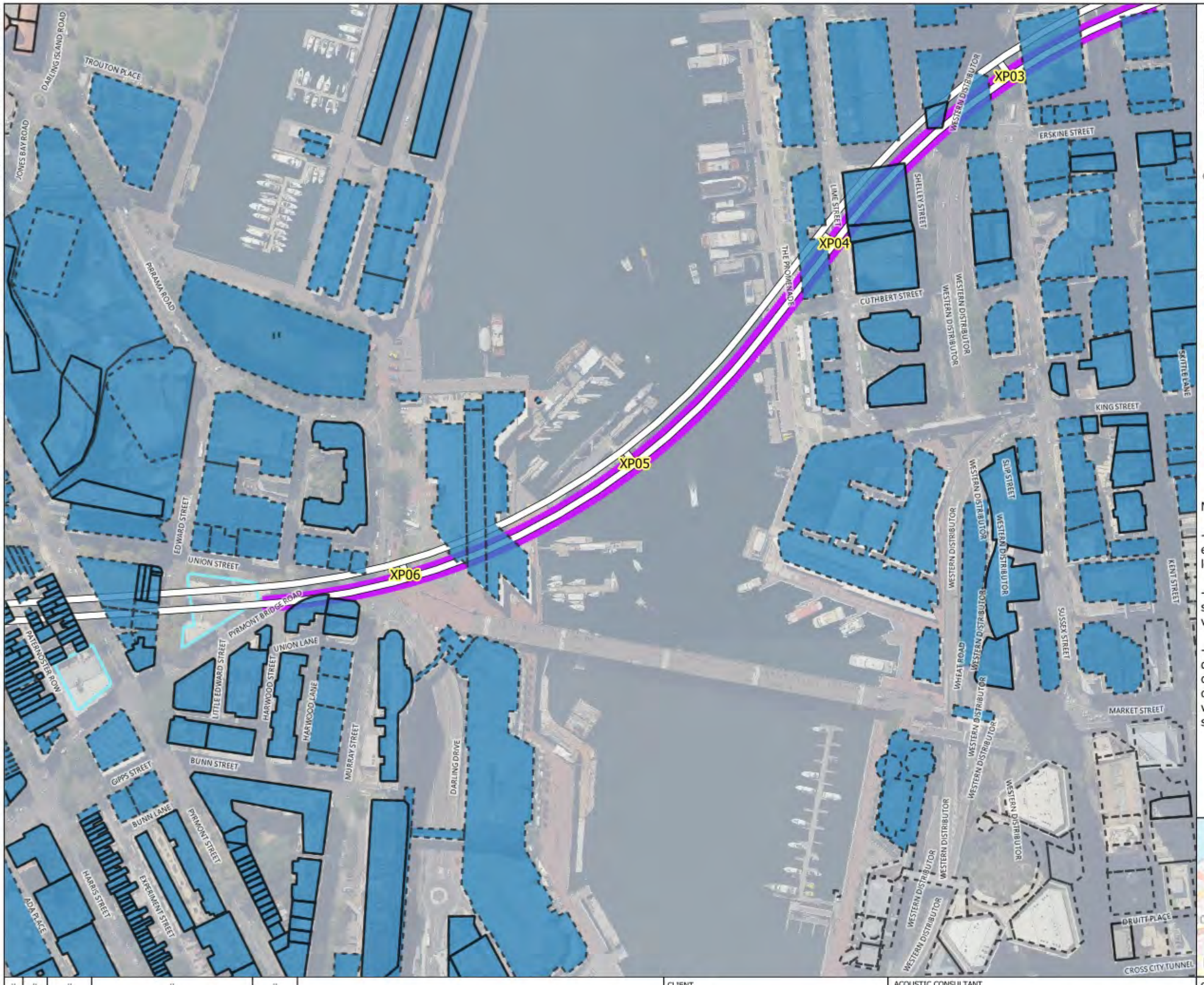
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Crown excavation (TBM)

Plot Date: 04/08/23 - 14:24 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Westbound Tunnel
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during TBM operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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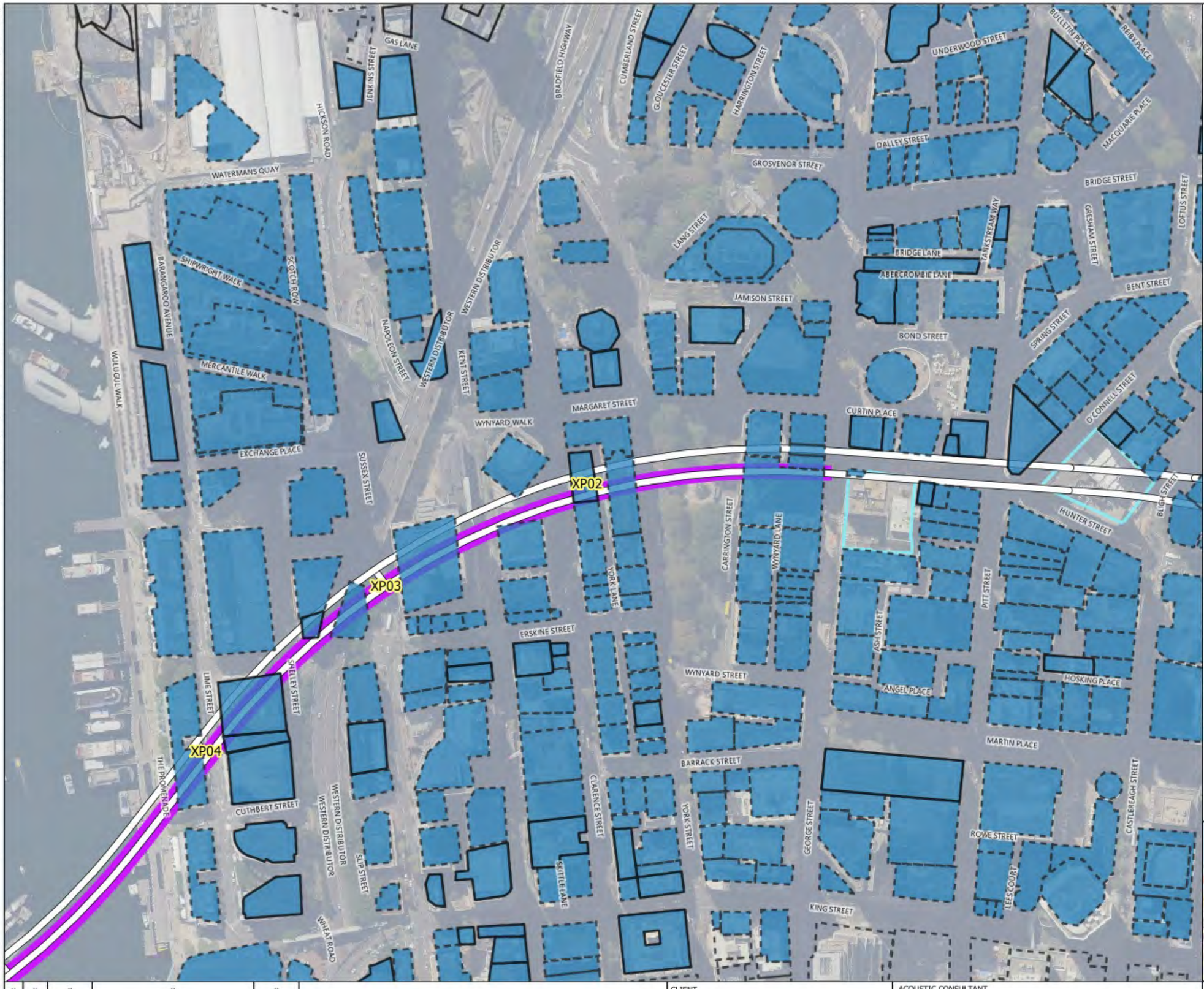
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Crown excavation (TBM)

Plot Date: 04/08/23 - 14:24 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Westbound Tunnel
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during TBM operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve

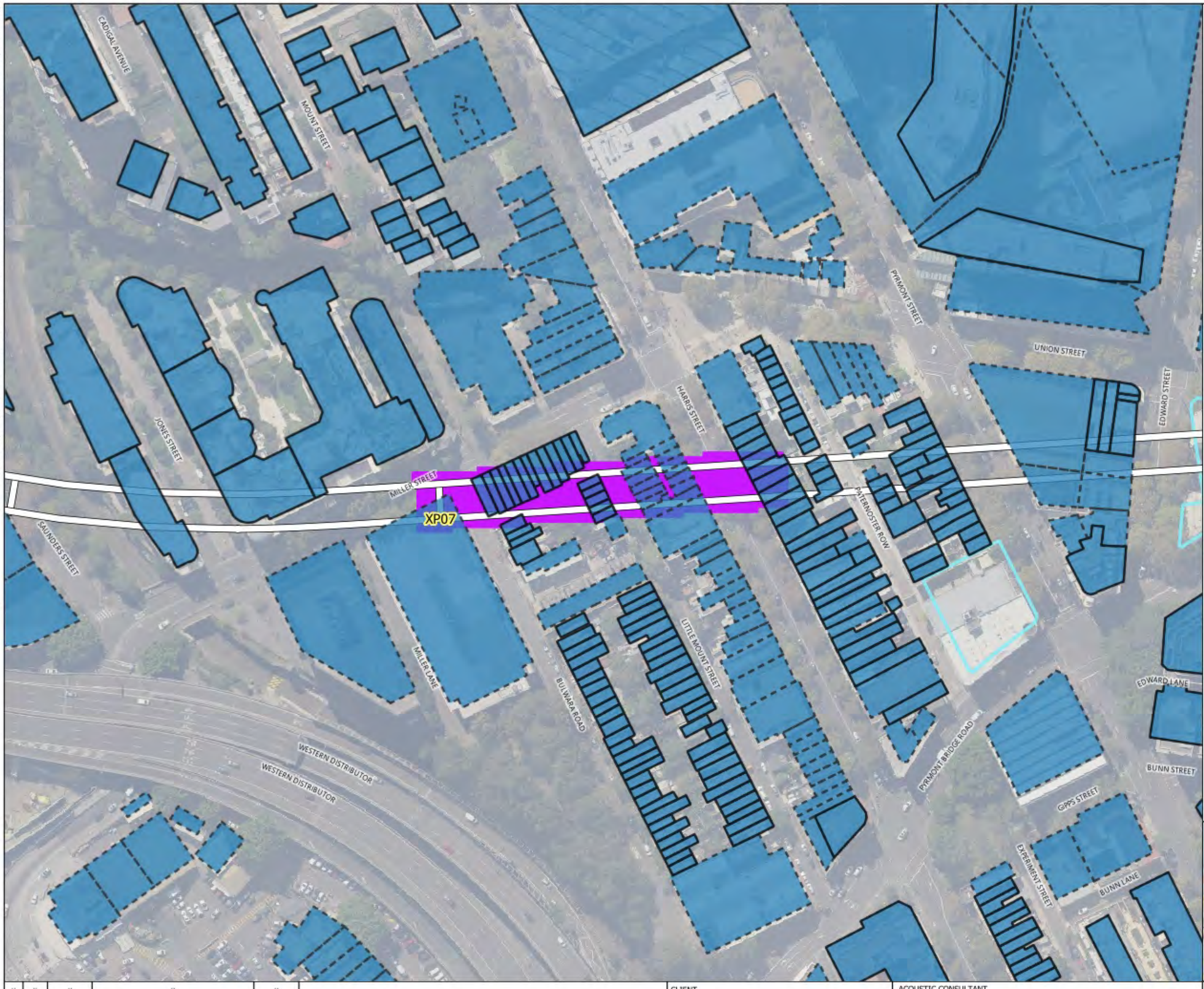
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Crown excavation (TBM)

Plot Date: 04/08/23 - 14:25 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Crossover Cavern
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

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EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

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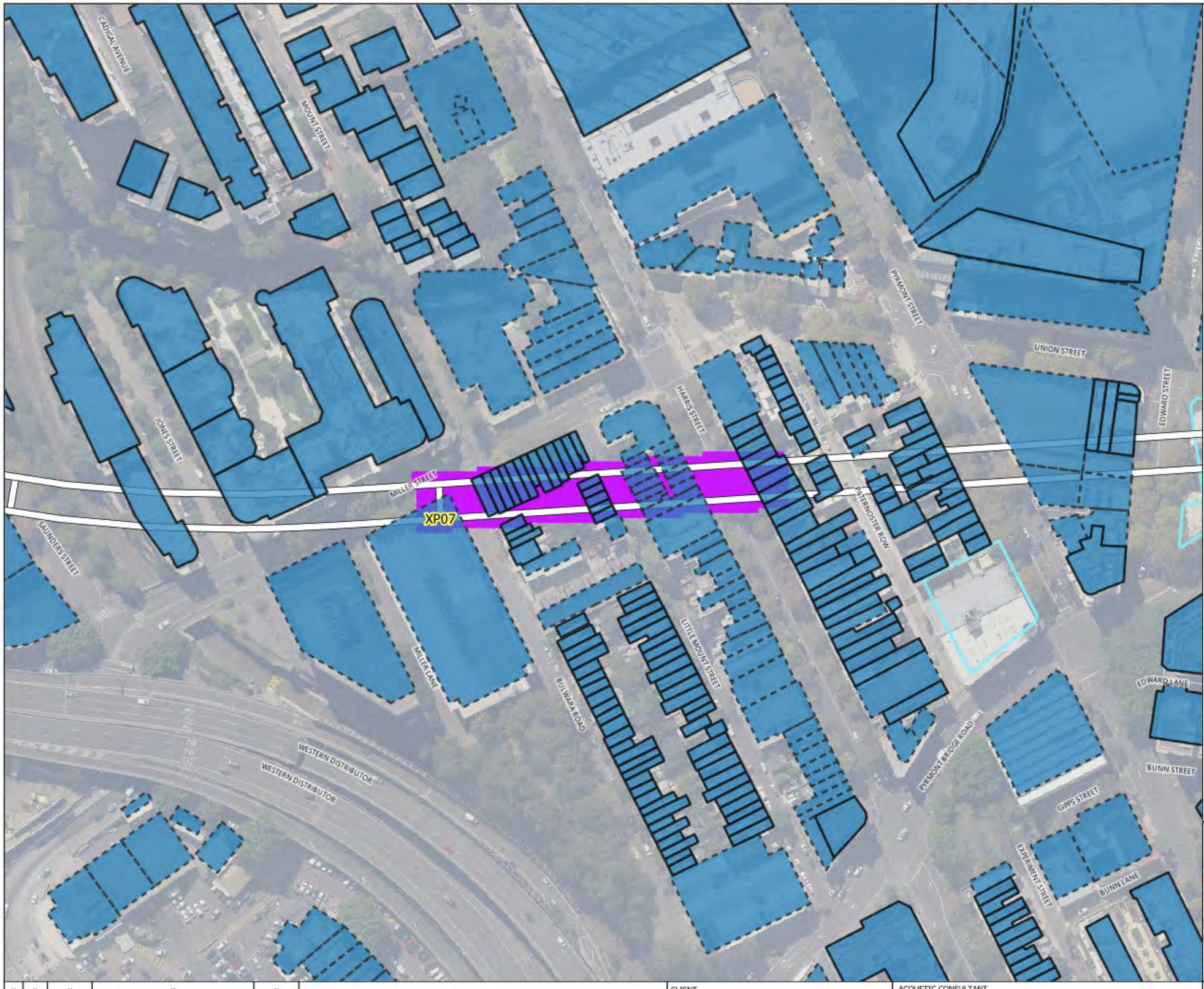
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:25 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Crossover Cavern
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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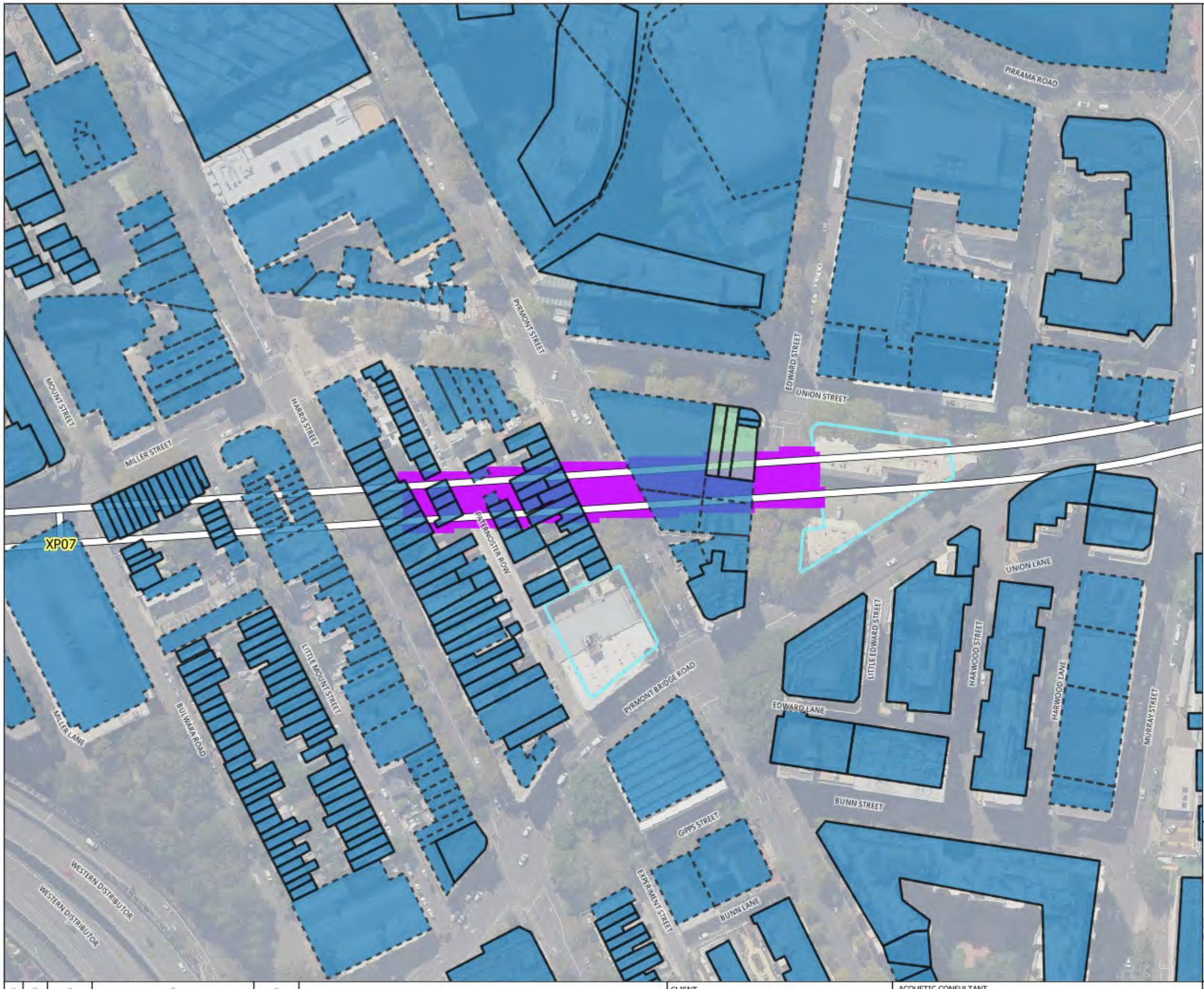
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Bencing 1 excavation (Roadheader)

Plot Date: 04/08/23 - 14:25 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Station Cavern
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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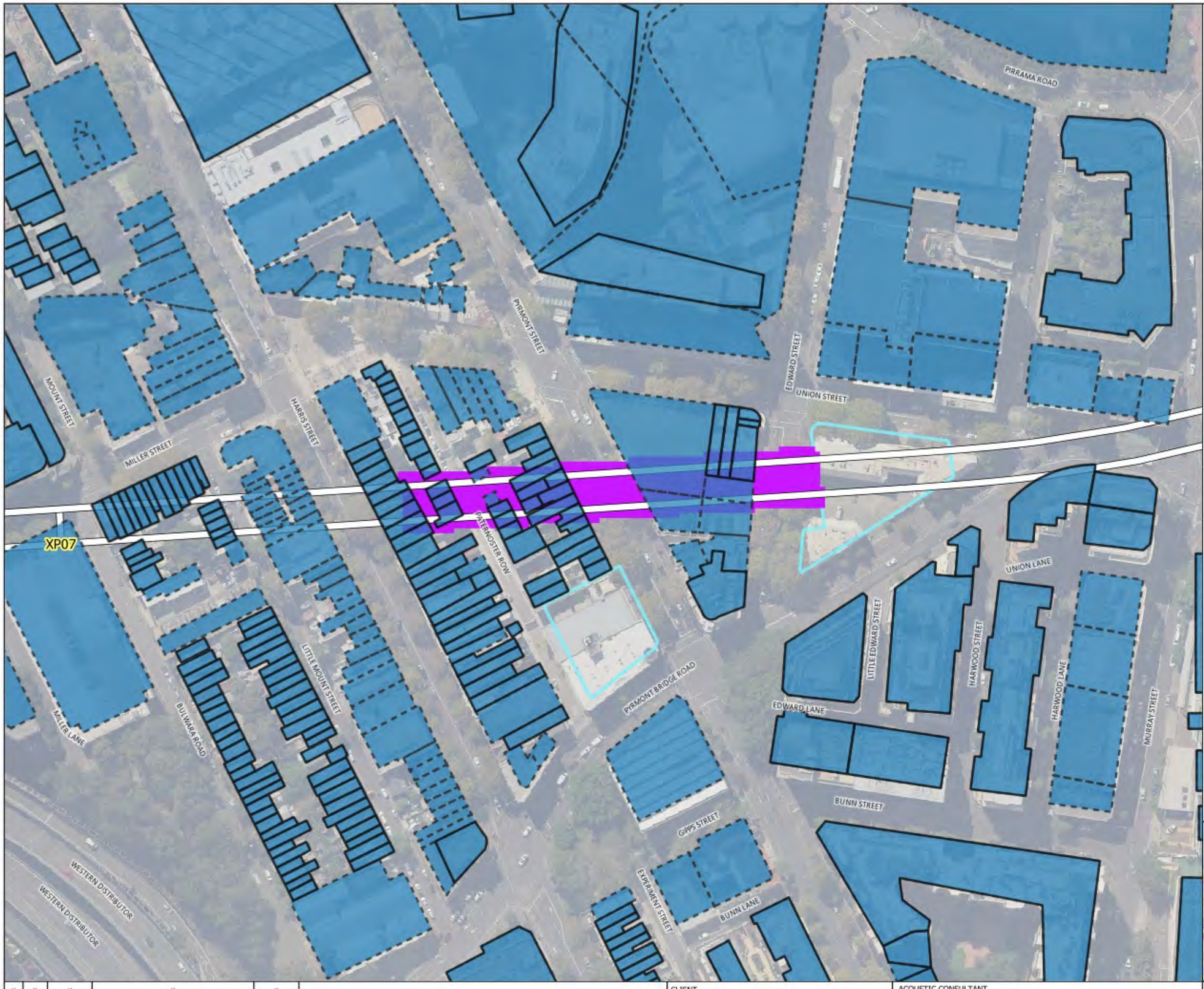
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:25 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Station Cavern
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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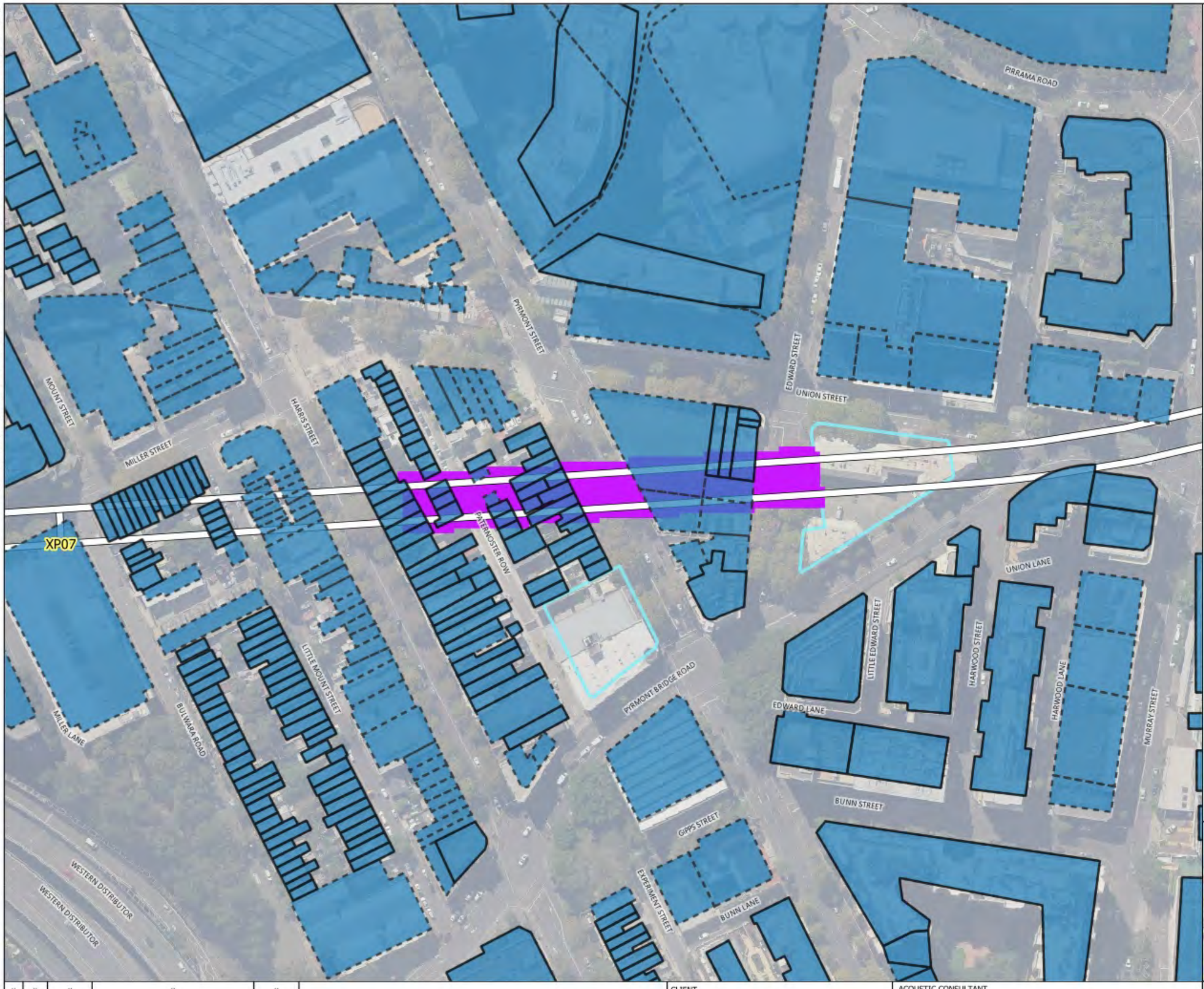
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Benching 1 excavation (Roadheader)

Plot Date: 04/08/23 - 14:25 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Station Cavern
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
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Notes:

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

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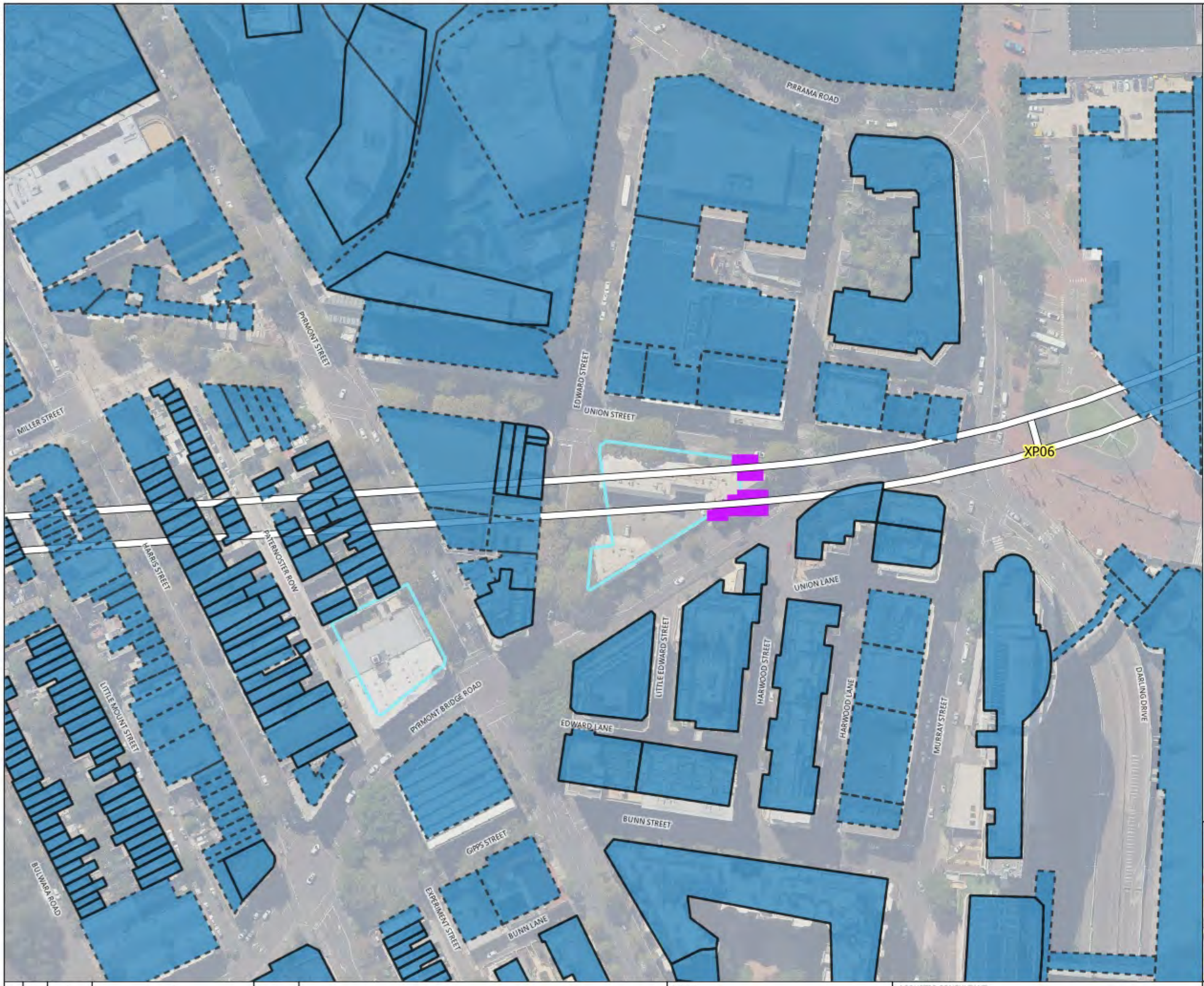
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Benching 2 excavation (Roadheader)

Plot Date: 04/08/23 - 14:25 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSyd\Projects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Nozzle
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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REV	BY	DATE	DESCRIPTION	APPROVER
..	..	..	..	..
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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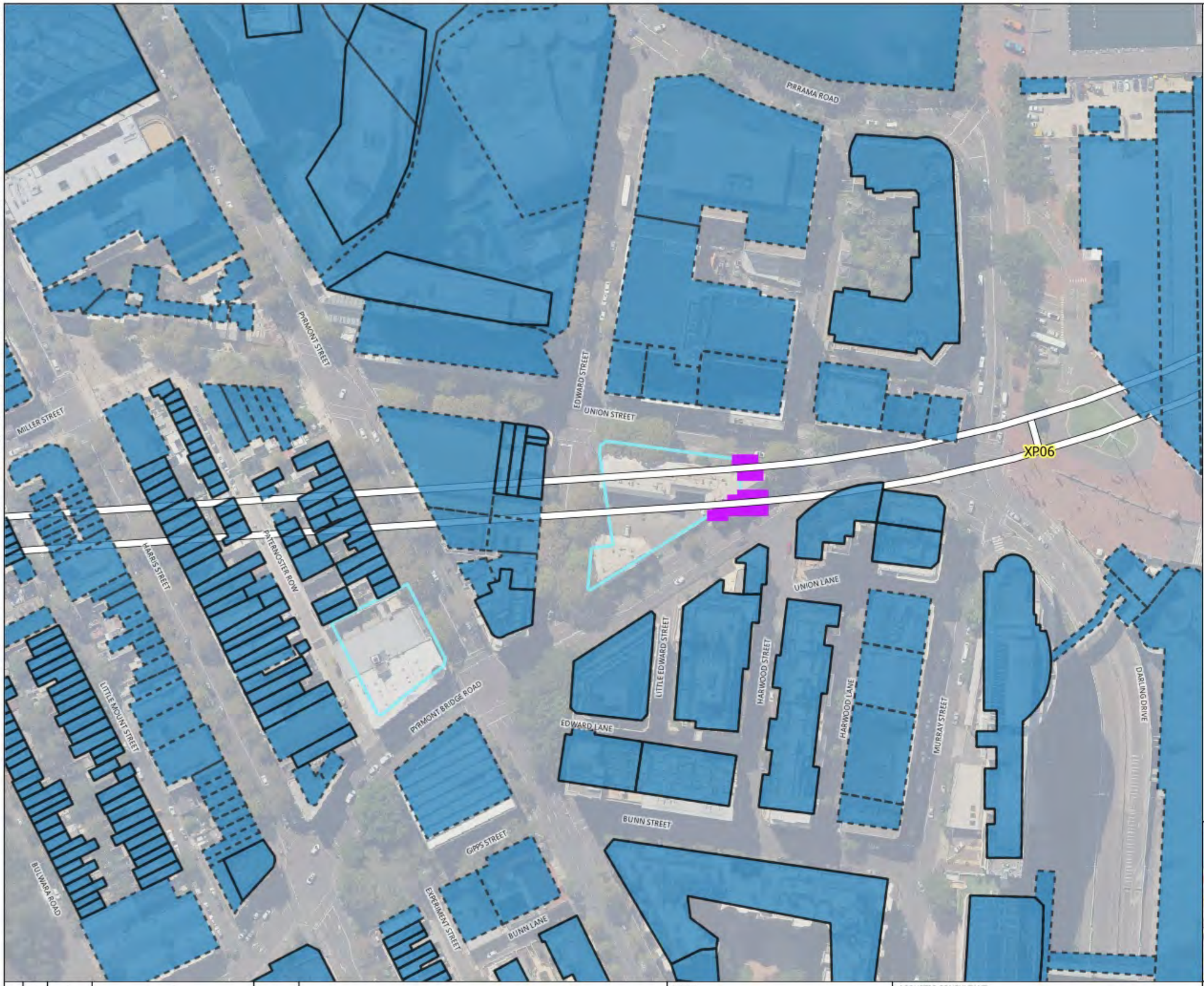
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:26 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Nozzle
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
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Notes:

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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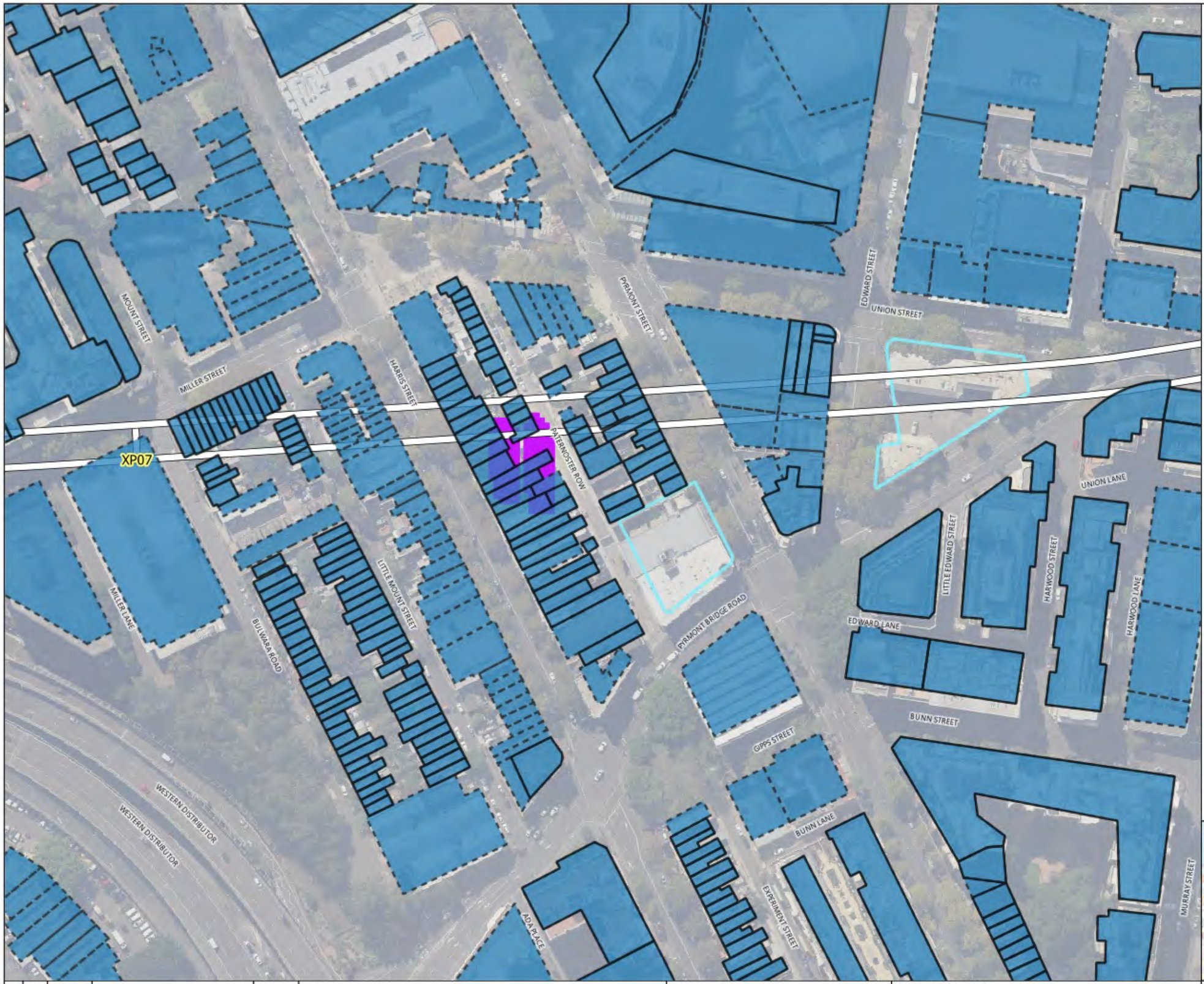
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Benching 1 excavation (Roadheader)

Plot Date: 04/08/23 - 14:26 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Service Adit SA2
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

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REV	BY	DATE	DESCRIPTION	APPROVER
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..	..	..	..	..
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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JOHN HOLLAND CPB Ghella

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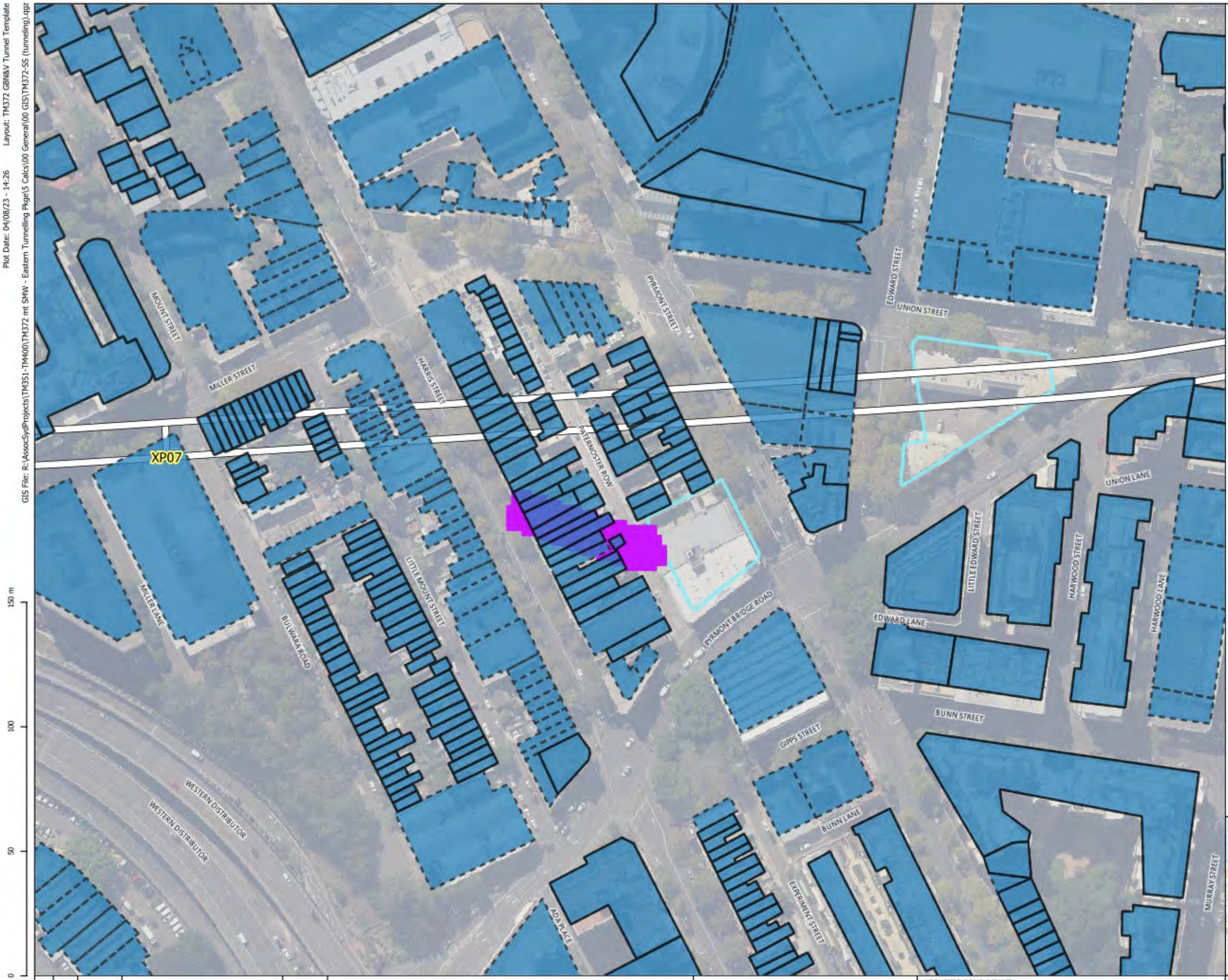
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:26 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Service Adit SA1
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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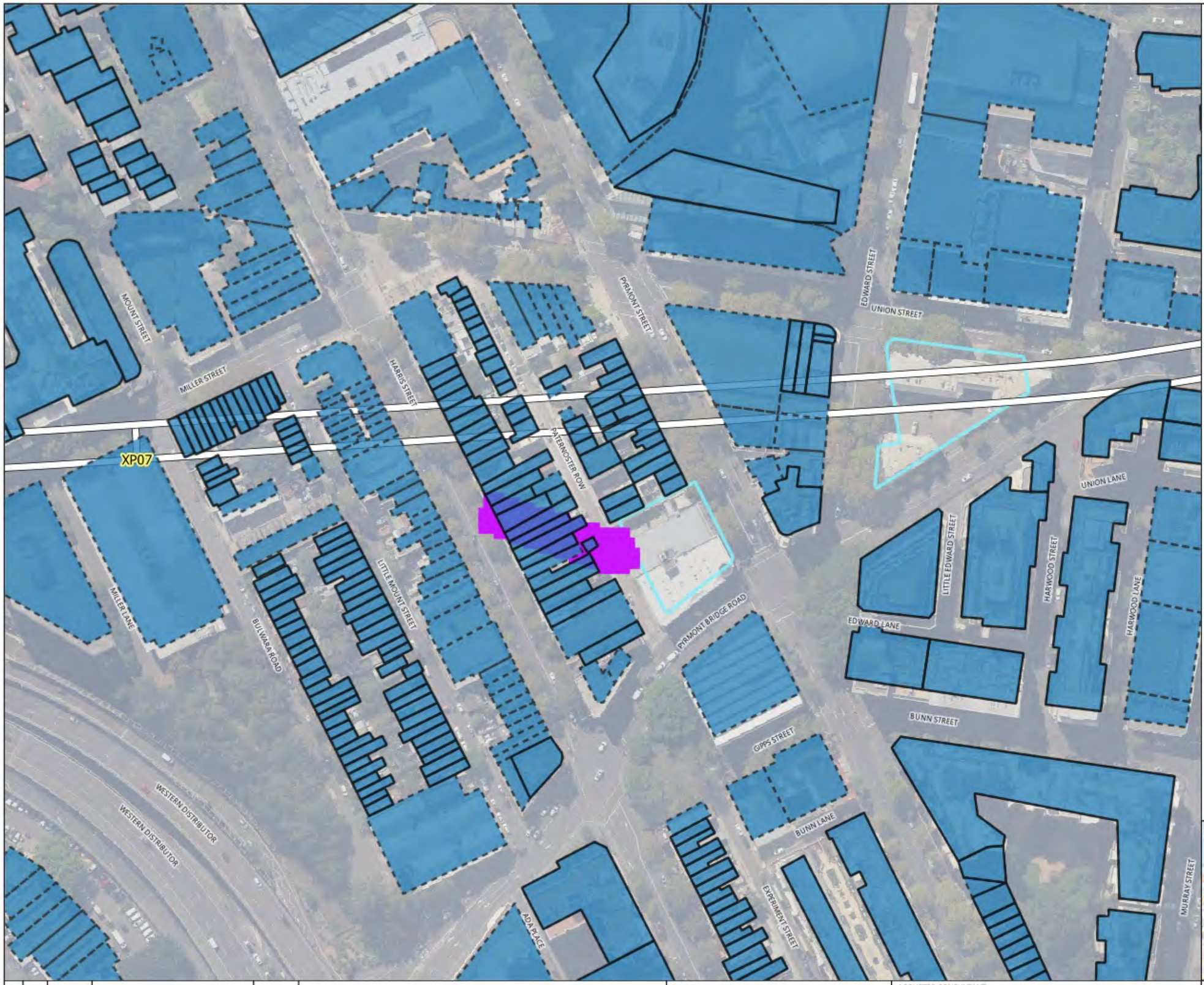
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:26 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Service Adit SA1
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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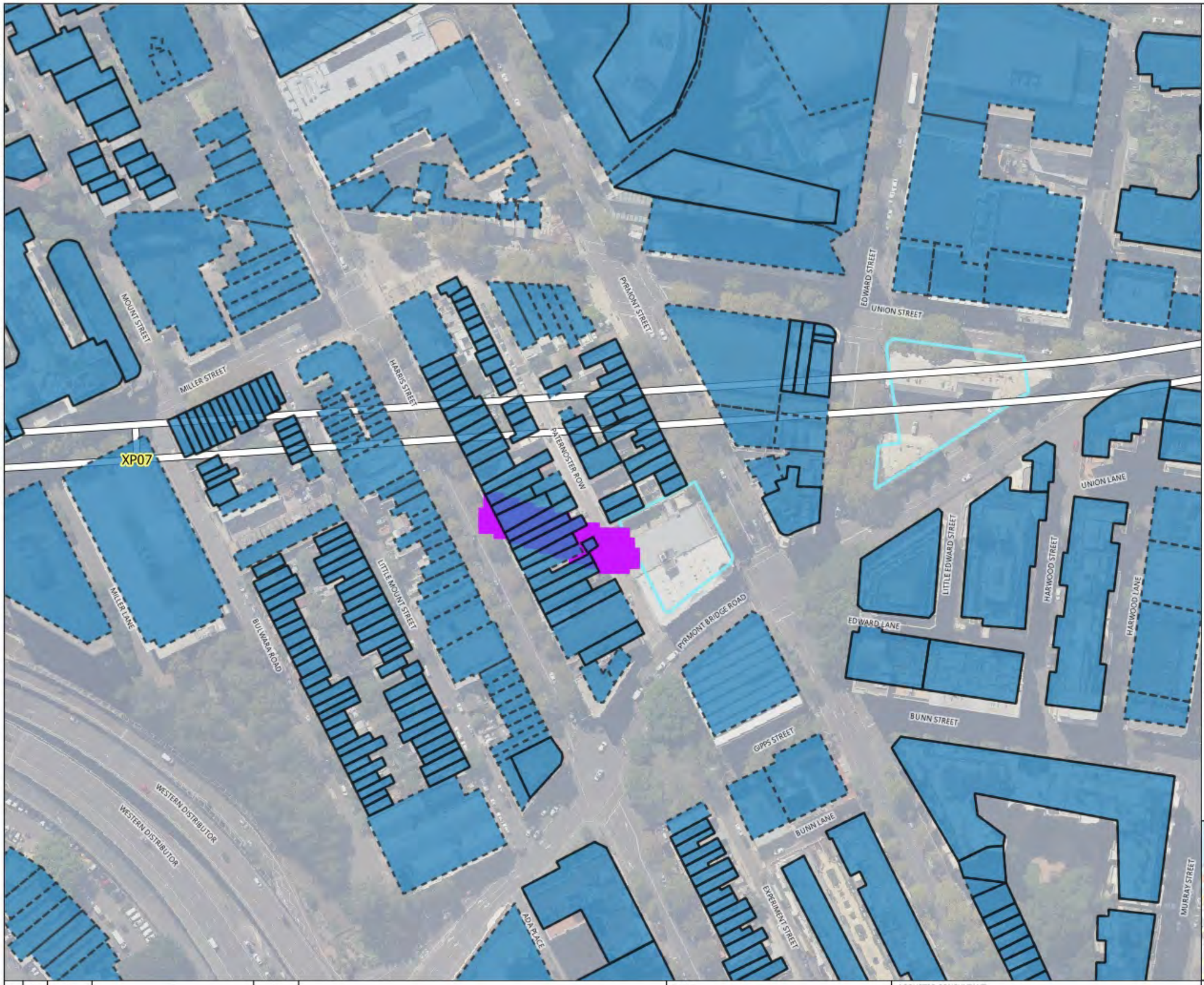
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Benching 1 excavation (Roadheader)

Plot Date: 04/08/23 - 14:26 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Service Adit SA1
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
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REV	BY	DATE	DESCRIPTION	APPROVER
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..	..	..	..	..
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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EASTERN TUNNELLING PACKAGE
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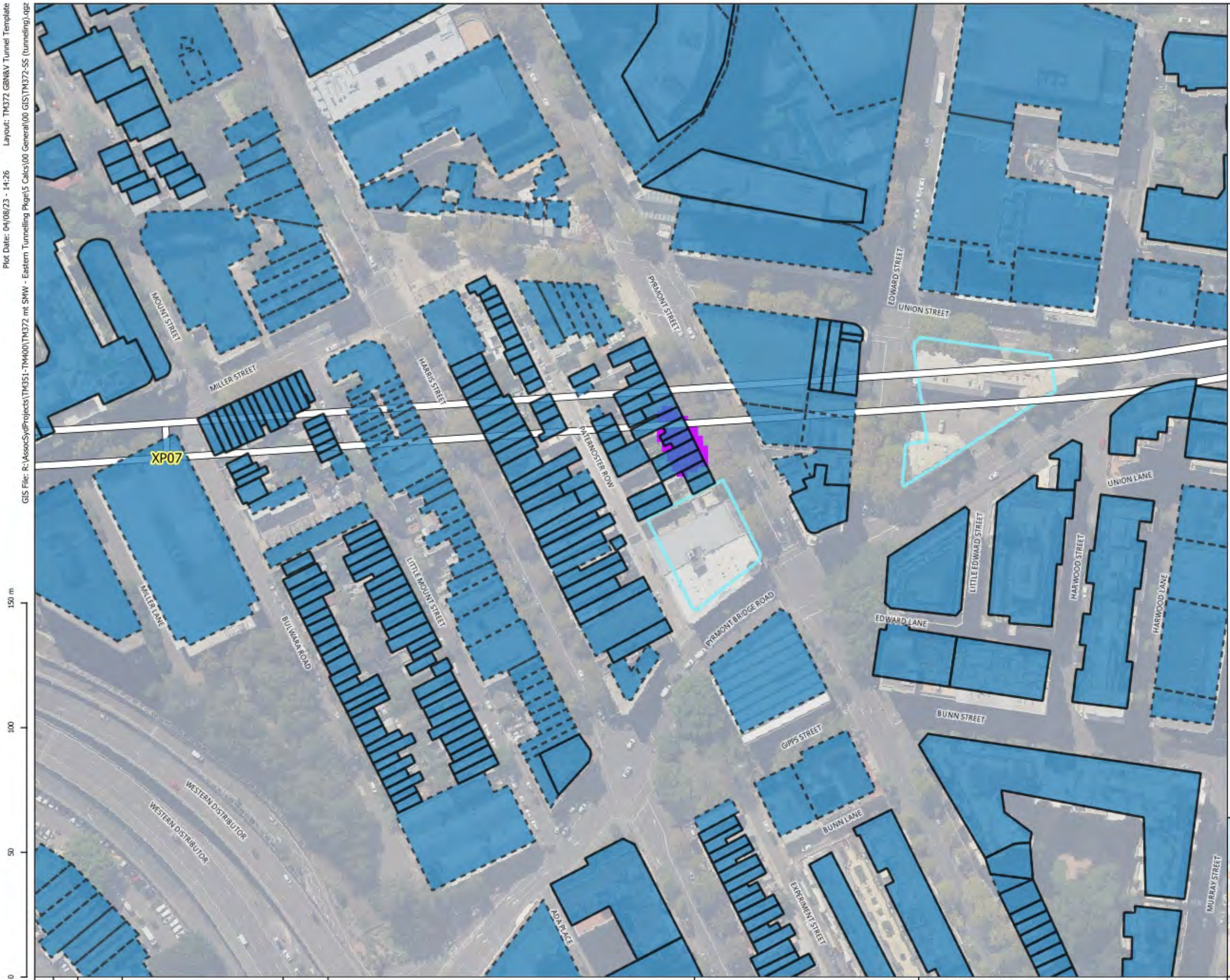
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Benching 2 excavation (Roadheader)

Plot Date: 04/08/23 - 14:26 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Pedestrian Adit PA1
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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REV	BY	DATE	DESCRIPTION	APPROVER
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

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JOHN HOLLAND CPB Ghella

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:27 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Pedestrian Adit PA2
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

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John Holland CPB Contractors Ghella JV

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:27 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Pedestrian Adit PA2
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

N

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Benching 1 excavation (Roadheader)

Plot Date: 04/08/23 - 14:27 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Pyrmont Pedestrian Adit PA2
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Benching 2 excavation (Roadheader)

Plot Date: 04/08/23 - 14:27 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Hunter Street Nozzle
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:27 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

150 m
100
50
0

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Hunter Street Nozzle
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

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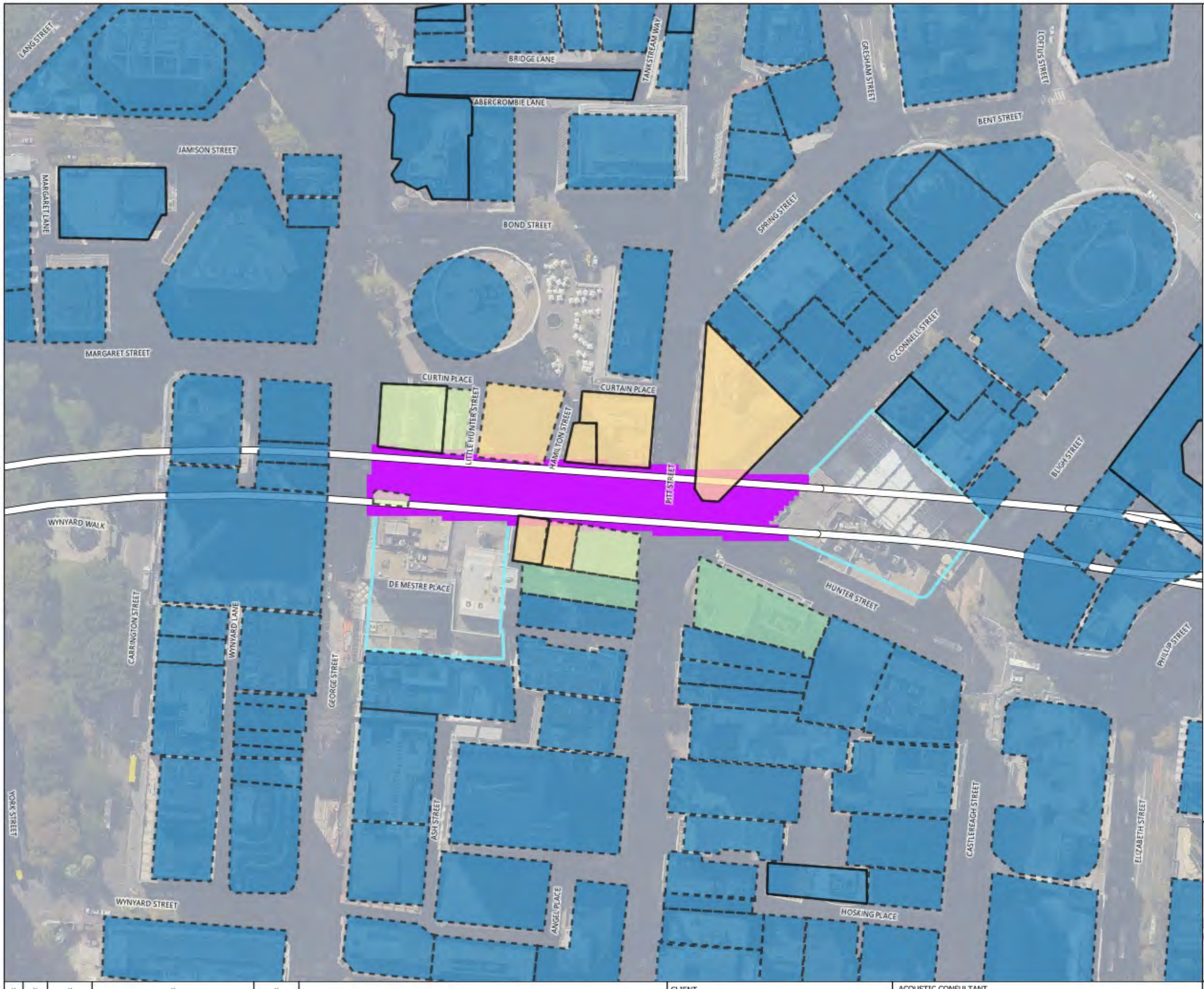
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Benching 1 excavation (Roadheader)

Plot Date: 04/08/23 - 14:27 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Hunter Street Station Cavern
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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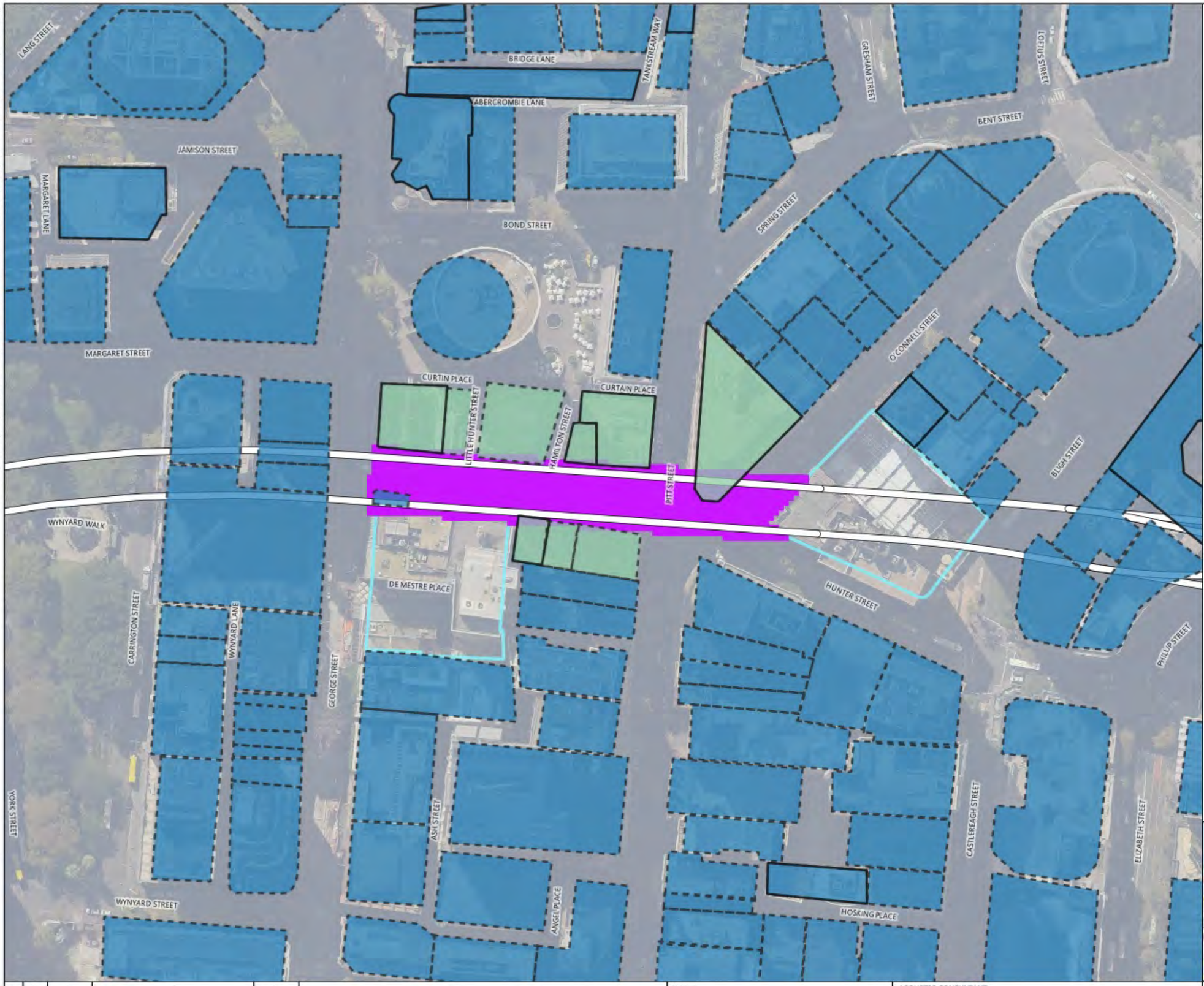
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:27 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Hunter Street Station Cavern
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

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REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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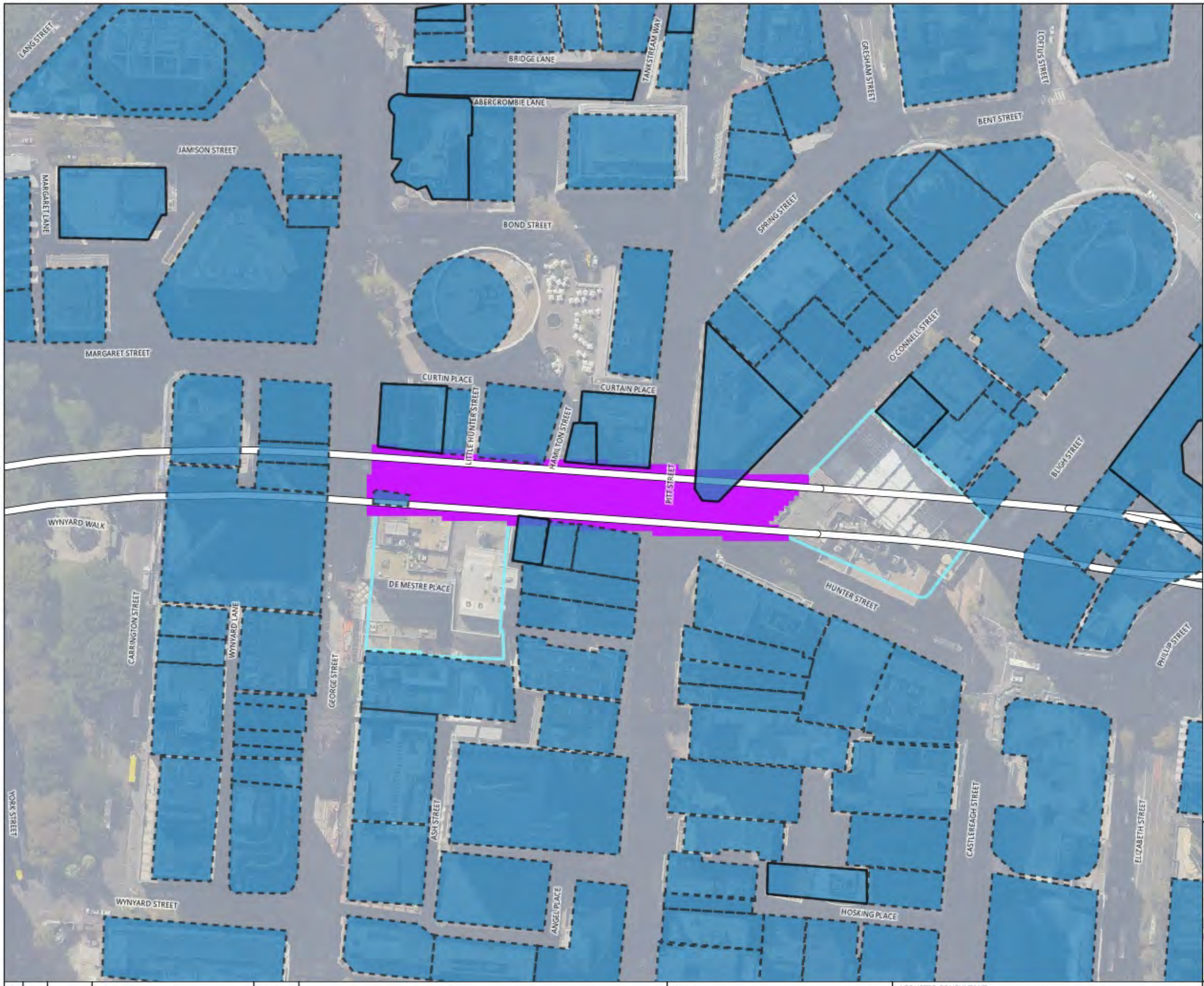
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Benching 1 excavation (Roadheader)

Plot Date: 04/08/23 - 14:28 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Hunter Street Station Cavern
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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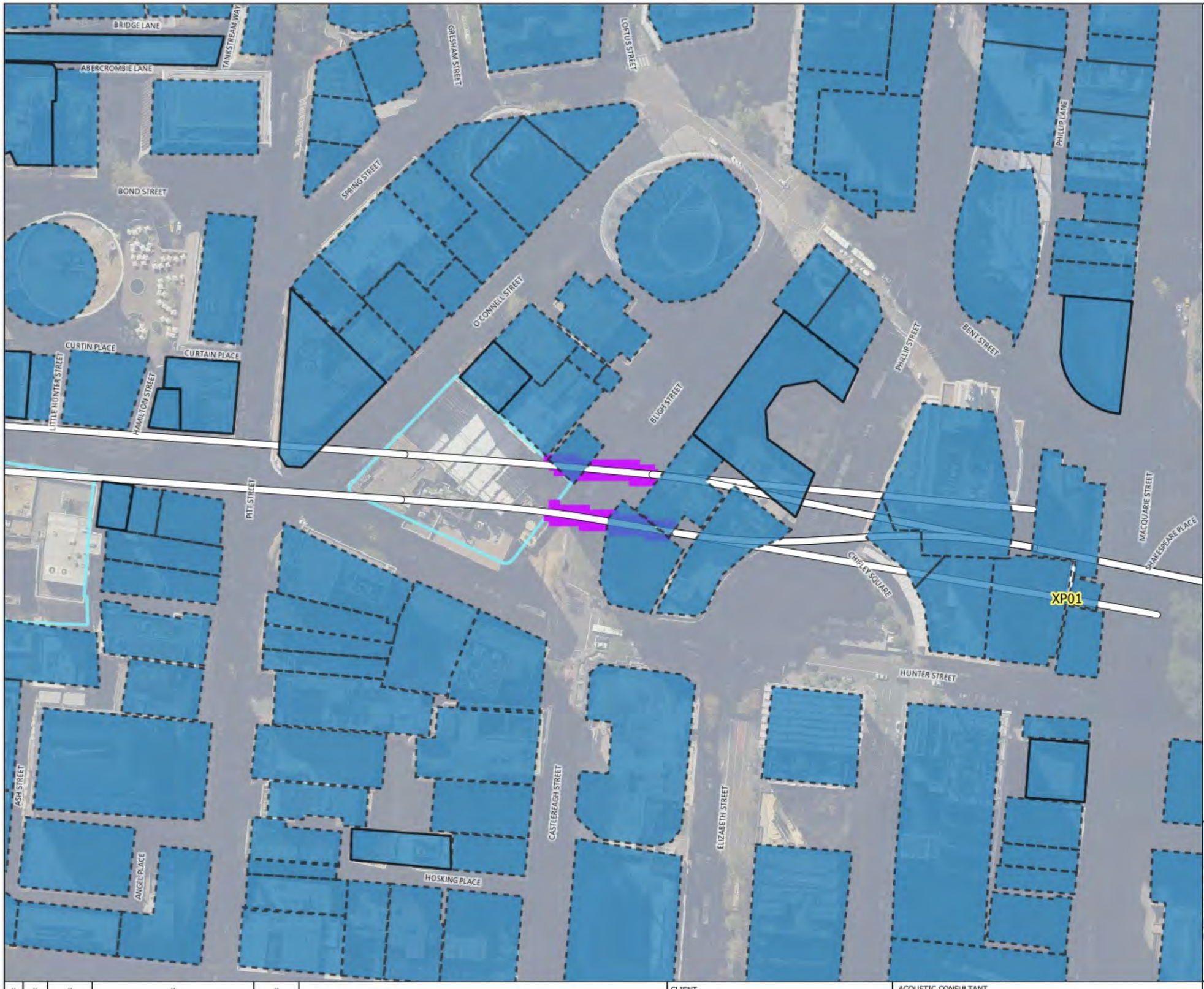
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Benching 2 excavation (Roadheader)

Plot Date: 04/08/23 - 14:28 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB1-S
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

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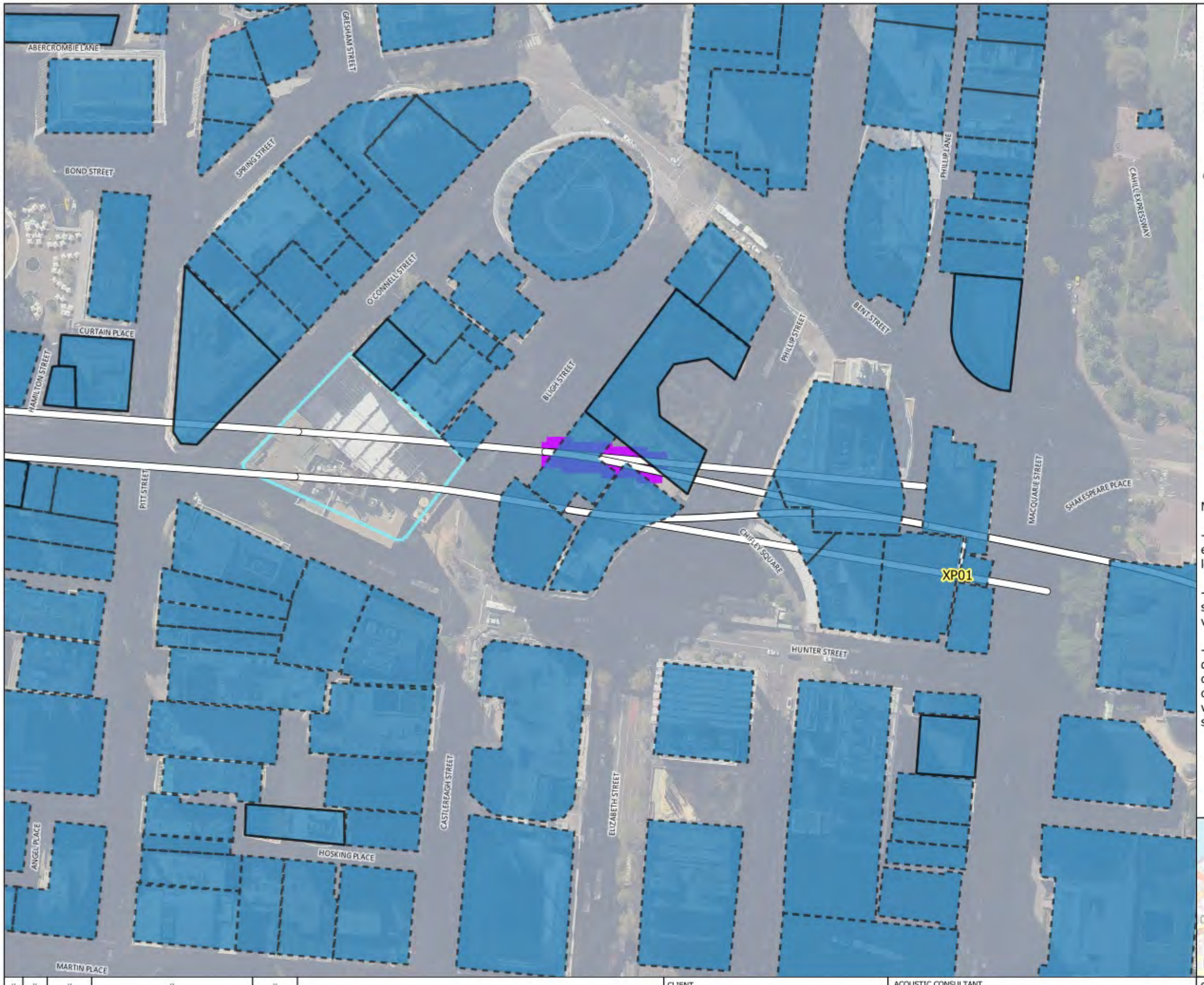
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:28 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB2 (North)
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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EASTERN TUNNELLING PACKAGE
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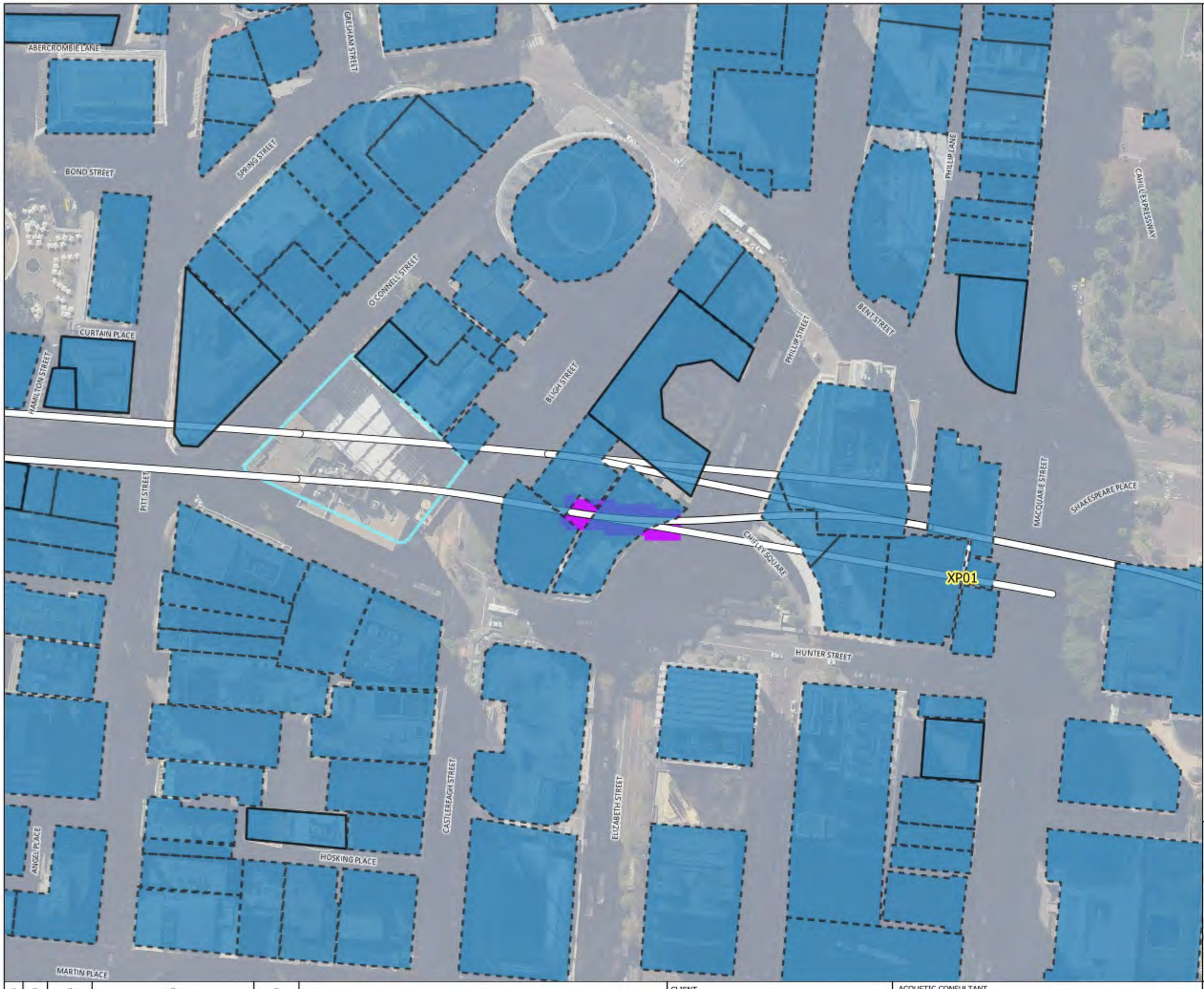
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:28 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB2 (South)
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:28 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB4 (West)
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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EASTERN TUNNELLING PACKAGE
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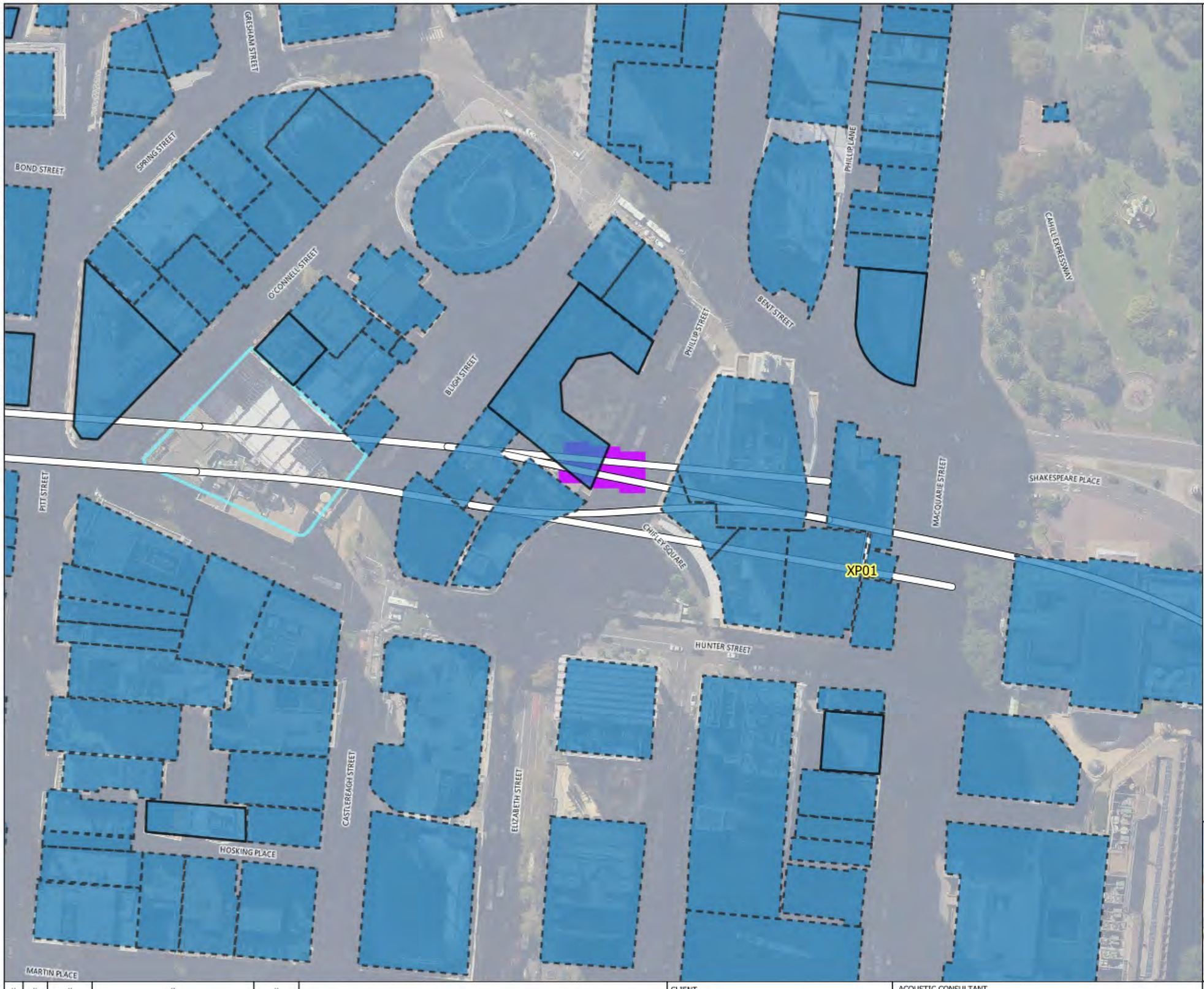
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:28 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB6
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
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SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:29 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz

LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB1-B
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
..	..	..	..	..
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
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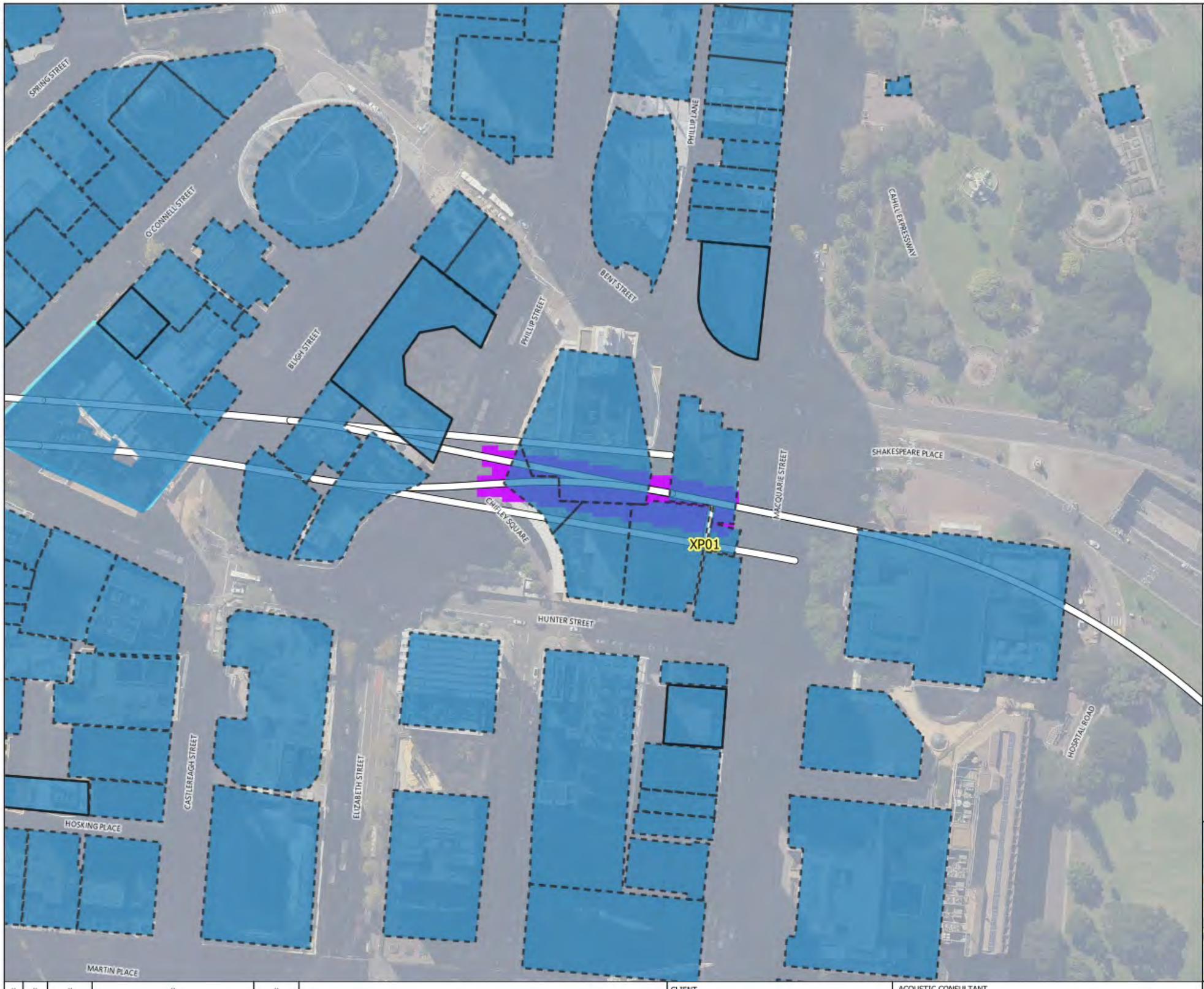
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:29 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB4 (East)
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 m

1:1,500

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

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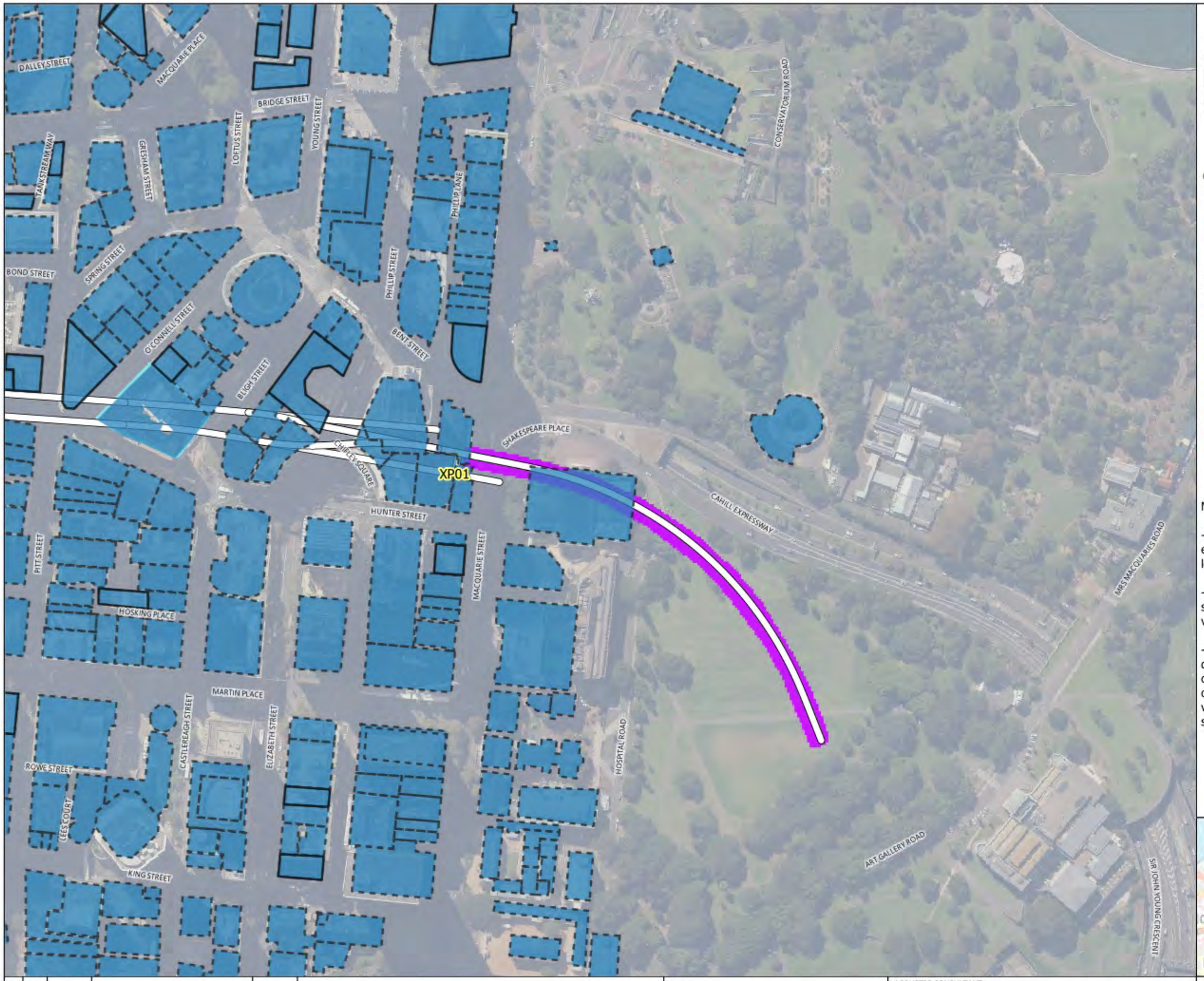
SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

Plot Date: 04/08/23 - 14:29 Layout: TM372 GBN&V Tunnel Template

GIS File: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\5 Calcs\00 General\00 GIS\TM372-SS (tunneling).qgz



LEGEND

Noise Sensitive Receivers

- Residential and Hotels
- Non-Residential

- Tunnel alignment
- Turnback TB5
- Station Shaft Footprint

Maximum GBV levels ppv(mm/s) during Roadheader operation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	04/08/23	Update Turnback Align	TG
r0	DA	26/06/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

CLIENT

EASTERN TUNNELLING PACKAGE
John Holland CPB Contractors Ghella JV

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve

Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST
Eastern Tunneling Package

Predicted Maximum GBV level during Heading excavation (Roadheader)

APPENDIX G Community consultation and construction noise respite program

G.1 Evidence of receiver specific consultation

Table G.1 Evidence of receiver specific consultation

Consultation ID	Date of consultation	Consultation trigger (D29, D30, D37, D38, other)	Consultation with	Consultation undertaken
G1.01	May - June 2023	D38 - ABN/ GBN >60 dB(A)	Properties located next to Pyrmont West site (127 Pyrmont St and 28 Paternoster Row)	- Specific meeting with stakeholders to provide work consultation and identify personal circumstances - Advise expected ground-borne noise impacts during excavation - Relocation finalised - Additional structural assessment offer made to properties adjoining the Pyrmont West site.
G1.02	May - June 2023	D27 Sensitive businesses - Recording Studios	Consultation with recording studios - Electric Avenue Studios (102 Pyrmont St) alocated within 20m of the site	- Specific meeting with stakeholders to detail work, confirm current noise insulation at the property and business requirements - Attended noise modelling to further understand impacts for businesses - Discussion regarding potential relocation options during high periods of impact - Confirmed no relocation required for Electric Avenue - Ongoing engagement to provide proactive information and expected impacts during construction - The ability to provide input into specific mitigation measures detailed in the DNVIS was discussed but no input was provided.
G1.03	May - June 2023	D27 Sensitive businesses - Recording Studios	Consultation with recording studios - Dodgy Sounds (102 Pyrmont Street) located within 20m of the site	- Specific meeting with stakeholders to detail work, confirm current noise insulation at the property and business requirements - Attended noise modelling to further understand impacts for businesses. - Discussion regarding potential relocation options during high periods of impact - Confirmed no relocation required for Dodgy Sounds - Ongoing engagement to provide proactive information and expected impacts during construction - The ability to provide input into specific mitigation measures detailed in the DNVIS was discussed but no input was provided.
G1.04	May - June 2023	D27 Sensitive businesses - Recording Studios	Consultation with recording studios - Otis Studios (198 Harris Street) located within 20m of the site	- Specific meeting with stakeholders to detail work, confirm current noise insulation at the property and business requirements - Attended noise modelling to further understand impacts for businesses. - Discussion regarding potential relocation options during high periods of impact - Relocation confirmed for Otis Studios to 113 Harris Street - Ongoing engagement to provide proactive information and expected impacts during construction - The ability to provide input into specific mitigation measures detailed in the DNVIS was discussed but no input was provided.
G1.05	May - June 2023		Consultation with nearby business - DXC Technology - Pyrmont Data Centre (13A Union Street), between Pyrmont East and West sites.	Specific meeting with stakeholder regarding sensitivities to specific construction impacts such as dust, vibration and noise Ongoing engagement with stakeholder to provide proactive updates - The ability to provide input into specific mitigation measures detailed in the DNVIS was discussed but no input was provided.
G1.06	May - June 2023	D38 - ABN/ GBN >60 dB(A)	Consultation with The Sebel hotel, located between Pyrmont east and west sites (within 20m).	- Specific meeting with stakeholders to detail work, confirm current noise insulation at the property and identify business requirements - Ongoing engagement with stakeholder to provide proactive information and expected impacts during construction - The ability to provide input into specific mitigation measures detailed in the DNVIS was discussed but no input was provided.
G1.07	May - June 2023	D38 - ABN/ GBN >60 dB(A)	Consultation with directly impacted residents in streets closest to the sites, including Paternoster Row, Pyrmont Street, Edward Street, Bowman Street and Harris Street Examples: 198 Harris Street, 113 Pyrmont Street, 2 Bowman Street, 107 Pyrmont Street, Community Information Day, Community Pop Ups (Union Square)	- Specific meeting with stakeholders to provide detailed work information, expected impacts, methodology - Advised expected ground-borne noise impacts during cavern excavation - Baseline monitoring and expected noise levels - The ability to provide input into specific mitigation measures detailed in the DNVIS was discussed but no input was provided. - Additional mitigaton measures as outliend in the DNVIS were discussed with occupants.
G1.08	May - June 2023		Consultation with directly impacted businesses throughout Pyrmont	- Specific meeting with stakeholders to provide detailed work information, expected impacts, methodology - Advised expected ground-borne noise impacts during cavern excavation - Baseline monitoring and expected noise levels - The ability to provide input into specific mitigation measures detailed in the DNVIS was discussed but no input was provided.
G1.09	Jan - June 2023	General Consultation	Radission Blu Hotel	Ongoing meetings and communications to detail upcoming work, consult on and outline mitigiation measures and understand impacts from Tunnelling works on the Hotel Specific meeting to share noise and vibration modelling and identify preferred locations including for GBN and vibration monitoring Consultation on locations of permanent noise and vibration monitors Site visit with Renzo Tonin to assess occupied levels and land use Receives all project communication including weekly, monthly and six-monthly updates Installation of noise and vibration monitoring devices in B4 basement Consultation has occurred regarding specific mitigation measures associated with Tunnelling works. JCG will communicate the upcoming tunnelling program including tunnelling locations to allow the Radisson to potentially adjust their room occupancy and office working areas to
G1.10	Mar - June 2023	General Consultation	Tank Stream Hotel	Meeting to detail work, consult on and outline mitigiation measures and understand impacts for Hotel Ongoing communications to discuss upcoming works and answer questions relating to the project. Meetings and site visit to install noise and vibration monitoring equipment including vibration in lower levels. Consultation has occurred regarding specific mitigation measures associated with Tunnelling works. JCG will communicate the upcoming tunnelling program including tunnelling locations to allow the Tank Stream Hotel to potentially adjust their room occupancy to avoid GBN and DBV affect areas
G1.11	Jan - June 2023	General Consultation	Sydney Water	Correspondence has been received from Sydney Water supporting the use of frequency dependent vibration criteria in accordance with DIN4150-3. This correspondence is attached to the DNVIS. JCG have lodged 3 Specialist Engineering Assessment (SEA) with Sydney Water to assessment the impacts of the hunter street cavern. 1.CN204578 Bennelong. 2.CN204579 Tank Stream. 3.CN204581 Other Assets. These assessments have been reviewed by Sydney Water and discussed during weekly meetings
G1.12	Feb - June 2023	General Consultation	A by Adina Hotel	Meeting to detail work, consult on and outline mitigiation measures and understand impacts for Hotel Ongoing communications to discuss upcoming works and answer questions relating to the project.

Table G.1 Evidence of receiver specific consultation

Consultation ID	Date of consultation	Consultation trigger (D29, D30, D37, D38, other)	Consultation with	Consultation undertaken
G1.13	Feb - March 2023	General Consultation	The Grand Hotel (Merivale)	Meeting to detail work, consult on and outline mitigiation measures and understand impacts for Hotel Ongoing communications to discuss upcoming works and answer questions relating to the project.
G1.14	Feb - Mar 2023	General Consultation	Hotel Sofitel Wentworth	Meeting to detail work, consult on and outline mitigiation measures and understand impacts for Hotel Ongoing communications to discuss upcoming works and answer questions relating to the project.
G1.15	Feb -April 2023	General Consultation	Merivale (ivy, Royal George, The Grand Hotel)	Ongoing meetings to detail upcoming, inspect premises, consult on and outline mitigiation measures and understand impacts for business Installation of noise and vibration monitoring devices
G1.16	Jan - March 2023	General Consultation	Brookfield	Fortnightlight meeting to detail work, outline mitigiation measures and understand impact to tenants. Meetings concluded in March 2023.
G1.17	Feb-23	General Consultation	NSW Parliament	Meeting to detail work, consult on and outline mitigiation measures and understand impacts for businesses
G1.18	Mar-23	General Consultation	NSW State Library	Meeting to detail work, outline mitigation measures and understand impacts for businesses
G1.19	Mar-23	General Consultation	Chifley Café	Multiple meetings to outline work and program,understand concerns from businesses owner and outline mitigiation measures
G1.20	Jan - April 2023	General Consultation	Domain	Meetings with Asset Manager and Site Supervisor to detail work, outline mitigiation measures and how reduce impact on-site.
G1.21	Jan-23	General Consultation	4-6 Bligh Street	Meeting with Building Manager to detail work, outline mitigiation measures and understand impacts for businesses
G1.22	Mar-23	General Consultation	68-96 Hunter St (Qantas House)	Meeting with Strata Committee to detail work, outline mitigiation measures and understand impacts for each business.
G1.23	Mar-23	General Consultation	165 Macquarie Street (Australian Club)	Meeting to detail work, outline mitigiation measures and understand impacts for businesses and Hotel
G1.24	Mar-23	General Consultation	175 Macquarie Street	Meeting to detail work, outline mitigiation measures and understand impacts for businesses
G1.25	Feb - April 2023	General Consultation	109 Pitt St Arcade Strata Committee	Ongoing meetings and communications to outline mitigiation measures and understand impacts for Strata Committee
G1.26	Feb - April 2023	General Consultation	109 Pitt Arcade Businesses	Ongoing meetings to upcoming detail work, outline mitigiation measures understand impacts for indivdual businesses.
G1.27	Mar-23	General Consultation	109 Pitt St Car Park	Meeting to detail work, outline mitigiation measures and understand impacts for businesses
G1.28	Feb-23	General Consultation	20 Hunter St	Meeting to detail work, outline mitigiation measures and understand impacts for businesses
G1.29	Feb-23	General Consultation	10 Hunter (NSW Sports Club)	Meeting to detail work, outline mitigiation measures and understand impacts for tenants Met individually with Hospitality venue located at rear of building (ground and basement) to discuss upcoming works and have emailed to schedule an additional meeting to discuss project
G1.30	Feb-23	General Consultation	275 George	Meeting to detail work, outline mitigiation measures and understand impacts for tenants and location of hospitatlity venue
G1.31	Mar-23	General Consultation	123 Pitt St (Angel Place)	Meeting to Building Management to detail work, outline mitigiation measures and understand impacts for tenants and understand locations of hospitality venues
G1.32	Mar-23	General Consultation	283 George	Meeting with Strate Commitee detail work, outline mitigiation measures and understand impacts for indivudal businesses
G1.33	Feb - April 2023	General Consultation	31 Bligh St	Meeting to detail work, outline mitigiation measures, and understand impacts for business Installed Building Movement equipment Weekly meetings now scheduled to outline program and understand any upcoming events so we can reduce impacts
G1.34	Jan - March 2023	General Consultation	25 Bligh St	Email sent to detail work, outline mitigiation measures and understand impacts for tenants Have approved request to install building movement equipment on site
G1.35	Feb-23	General Consultation	66 Hunter	Emailed to request meeting and detail work, outline mitigiation measures and understand impacts for businesses
G1.36	Feb-23	General Consultation	68 Pitt Street	Email sent to outline work, mitigiation measures and understand impacts for tenants Have approved request to install building movement equipment on site
G1.37	Jan-23	General Consultation	39 Hunter St	Meeting to detail work, outline mitigiation measures and understand impacts for business Outlined that business is trading company that may be disrupted by noise Responded to enquiries regarding road closures and out of hours work
G1.38	Mar-23	General Consultation	6-10 O'Connell St	Meeting to detail work, outline mitigiation measures and understand impacts for tenants
G1.39	Feb-March 2023	General Consultation	8-12 Chifley Square (103-107 Phillip)	Meeting to detail work, outline mitigiation measures and understand impacts fortenants
G1.40	Jan - April 2023	General Consultation	5 Elizabeth Street (Martin Place North)	Monthly Meeting to detail work, outline mitigiation measures and understand impacts for tenants
G1.41	April - June 2023	General Consultation	Milligan Group (15-21 Hunter Street and 101-107 Pitt Street	Meeting to detail work, consult on and outline mitigiation measures and understand impacts for businesses Ongoing communications to discuss upcoming works and answer questions relating to the project.
G1.42	May-23	General Consultation	1 O'Connell Street	Meeting to detail work, consult on and outline mitigiation measures and understand impacts for businesses Ongoing communications to discuss upcoming works and answer questions relating to the project.
G1.43	May-23	General Consultation	16 O'Connell (The Carter)	Meeting to detail work, consult on and outline mitigiation measures and understand impacts for businesses Ongoing communications to discuss upcoming works and answer questions relating to the project.

G.2 Sydney Water Assets - Engineering Review of Red Vibration Trigger Event

Correspondence with Sydney Water regarding appropriate criteria to be adopted to manage impacts should the 3mm/s trigger level be exceeded, taking into consideration the frequency of the vibration. This approach has been included in Section 4 and Section 7.2.4.

From: Hanka Shabilla <HANKA.SHABILLA@sydneywater.com.au>
Sent: Thursday, 20 April 2023 9:42 AM
To: Alejandro Nino-ETP <alejandro.nino@jcgjv.com.au>
Cc: Ken Dillon <ken.dillon@transport.nsw.gov.au>; Nathan Bryant-JHG <Nathan.Bryant@JCGJV.com.au>; Ta Christian Duong <TACHRISTIAN.DUONG@sydneywater.com.au>
Subject: RE: [External] Hunter Street MAT Meeting - 02 - 230419 - Engineering Review of Red Vibration Trigger Event

Hi Alejandro,

We have reviewed the general correspondence letter.

We agree with the assessment that the 3mm/s trigger level is appropriate for these assets when looking at vibration independent of frequency. We also agree that for the 293Hz frequency of the vibration, that the 10mm/s limit is more appropriate, as per DIN 4150-3. There is also a Swedish standard for blasting in quarries which confirms that as the frequency rises above 100Hz (the uppermost frequency in DIN 4150-3), that the damage threshold limit further increases.

If PSM feel the need to change their triggers, we would suggest they only do that if the loggers can trigger on the basis of the frequency dependent limit (which may or may not be possible).

Thank you.

Kind Regards,

Hanka Shabilla
Mob 0466 491 392

From: Alejandro Nino-ETP <alejandro.nino@jcgjv.com.au>
Sent: Wednesday, 19 April 2023 6:50 PM
To: Hanka Shabilla <HANKA.SHABILLA@sydneywater.com.au>
Cc: Ken Dillon <ken.dillon@transport.nsw.gov.au>; Nathan Bryant-JHG <Nathan.Bryant@JCGJV.com.au>
Subject: [External] Hunter Street MAT Meeting - 02 - 230419 - Engineering Review of Red Vibration Trigger Event

CAUTION: This email originated from outside the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hi Hanka,

There was a red vibration trigger alert at the monitor within Bligh St adit, below Bennelong sewer tunnel. Please find attached the engineering review from our consultant PSM.

I will formalise this correspondence tomorrow. Please feel free to give me a call if you have any questions with the review.

Regards, H

Alejandro Niño
Utilities Manager

Sydney Metro West
Eastern Tunnelling Package
John Holland CPB Contractors Ghella JV

Level 4, 60 Union Street
Pyrmont NSW 2009
M 0431 402 050
E alejandro.nino@jcgjv.com.au

ACOUSTICS ADVISOR ENDORSEMENT
SYDNEY METRO WEST (SSI 19238057)

Review of	Eastern Tunnelling Package: Detailed Noise and Vibration Impact Statement (DNVIS) – Tunnelling	Reviewed document reference:	TM372-02-1-04F01 SMW-ETP_DNVIS-TUN Revision 1 dated 24 August 2023
Prepared by:	Dave Anderson, Acoustics Advisor		
Date of issue:	25 August 2023		

I endorsed Revision 0 of this DNVIS, which focussed on the Hunter Street cavern works, in June 2023. The DNVIS has since been updated to finalise the content for the full scope of tunnelling works across the ETP project alignment (The Bays to Hunter Street). I have reviewed and provided comments on 2 drafts of this content, and I am satisfied that the Revision 1 has been updated to address my comments.

I note that:

- The DNVIS has been updated to include reference to the daytime ground borne noise management level for residential receivers, for consistency with the EIS;
- The DNVIS has been updated to include the auditorium currently under construction at the State Library, near the stub tunnels;
- Cross passage excavation will be limited to standard construction hours only, except where it can be carried out OOH without exceeding applicable ground borne noise management levels at residential and hotel receivers;
- The cavern excavation at Pyrmont will be undertaken with road headers rather than hydraulic hammering (including for the benching). This activity is likely to progress at a rate of around 20m per week which means that nearby receivers are likely to be affected for a week or two at a time, rather than for the full duration of cavern excavation (which would be months);
- JCG have indicated that they are committed to consulting with the community about the tunnelling work and determining appropriate specific mitigation (such as noise cancelling headphones or alternate work space for residents working from home), whether or not this is strictly required under Sydney Metro's Construction Noise and Vibration Standard.

I endorse this DNVIS for implementation.

DCAnderson

Dave Anderson, Metro West Acoustics Advisor