Planning Approval Consistency Assessment Form

SM 17 00000111

Metro Body of Knowledge (MBoK)

Assessment name:	Sydney Metro West – Tunnel boring machine drive strategy and future Rosehill crossover
Prepared by:	Sydney Metro
Prepared for:	Sydney Metro and Western Tunnelling Package contractor
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The Planning Approval Consistency Assessment Form should be completed in accordance with SM-17-00000103 Planning Approval Consistency Assessment Procedure.

1. Existing Approved Project

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

- SSI-10038 Sydney Metro West – Concept and major civil construction work for Sydney Metro West between Westmead and The Bays (Stage 1 of the planning approval process for Sydney Metro West)

Date of determination:

- SSI 10038: 11 March 2021

Type of planning approval: Critical SSI (Division 5.2)

Sydney Metro West (the Concept)

Sydney Metro West (the Concept) would involve the construction and operation of a metro rail line around 24 kilometres long between Westmead and Hunter Street in the Sydney CBD. The key components are expected to include (as described in Chapter 6 of the Environmental Impact Statement (EIS)):

- Construction and operation of new passenger rail infrastructure between Westmead and the central business district of Sydney, including:
  - Tunnels, stations (including surrounding areas) and associated rail facilities
  - Stabling and maintenance facilities (including associated underground and overground connections to tunnels)
- Modification of existing rail infrastructure (including stations and surrounding areas)
- Ancillary development.

Sydney Metro West - all major civil construction works between Westmead and The Bays (the approved project)

The Sydney Metro West Project Concept; and all major civil construction works between Westmead and The Bays, including station excavation and tunnelling was determined on 11 March 2021. The scope of Stage 1 of the planning approval process for Sydney Metro West (the approved project) is described in Chapter 9 of the EIS, with the key features including:

- Tunnel excavation including tunnel support activities between Westmead and The Bays
- Station excavation for new metro stations at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock and The Bays

- Shaft excavation for services facilities
- Civil work for the stabling and maintenance facility at Clyde.

Tunnelling construction methodology for the approved project

The EIS identifies the following methodology for excavation of the tunnels. Tunnel boring machines would be used to excavate twin tunnels about 21 kilometres long. 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 EIS identified two tunnel boring machine launch and support sites for the approved project:

1. Westmead metro station construction site: Two tunnel boring machines (one for each tunnel) would be launched from the Westmead metro station construction site. These two tunnel boring machines would be driven about nine kilometres eastwards to the Sydney Olympic Park metro station construction site. The tunnel boring machines would be launched from the station box excavation.
2. The Bays construction site: Two tunnel boring machines (one for each tunnel) would be launched from The Bays Station construction site. These two tunnel boring machines would be driven about 11 kilometres westwards to the Sydney Olympic Park metro station construction site. The tunnel boring machines would be launched from the station box excavation. The tunnel boring machines would be dismantled and retrieved at the Sydney Olympic Park metro station construction site.

Rosehill services facility

The EIS for the approved project describes the services facilities shaft to be constructed at Rosehill, which would involve excavation of a shaft to the mainline tunnels below, and would house future services facilities.

This would require removal of about 20,000 cubic metres of spoil as assessed within the EIS.

Construction works for the services facilities would involve:

- Demolition of structures on the site and vegetation removal, where required
- Excavation of a vertical shaft to the tunnels below. This may be carried out using excavators and rock hammers, however drill and blast or penetrating cone fracture techniques may also be used
- Temporary lining and reinforcement of the shaft.

Indicative construction program as assessed in the EIS

The indicative construction program for major civil works as outlined within the EIS considered that tunnelling between Westmead metro Station construction site to the Bays Station construction site would occur between approximately mid 2022 and 2026 (refer Figure 1).

Note: This program only shows major civil works (Stage 1) indicative duration and not the total works.

Figure 1 Indicative construction program as identified in the Environmental Impact Statement

Relevant background information (including EA, REF, Submissions Report, Director General's Report, MCoA):
This Consistency Assessment has been undertaken for The Sydney Metro West Concept and major civil construction work for Sydney Metro West between Westmead and The Bays (Stage 1 of the planning approval process for Sydney Metro West). This includes the following planning approval documentation:

- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Environmental Impact Statement (15 April 2020)
- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Submissions Report (20 November 2020)
- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Amendment Report (20 November 2020)
- Instrument of Approval (11 March 2021).

All documentation has been published on the Department of Planning, Industry and Environment Major Projects website located here (Major Project Number: SSI-10038): https://www.planningportal.nsw.gov.au/major-projects/project/25631

All proposed works identified in this assessment would be undertaken in accordance with the mitigation measures identified in the EIS, Submissions Report and Amendment Report and the conditions of approval.

2. Description of proposal

The purpose of this Consistency Assessment is to assess a proposed construction sequencing change of the tunnel boring machines. Since the approval of the project, further construction methodology planning for the tunnel boring machine sequencing has been undertaken. Sydney Metro identified the opportunity to improve the construction interfaces with other construction activities along the alignment, and as a result an improved tunnel boring machine drive strategy / sequence has been identified. Whilst the sequencing of the tunnelling program in Section 9.3 of the Environmental Impact Statement would be revised (refer Figure 1), the overall construction program timeframes would remain consistent with the approved project.

The indicative tunnel boring machine sequencing has been revised to allow for the tunnel boring machines to be launched and driven from the Clyde stabling and maintenance facility construction site. Due to the surrounding industrial nature of the Clyde stabling and maintenance facility construction site, it is considered a more suitable location for tunnel boring machine launch and tunnelling support activities when compared to the low to medium residential area surrounding the Westmead metro station construction site.

Further analysis of the operation of the line identified the need for an additional rail crossover around Rosehill. This would provide for more efficient operations and maintenance, and improved response in degraded operational modes (such as if there is an incident in one tunnel). As a result, the proposal also includes additional excavation of the Rosehill services facility shaft to allow for a future rail crossover. Assessment of the fit-out and operation of the future rail crossover would be undertaken as part of future stages of the planning approval.

Key features of the proposal include:

- A revised tunnel boring machine drive strategy from Westmead to Sydney Olympic Park (refer Figure 2). Tunnel boring machines would now be launched from the Clyde stabling and maintenance facility construction site, from within the indicative Rosehill services shaft excavation for the approved project. The Rosehill services shaft would contain new tunnel support and tunnel boring machine launch facilities. The revised tunnel excavation methodology includes:
  - Two tunnel boring machines (one for each tunnel) would be driven eastward to the Sydney Olympic Park metro station construction site. The tunnel boring machines would be dismantled and retrieved at the Sydney Olympic Park metro station construction site (as per the approved project) and transported back to the launch site at the Clyde stabling and maintenance facility construction site
  - The two tunnel boring machines (one for each tunnel) would then be driven westwards to the Westmead metro station construction site. The tunnel boring machines would be dismantled and retrieved from the Westmead metro station construction site (within the approved station box excavation).
- The indicative Rosehill services shaft as discussed in the EIS would be relocated approximately 80 metres further north-west within the approved Clyde stabling and maintenance facility construction site, and would be extended in length and would be slightly deeper to allow for:
  - a future rail crossover to allow trains to change to the other track to support more efficient operations and so maintenance work can be carried out with minimal interruption to services
  - tunnel boring machine launch and support activities (refer Figure 2)
- Minor tunnel realignment between James Ruse Drive and Silverwater Road to accommodate the revised services shaft location (refer Figure 2). The tunnel would be realigned up to approximately 50 metres south of the tunnel corridor compared with the indicative alignment in the EIS
- The Eastern Creek Precast Facilities project was determined by Sydney Metro on 11 March 2021, which includes the construction and operation of two adjacent precast facilities to support the construction of Sydney Metro West. The Sydney Metro West Concept and major civil construction work for Sydney Metro West between Westmead and The Bays (the approved project) also includes a precast facility at the Clyde stabling and maintenance facility construction site. Further construction planning including assessment of the precast segment productivity requirements has indicated that the two precast facilities at Eastern Creek would have the capacity to support all Sydney Metro West tunnelling works, and therefore the precast facility at the Clyde site would no longer be required. The indicative area designated for the precast facility within the Clyde stabling and maintenance facility construction site would be retained and utilised for the road diversion works site required for the approved project (refer Figure 3)

- The tunnel support services and tunnel boring machine launch activities approved for the Westmead metro station construction site (within the approved station box excavation) would no longer be required, eliminating the associated spoil haulage occurring from this site. The Westmead metro station construction footprint and station box excavation would remain consistent with the approved project.

It is estimated that 675,000 cubic metres of tunnelling spoil would be retrieved from the Clyde stabling and maintenance facility construction site as opposed to the Westmead metro station construction site, reducing heavy vehicle movements around the surrounding residential area of Westmead, and therefore reducing traffic impacts in that locality. Spoil would be beneficially reused by either being placed on site at the Clyde stabling and maintenance facility construction site or hauled offsite via approved haulage routes. Given the removal of the precast facility from the site (and associated heavy vehicles) and the potential ability to reuse tunnel spoil at the site (thereby avoiding the need to import fill), vehicle movements accessing and egressing the Clyde stabling and maintenance facility construction site would consistent with those assessed for the approved project.

Plant and equipment and vehicles required for the additional excavation at the Clyde stabling and maintenance facility construction site are consistent with those identified in the EIS for shaft excavation works.

Daily construction movements per day would remain consistent with the indicative estimates as assessed within the EIS, due to:

- The removal of the precast facility and associated truck numbers to import raw materials and transport segments to other sites
- Potential removal of trucks importing fill material for the stabling facility from other sites.

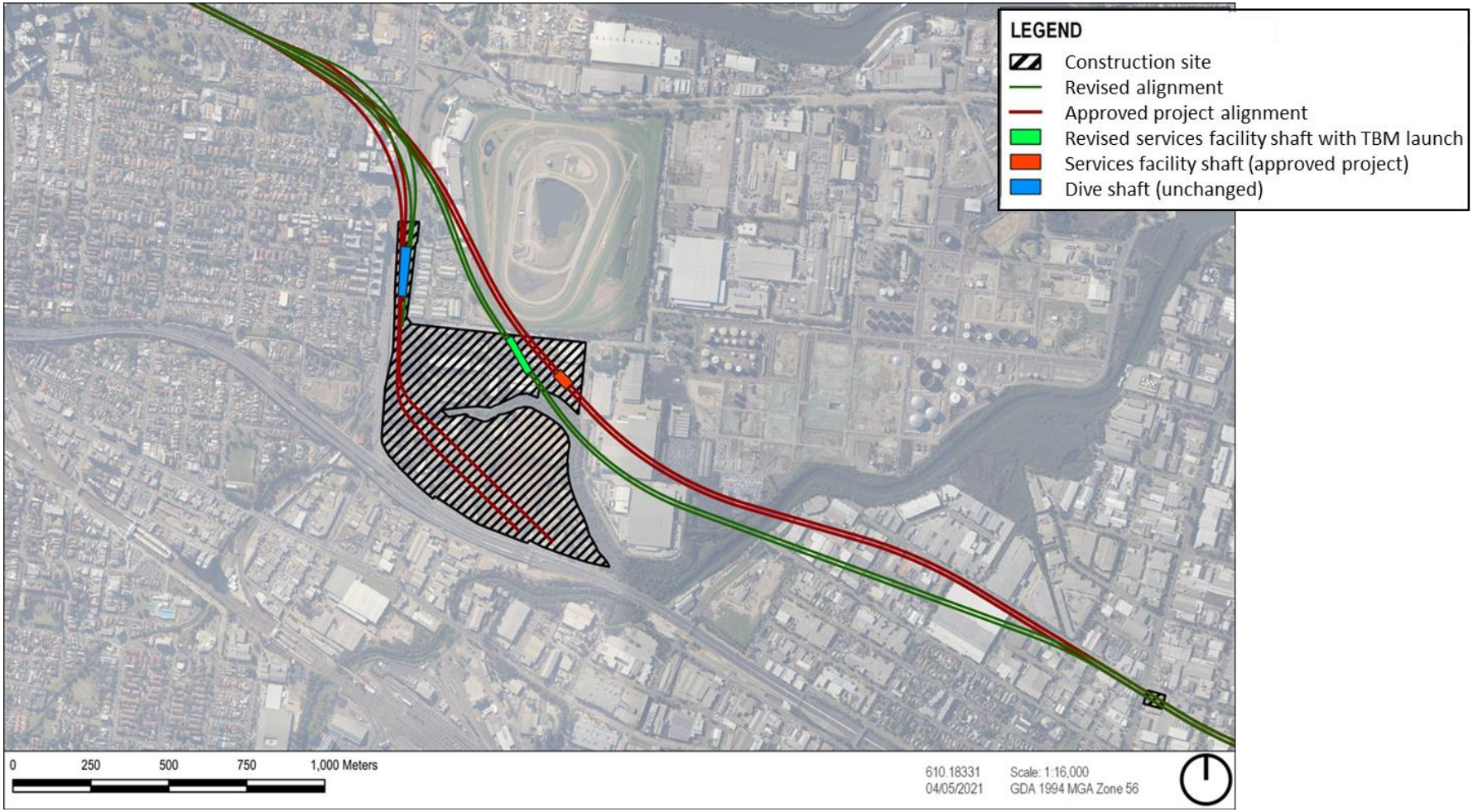


Figure 2 Revised Rosehill services shaft and tunnel realignment (SLR, 2021)

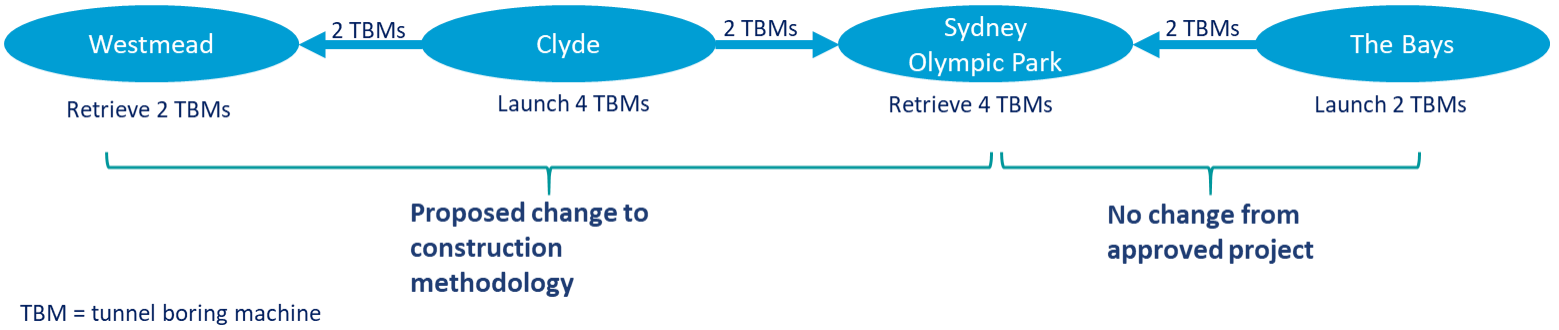


Figure 3 Revised tunnel boring machine tunnelling sequence

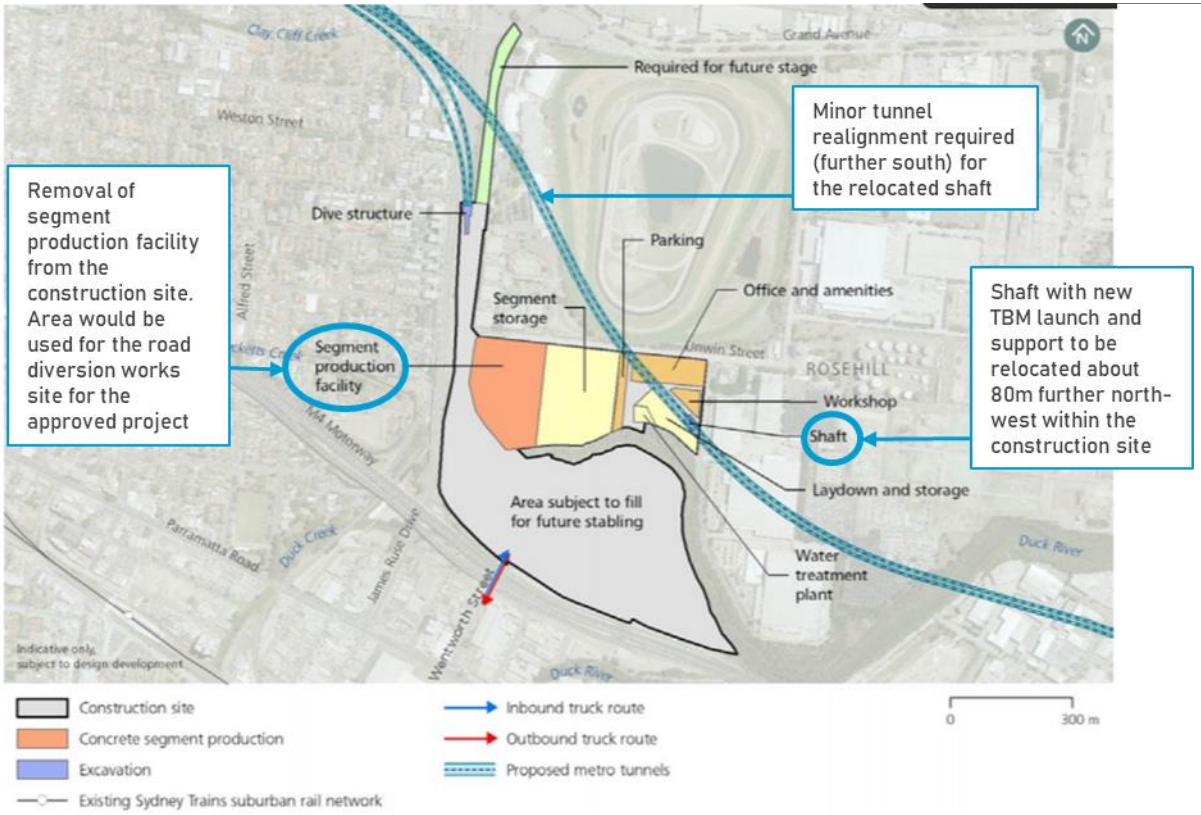


Figure 9-17: Clyde stabling and maintenance facility indicative construction site layout

Figure 4 Proposed changes to the Clyde stabling and maintenance facility indicative construction site layout

3. Timeframe

The approved standard working hours for the approved project are as follows:

- 07:00 – 18:00 Monday to Friday
- 08:00 – 18:00 Saturdays
- No works Sundays or Public holidays.

The approved project also permits the following activities to be carried our 24 hours per day, seven days per week:

- Tunnelling (excluding cut and cover tunnelling and surface works)
- Haulage of spoil except between the hours of 10:00pm and 7:00am to / from the Five Dock and Westmead construction sites and to / from Burwood North construction site using any roads / streets other than directly from Parramatta Road
- Concrete batching at the Clyde construction site.

In accordance with the approved project, tunnelling and spoil haulage at the Clyde stabling and maintenance facility construction site would be carried out up to 24 hours per day and seven days per week.

Other out of hours works which may be required would be undertaken in accordance with the conditions of approval, any relevant approved Traffic Management Plans and the applicable contractors Environmental Protection Licence. This is consistent with the approved project.

The tunnelling program as set in Section 9.3 of the Environmental Impact Statement (and as shown in Figure 1) would be revised to improve the construction interfaces with other construction activities along the alignment, however the overall construction program timeframes would remain consistent.

Construction works subject to the approved project at the Clyde stabling and maintenance facility construction site is anticipated to commence in late 2021 and would continue until the completion of the tunnelling program in approximately 2026.

4. Site description

The Clyde stabling and maintenance facility construction site covers about 380,000 square metres between the M4 motorway, James Ruse Drive and Rosehill Gardens Racecourse. The site currently contains industrial and commercial buildings, Sydney Speedway (located on NSW Government owned land) and the redundant T6 Carlingford Line at Rosehill.

The revised services shaft (with tunnel boring machine launch and future crossover) would be located within the approved Clyde stabling and maintenance facility construction site, as shown in Figure 2 and Figure 4. To accommodate the additional facilities required for the crossover and the tunnel boring machine launch and support, the indicative location of the Rosehill services shaft has been relocated further north-west within the approved Clyde stabling and maintenance facility construction site (refer Figure 2). No changes to the approved project area are required for the proposal. The minor tunnel realignment required between James Ruse Drive and Silverwater Road is within the industrial areas of Rosehill and Silverwater. The tunnel would be realigned up to approximately 50 metres south of the tunnel corridor compared with the indicative alignment in the EIS. The environmental characteristics of the proposed tunnel realignment would similar to the environmental characteristics of the indicative tunnel corridor in the EIS.

5. Site Environmental Characteristics

This section includes a summary of the environmental characteristics of the Clyde stabling and maintenance facility construction site of which the all proposed surface works would occur within. The revised location for the Rosehill services shaft and tunnel boring machine launch and support site would be located at 1B Unwin Street, Rosehill (Lot 201 DP870298 and partially Lot 11 DP1242950).

A summary of the environmental characteristics of the Clyde stabling and maintenance facility construction site are as follows:

- The Clyde stabling and maintenance facility construction site is bound by Shirley Street, Unwin Street, James Ruse Drive and the M4 Western Motorway
- Lot 201 DP870298 where the Rosehill services shaft would be relocated currently consists of warehousing for a supply chain logistics company. The carpark of a concrete and aggregate supplier at Lot 11 DP1242950 would also be impacted and both of these lots are subject to acquisition for the approved project as they are within the approved Clyde stabling and maintenance facility construction site boundary. No additional property acquisition is required for the proposal
- Existing noise levels in area surrounding Clyde stabling and maintenance facility construction site are generally controlled by road traffic noise on the surrounding road network. Clyde is characterised by four noise catchment areas which were assessed as part of the Noise and Vibration Impact Assessment (SLR, 2020) to support the EIS for the approved project including:
    - NCA04 is south of the Parramatta River and west of James Ruse Drive. The catchment is mainly residential with small areas of commercial receivers

  - NCA05 is north of the M4 Motorway and west of James Ruse Drive. The catchment is mainly residential. 'Other sensitive' receivers include Rosehill Public School and a number of hotels and child care centres
  - NCA06 is south of the M4 Motorway in Granville. The catchment is mostly residential adjacent to the motorway, with some commercial use in the south-east
  - NCA07 is east of James Ruse Drive, this catchment is mostly commercial and covers Rosehill Gardens racecourse (and associated stables), the Clyde commercial/industrial area, and Silverwater and Newington. Residential receivers and Newington Public School are in the south-east.
- Significant non-Aboriginal archaeological remains have not been predicted to be located within the Clyde stabling and maintenance facility construction site. The approved works are anticipated to impact the following local heritage items at the Clyde stabling and maintenance facility:
  - Wetlands - Parramatta LEP 2011 (I1) (potential minor direct impact and minor indirect impact)
  - RTA Depot - Parramatta LEP 2011 (I576) (potential minor direct impact, minor indirect impact)
  - Capral Aluminium - Parramatta LEP 2011 (I575) (potential minor indirect impact)
- The majority of the construction site has been assessed as having low Aboriginal archaeological potential as the site has been substantially disturbed by former development. No identified Aboriginal sites would be impacted by the approved works at the Clyde stabling and maintenance facility construction site. Historical aerial photographs suggest that a small portion of the Clyde stabling and maintenance facility construction site has not been subject to substantial disturbance (the grassed area within the Sydney Speedway site, south of the proposed tunnel boring machine launch and support site). In this portion of the site, it is considered that there is a low-moderate potential for Aboriginal objects related to intact or redeposited soils to be present, however the proposed changes subject to this Consistency Assessment would not impact this area
- The Clyde stabling and maintenance facility construction site is currently characterised by industrial uses (zoned IN3 Heavy Industrial) and major recreational facilities (Sydney Speedway zoned RE2 Private Recreation and IN1 General Industrial), and is bisected by Duck Creek (zoned W1 Natural Waterway) and A'Becketts Creek. The proposed tunnel realignment would be through areas currently characterised by industrial uses (zoned IN3 Heavy Industrial and IN1 General Industrial) which is consistent with the characteristics of the indicative alignment in the EIS.
- The nearest watercourse to the revised Rosehill services shaft is Duck Creek, located approximately 80 metres to the south (which flows to Parramatta River). The revised location of the Rosehill services shaft has been shifted slightly further north away from Duck Creek
- Land uses surrounding the Clyde stabling and maintenance facility construction site include the following:
  - North of the site is the Rosehill Gardens racecourse which has a regional landscape and visual sensitivity level. Rosehill Gardens is directly opposite the revised Rosehill services facility across Unwin Street

- East of the site is Duck Creek and Shirley Street, beyond which are large warehouses, and the Viva Energy site that was formerly used as part of Clyde oil refinery
- South of the site is the M4 Western Motorway, beyond which the Clyde industrial area continues
- West of the site is a corridor containing James Ruse Drive and the now closed T6 Carlingford Line. Further west are low density residential areas in Rosehill and Granville.

- Most of the original soil at the site has been completely disturbed, removed or buried. Landfill may include soil, rock, building and waste material with a cap of sandy loam. Soil may by strongly acidic to strongly alkaline, and there is potential to encounter acid sulfate soils and contaminated land
- Patches of mangrove vegetation (in poor condition) at A'Becketts and Duck Creeks correspond to the Plant Community Type: Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (Plant Community Type 920) which is not classified as a threatened ecological community however, it is considered protected marine vegetation under the *Fisheries Management Act 1994*
- Duck River and Duck Creek are mapped as SEPP (Coastal Management) 2018 wetlands, and are considered Class 1 - major key fish habitat.

6. Justification for the proposed works

The proposal would be consistent with the objectives and functions of the approved project. The EIS for the approved project noted that the tunnelling sequence and tunnel alignment is indicative, as during detailed design these aspects may change. As such, any changes to be made during detailed design would be reviewed for consistency with the approved project. Justification for each aspect of the proposal is as follows:

- **Tunnel boring machine strategy:** The construction methodology planning has indicated that by launching the tunnel boring machines from Clyde, there would be improved interfaces between the tunnelling progression and other construction activities along the alignment. The Clyde stabling and maintenance facility construction site is also considered a more suitable location for tunnel boring machine launch and tunnelling support activities when compared to the low to medium residential area surrounding the Westmead metro station construction site
- **Future Rosehill crossover and Rosehill services shaft:** Further analysis of the operation of the line identified the need for an additional rail crossover around Rosehill to provide for more efficient operations and maintenance, and improved response in degraded operational modes (such as if there is an incident in one tunnel). As a result, the proposal also includes additional excavation of the Rosehill services shaft to be longer and slightly deeper to allow for a future rail crossover. The Rosehill services shaft would also be used to facilitate the launch of the tunnel boring machines. Given the Rosehill services shaft would be longer to accommodate these changes,

it has been located slightly further north-west within the construction site compared with the indicative location in the EIS to minimise impacts on nearby waterways

- **Tunnel realignment:** the indicative tunnel alignment in the EIS has been realigned further south to accommodate the revised location for the Rosehill services shaft. The design of the tunnel realignment has considered the impacts on the tunnelling program, spoil volumes and existing land uses to ensure these elements are similar to tunnel corridor proposed for the approved project
- **Precast facilities:** as previously discussed, the precast facility is no longer required at the Clyde stabling and maintenance facility construction site due to the sufficient segment production capacity of the Eastern Creek Precast Facilities project (subject to separate approval). As such, precast segment production at the Clyde site is no longer required, also reducing the associated construction traffic and noise generating activities.

The indicative construction methodology within the EIS has changed to minimise program risks and shift key construction impacts from a predominantly residential area to an industrial site. As outlined above, there is a minor change in the scope of work to be delivered. Environmental benefits of the proposal are further discussed below.

7. Environmental benefit

Environmental benefits of the proposal include:

- The Westmead metro station construction site is in an area of low and medium density residential development and includes local retail and business premises. North of the existing Westmead Station is the Westmead town centre and the health and education precinct including Westmead Hospital. Westmead Public School is immediately to the south-west of the construction site. The proposal to remove the tunnel boring machine launch activities at Westmead would have a positive socio-economic impact on the surrounding community through the reduction of noise generating activities, vehicle movements, and potential dust generating activities in proximity to these sensitive receivers
- The Clyde stabling and maintenance facility construction area is considered to be a more appropriate location for the tunnel boring machine launch and support site given the existing industrial area surrounding the site. As a result, the relocation would have a net environmental benefit due to the reduction of impacts at Westmead whilst not having a greater impact on the noise and traffic impacts at Clyde compared to the approved project
- Although the Clyde stabling and maintenance facility construction site will now include the tunnel boring machine launch and support from within the proposed Rosehill services facility, the precast facility at this site is no longer required due to the precast facilities at Eastern Creek (assessed under a separate Review of Environmental Factors determined on 11 March 2021). This provides greater flexibility in the delivery strategy of the tunnelling works as it enables multiple tunnelling contractors to be supported concurrently. This also means that whilst there will be some changes to the indicative construction site layout including the relocation of the Rosehill services shaft and the removal of the precast facility, no additional land is required (refer to Figure 3). The tunnel boring machine launch and support site sits within the construction area assessed as part of the approved project.

8. Control Measures

The Sydney Metro Construction Environmental Management Framework, Construction Noise and Vibration Standard and Construction Traffic Management Framework set out the overall approach to environmental management. The proposal would also be undertaken in accordance with the mitigation measures and the conditions of approval for the approved project.

The proposal would be managed in accordance with the relevant Construction Environmental Management Plans, which must be produced in accordance with the conditions of approval for the approved project.

9. Climate Change Impacts

This scope is temporary (during construction) and would not directly be impacted by climate change.

10. Impact Assessment – Construction

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Flora and fauna	**Flora and fauna** There are no additional construction impacts on flora and fauna relative to the approved project, as a result of revised tunnel boring machine drive strategy. No additional works outside of the approved Clyde stabling and maintenance facility construction site are proposed. **Groundwater dependent ecosystems** A Groundwater Assessment has been prepared by Jacobs (2021) (Appendix A) to assess the potential impacts on groundwater dependent ecosystems associated with the revised tunnel alignment and the increased excavation area for the Rosehill services shaft. Compared to the assessment of the approved project, additional drawdown is predicted in the vicinity of the Duck Creek. The assessment of the approved project predicted that there would be no groundwater level drawdown in the vicinity of these groundwater dependent ecosystems. However, as a result of the proposal, groundwater level drawdown is now predicted at two years after excavation in the vicinity of the Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion, located along Duck Creek. The Groundwater Assessment concluded that the increase in groundwater level drawdown in the vicinity of this bioregion is relatively minor and the significance of the potential impact on these ecosystems is considered to be low. The Groundwater Assessment identified that the management and mitigation measures that form part of the approved project would be applied to the proposal and are considered sufficient to manage the potential impacts on groundwater (Jacobs, 2021). The approved project includes requirements for additional investigations and assessment to be completed to confirm the potential for impacts to groundwater dependant ecosystems due to groundwater drawdown, and to identify any required mitigation through design. **Mitigation measure B3** for the approved project states: additional investigations and assessment would be completed to confirm the potential for impacts to groundwater dependant ecosystems due to groundwater drawdown, and to identify any required mitigation through design. Further existing mitigation measures and conditions of approval for the approved project relevant to groundwater are identified in the groundwater section below.	No additional measures required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Surface water	The revised tunnel boring machine drive strategy, and addition of tunnel boring machine launch and support activities at the Clyde construction site, may increase volumes of treated wastewater to be discharged from the Clyde construction site to the local stormwater network. The revised location of the Rosehill services shaft to accommodate the tunnel support activities and future crossover is located further north within the approved construction site, slightly further north of Duck Creek. This revised location may reduce the potential impacts associated with surface water quality from the associated earthworks. Table 19-12 of the Environmental Impact Statement outlines the mitigation measures that would be implemented to minimise potential impacts to receiving environments. These measures include the development and implementation of a surface water quality monitoring program and further design development to confirm the local stormwater systems capacity to receive construction water treatment plant inflows. In the event there is a stormwater infrastructure capacity issue with existing infrastructure, mitigation measures such as storage detention to control water outflow during wet weather events would be implemented. The existing mitigation measures are considered suitable to manage an increase in discharge volumes and minimise any potential impacts on the receiving environment. The tunnel support services previously envisioned for the Westmead metro station construction site would no longer be required. As a result, construction wastewater treatment discharge volumes from the Westmead site are anticipated to be less than those stated within the EIS.	No additional measures required.	Y	Y	

Groundwater	The Groundwater Assessment prepared by Jacobs (2021) (Appendix A) assessed the potential groundwater impacts as a result of the proposal, using the same assessment approach as that adopted for the approved project. Consistent with the assessment undertaken for the approved project, the groundwater modelling undertaken has adopted a conservative approach and the extent of potential drawdown is therefore a conservative estimate. Additional excavation required for the revised Rosehill services facility is expected to intercept groundwater and, therefore, has the potential to cause a minor increase in groundwater related impacts including: • The proposal is predicted to result in increased groundwater inflows to the excavation. However in practice, this would be managed in accordance with the mitigation measures outlined for the approved project to reduce groundwater inflows into the shaft excavation. This includes monitoring and review of groundwater levels during and after construction by a qualified hydrogeologist • A proportion of the groundwater inflows to the excavation for the revised Rosehill services facility may be indirectly sourced from the waters of Duck Creek, with these waters leaking into the underlying and adjacent ground, and migrating towards the excavation. Compared to the assessment of the approved project, additional drawdown is predicted in the vicinity of the creek. However, this increase is minor, and the significance of potential impacts on the creek due to the proposal is likely to be low. The approved project includes requirements for baseline monitoring of hydrological attributes, and where potential impacts associated with baseflow loss to Duck Creek are predicted, design responses would be implemented at the shaft excavation to reduce the potential baseflow loss • The proposal would result in a potential increase in groundwater level drawdown in the vicinity of the Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion, located along Duck Creek. However, the increase is relatively minor and the significance of the potential impact on these ecosystems is considered to be low (refer to the Flora and Fauna assessment above for more information). The approved project includes requirements for additional investigations and assessment to be completed to confirm the potential for impacts to groundwater dependant ecosystems due to groundwater drawdown, and to identify any required mitigation through design). The Groundwater Assessment concluded that no additional impacts would be expected for the following: • Given that the location of the excavation is at significant distance from any high risk acid sulfate soil areas, the likelihood of excavations at this construction site impacting acid sulfate soils is considered to be low (consistent with that of the approved project) • There would be no change to the potential impacts associated with saltwater intruding into freshwater groundwater systems (saline intrusion)	No additional measures required.	Y	Y	

	• The tunnel realignment is not expected to change previously assessed potential impacts to groundwater • he proposal is not expected to modify groundwater recharge significantly from that identified for the approved project • WaterNSW-registered water supply bores are not likely to be impacted by the proposal • The assessed potential contamination impacts due to the proposal are the same as identified for the approved project. Consistent with the approved project, additional desktop review and field investigation is required to confirm the presence of groundwater contamination at the site and at adjacent sites • Consistent with the approved project, the proposal is not likely to change the impact on the unassigned water available under the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011. Relevant mitigation measures and conditions of approval for the approved project include: • **Mitigation measure GW2**: A review of additional geotechnical and hydrogeology data would be undertaken to confirm the geological and groundwater conditions and determine, based on these local conditions, whether predicted groundwater drawdown from Stage 1 is likely to occur in the vicinity of these creeks. Where the additional data review shows local conditions and predicted groundwater drawdown are likely to cause surface water/groundwater interaction, then additional site investigations (in accordance with GW3) would be undertaken for those creeks or surface water bodies • **Mitigation measure GW3**: Additional site investigations would be carried out at creeks or surface water bodies where the additional data review in GW2 shows there is a likely surface water/groundwater interaction. This would involve baseline monitoring of creek flows (streamflow gauging) prior to construction, and baseflow streamflow analysis to confirm the existing groundwater baseflow contribution to streamflow for each creek. Where a significant reduction in baseflow is predicted due to Stage 1, design responses would be implemented at station and shaft excavations to reduce potential baseflow loss • **Mitigation measure B3**: Additional investigations and assessment would be completed to confirm the potential for impacts to groundwater dependant ecosystems due to groundwater drawdown, and to identify any required mitigation through design. • **Condition of approval C17:** Groundwater Construction Monitoring Program must include: a) groundwater monitoring networks at each construction excavation site; b) detail of the location of all monitoring bores with nested sites to monitor both shallow and deep groundwater levels and quality;				

	c) define the location of saltwater interception monitoring where sentinel groundwater monitoring bores will be installed between the saline sources of the estuary or river and that of the stations or shafts; d) results from existing monitoring bores; e) monitoring and gauging of groundwater inflow to the excavations, appropriate trigger action response plan for all predicted groundwater impacts upon each noted neighbouring groundwater system component for each excavation construction site; f) trigger levels for groundwater quality, salinity and groundwater drawdown in monitoring bores and / or other groundwater users; g) daily measurement of the amount of water discharged from the water treatment plants; h) water quality testing of the water discharged from treatment plants; i) management and mitigation measures and criteria; j) groundwater inflow to the excavations to enable a full accounting of the groundwater take from the Sydney Basin Central Groundwater Source; and k) reporting of groundwater gauging at excavations, groundwater monitoring, groundwater trigger events and action responses; and l) methods for providing the data collected to Sydney Water where discharges are directed to their assets. • **Condition of approval D122**: The Proponent must submit a revised Groundwater Modelling Report in association with Stage 1 of the CSSI to the Planning Secretary for information before bulk excavation at the relevant construction location. The Groundwater Modelling Report must include: a) for each construction site where excavation will be undertaken, cumulative (additive) impacts from nearby developments, parallel transport projects and nearby excavation associated with the CSSI; b) predicted incidental groundwater take (dewatering) including cumulative project effects; c) potential impacts for all latter stages of the CSSI or detail and demonstrate why these later stages of the CSSI will not have lasting impacts to the groundwater system, ongoing groundwater incidental take and groundwater level drawdown effects; d) actions required after Stage 1 to minimise the risk of inflows (including in the event latter stages of the CSSI are delayed or do not progress) and a strategy for accounting for any water taken beyond the life of the operation of the CSSI; e) saltwater intrusion modelling analysis, from estuarine and saline groundwater in shale, into The Bays metro station site and other relevant metro station sties; and f) a schematic of the conceptual hydrogeological model.				

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Air quality	**Clyde stabling and maintenance facility** Potential air quality impacts during construction would be associated with the potential generation of dust due to increased spoil generation and movement associated with the tunnel boring machine launch site at Clyde. However, the approved project includes large scale earthworks and filling across the Clyde construction site and the increased spoil management at this site would be relatively minor. Implementing the existing air quality mitigation measures specified for the approved project is considered suitable to manage any potential air quality impacts. **Westmead metro station construction site** The proposal would also reduce potential air quality impacts associated with the Westmead metro station construction site, which is in an area of low and medium density residential development, with sensitive receivers such as Westmead Public School in close proximity to the construction site. Given the proposal to remove the tunnel boring machine launch and support site at Westmead, this would reduce the potential for air quality impacts within the surrounding residential community through the reduction of potential dust generating activities.	No additional measures required.	Y	Y	
Noise and vibration	**Clyde stabling and maintenance facility** The inclusion of the tunnel boring machine launch and support activities and provision for a future crossover within the Rosehill services shaft at the Clyde stabling and maintenance facility construction site would involve additional excavation and construction activities. This would introduce potential temporary impacts associated with tunnelling support not previously assessed at the site. This includes increased spoil volumes generated at the site, heavy vehicle haulage, and modifications to the construction program to improve construction interfaces. However, given the approved precast facility at the Clyde construction site is no longer required, there would be a reduction in noise and vibration impacts associated with the precast facility construction and operations (including reduced heavy vehicle movements). A construction Noise and Vibration Impact Assessment memorandum (SLR, 2021) has been prepared to review the potential noise and vibration impacts associated with the changes to the construction works at the Clyde stabling and maintenance facility construction site and the tunnelling alignment (refer to Appendix B). The Noise and Vibration Impact Assessment (SLR, 2021) identified that: • Works associated with tunnel boring machine launch and support would occur 24/7, and the worst-case impacts during the night-time are predicted to be minor at the nearest receivers	No additional measures required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	• The number of receivers predicted to have minor impacts during standard construction hours due to *Excavation – Through rock using a rockbreaker* are predicted to increase, however the number of receivers with high impacts due *to Excavation – Through rock using a rockbreaker* are predicted to reduce due to the removal of the concrete batch plant from the Clyde stabling and maintenance facility construction site, which was relatively near to these receivers • Minor impacts are predicted at additional buildings within Rosehill Public School, and at two additional childcare facilities. However, the impacts presented above are based on all equipment working simultaneously in each assessed scenario. There would be periods when construction noise levels would be much lower than the worst-case levels predicted and there would be times when no equipment would be in use and no impacts occur • The worst-case night-time noise levels from tunnel boring machine launch and support are predicted to result in minor impacts at the five nearby receivers. This includes three residential receivers and two stables buildings at Rosehill Gardens. However several distant residential receivers which previously had minor impacts from the removed concrete batch plant works assessed for the approved project are not predicted to be impacted from the tunnel boring machine launch and support work • The receivers predicted to be Highly Noise Affected during the worst-case impacts are consistent with those identified in the EIS Noise and Vibration Technical Paper (SLR, 2020) for the approved project • No additional receivers are predicted to be impacted by vibration from the construction site due to the proposed changes in site layout, and the impacts are therefore consistent with those for the approved project • Ground-borne noise impacts from tunnelling are generally consistent with the assessment in the EIS Noise and Vibration Technical Paper for the approved project in terms of affected receivers and impact category • The predicted vibration impacts from the tunnel realignment during construction (from the tunnel boring machines) are generally consistent with the impacts presented in the EIS Noise and Vibration Technical Paper for the approved project. No receivers are predicted to be subject to vibration levels during tunnelling which exceed the cosmetic damage or sensitive equipment screening criteria. As such, the Noise and Vibration Impact Assessment (SLR, 2021) concluded that the assessed noise and vibration impacts from works specific to the proposal are, in general, consistent with				

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	the range and magnitude of impacts predicted for the approved project. Therefore, the proposal would not require any changes to, or additional, noise and vibration mitigation measures than those provided for the approved project. The qualitative noise and vibration assessment undertaken for the Concept (Chapter 8 of the EIS for the approved project) acknowledged that the tunnels would be designed to meet relevant operational noise and vibration guidelines. Where there is the potential for ground-borne noise and vibration impacts from operational rail lines in tunnels, design elements such as the use of resilient track forms would be considered to ensure there are no additional operational noise impacts from the proposed tunnel realignment (subject to future planning approvals). Relevant mitigation measures and conditions of approval include: • **Mitigation measure NV15:** Consultation with the owners and operators of the horse stables near the Clyde stabling and maintenance facility construction site would be carried out so that potential impacts to horses are appropriately managed • **Condition of approval D34:** A detailed land use survey must be undertaken to confirm sensitive receivers (including critical working areas such as operating theatres and precision laboratories) potentially exposed to construction noise and vibration and construction ground-borne noise. The survey may be undertaken on a progressive basis but must be undertaken in any one area before the commencement of work which generates construction noise, vibration or ground-borne noise in that area. The results of the survey must be included in the Noise and Vibration CEMP Subplan required under Condition C5 of this schedule. **Westmead metro station construction site** As part of the proposal, the Westmead metro station construction site would no longer require a tunnel boring machine launch site, eliminating the associated tunnelling support activities, spoil volumes and heavy vehicle haulage occurring from this site. This change would result in a reduction in potential noise and vibration impacts at Westmead station, given the removal of the tunnel boring machine launch and support activities which would have been required 24/7 for a period of approximately 78 weeks. This was predicted to result in noise management level exceedances for up to 59 receivers during the TBM assembly and launch scenario for night time works, with sleep disturbance impacts predicted at up to 50 receivers. The removal of the tunnel boring machine launch and support activities from the Westmead metro station construction site is considered a substantial environmental benefit of the proposal.				

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Aboriginal heritage	There are no additional construction impacts on Aboriginal heritage as a result of revised tunnel boring machine drive strategy. No additional works outside of the approved Clyde stabling and maintenance facility construction site are proposed.	No additional measures required.	Y	Y	

Non-Aboriginal heritage	There are no additional construction impacts on non-Aboriginal heritage as a result of revised tunnel boring machine drive strategy. The revised Rosehill services shaft location is within the curtilage of the RTA Depot which is listed under the Parramatta Local Environment Plan No. I576. The proposal however, would not directly impact the heritage significant fabric of the site which is limited to the c1944 brick workshop with 'Department of Main Roads 1944' pediment, as assessed in the Non-Aboriginal Heritage Assessment prepared for the approved project (Artefact, 2020). This heritage significant fabric as shown in Figure 4 would be retained and would not be demolished, consistent with the approved project. The approved project includes the demolition of modern development/additions within the heritage curtilage of this item, in addition to all other developments/structures within the Clyde stabling and maintenance facility construction site, excluding the c1944 brick workshop. Therefore, the potential impacts on the heritage listing of this item are consistent with the approved project, which considered the approved project would have a potential minor direct impact. The Non-Aboriginal Heritage Assessment for the approved project (Artefact, 2020) considered the heritage item is predicted to experience potential direct (minor) impact from vibration, as vibration levels above the cosmetic damage screening criteria. Further assessment (including a structural assessment) and vibration monitoring (if required) would be completed in accordance with the mitigation and management measures for the approved project. The potential vibration impacts on this item is consistent with the approved project. No additional indirect heritage impacts are anticipated as a result of the proposal. No additional works outside of the approved Clyde stabling and maintenance facility construction site are proposed.  **Figure 5 RTA Depot c1944 brick workshop - source: Artefact Heritage 2019**	No additional measures required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Community and stakeholder	The proposal would reduce the impacts to sensitive receivers near the Westmead construction site. Due to the surrounding industrial nature of the Clyde site, it is considered a more suitable location for tunnel boring machine launch and tunnelling support activities when compared to the low to medium residential area surrounding the Westmead metro station construction site. Assessment to support this Consistency Assessment have also identified that the potential amenity related impacts of the changes at the Clyde construction site are consistent with the approved project. Consultation with key stakeholders including Parramatta City Council, Australian Turf Club, Schools Infrastructure and the wider Transport for NSW traffic and transport teams have been undertaken throughout the preparation of this Consistency Assessment. Feedback relating to traffic and noise and vibration impacts were received and these impacts would be managed through existing Condition of Approval and mitigation measures.	No additional measures required.	Y	Y	
Traffic	Daily maximum construction vehicle movements would remain consistent with the indicative estimates as assessed within the EIS, due to: • The removal of the precast facility and associated truck numbers to import raw materials and transport segments to other sites • Reduction of trucks importing fill material for the stabling facility from other sites. The EIS for the approved project considered the requirement for import and placement of fill material to construct the stabling and maintenance facility. The proposal would involve the removal of 675,000m^3 of tunnelling spoil to the Clyde construction site, in addition to the spoil to be removed during the excavation of the Rosehill services facility. This spoil would mainly be used as fill to construct the stabling and maintenance facility. The proposal therefore reduces the requirement for the importation of spoil to the site, given the retrieval of tunnelling spoil would be occurring on site (as opposed to the Westmead metro station construction site). This reduces the number of heavy vehicles transporting spoil from other sites to the Clyde stabling and maintenance facility construction site. Excess spoil that can't be placed on site at the Clyde stabling and maintenance facility construction site would be hauled off site via existing routes. The removal of the precast facility from the Clyde stabling and maintenance facility construction site would also reduce associated heavy and light vehicle numbers to import raw materials and transport segments to other sites.	No additional measures required.	Y	Y	

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

	The EIS Traffic and Transport Technical Paper (Jacobs, 2020) for the approved project considered the following total indicative vehicle movements would be required, as shown in Figure 6. Heavy vehicles have been assumed to travel to and from the construction site within the hour, for example 44 heavy vehicle movements during an hour would comprise 22 heavy vehicle movements to the construction site and 22 heavy vehicle movements from the construction site:
	• Phase 1 – Demolition and site establishment: approximately 662 total vehicle movements per day
	  ○ The proposal would not change the vehicle requirements during Phase 1 as there is no change in demolition and site establishment works
	• Phase 2 – Piling and excavation (24 hours): approximately 876 total vehicle movements per day
	  ○ The proposal may slightly increase the heavy vehicle moments during this phase due to the additional excavation required for the Rosehill services shaft, however heavy vehicle haulage during this phase would remain lower than the predictions for Phase 3 below
	• Phase 3 – Excavation, soil importation, precast facility and civil works: approximately 1552 total vehicle movements per day
	  ○ The proposal would result in a reduction of heavy vehicles required during this phase due to the removal of the precast facility from the Clyde stabling and maintenance facility and the reduction of heavy vehicles for spoil importation.
	Minimal changes to the indicative volume of light vehicles required during construction at the Clyde stabling and maintenance facility construction site is anticipated.				

Table 4-10: Daily construction movements per day by phase – Clyde stabling and maintenance facility construction site

Phase	Total movements per day		
	Light vehicles	Heavy vehicles	Total
Phase 1 – Demolition and site establishment	310	352	662
Phase 2 – Piling and excavation (24 hours)	444	432	876
Phase 3 – Excavation, spoil importation, concrete segment facility and civil works	496	1,056	1,552

Figure 6 EIS Traffic and Transport Technical Paper - indicative daily construction movements per day by phase at the Clyde stabling and maintenance facility construction site (Jacobs, 2020)

The EIS Traffic and Transport Technical Paper (Jacobs, 2020) for the approved project assessed heavy vehicle movements in accordance with the Phase 3 construction activities which represents the estimated maximum vehicle movements required during construction at the site (i.e. 1552 total vehicle movements per day). The peak hour presented in the assessment was selected to represent when background traffic demand is at its greatest. The construction traffic scenario for the intersection performance assessment is as follows:

- During morning peak (7am-8am), construction traffic includes 44 heavy vehicle movements and 92 light vehicle movements
- During evening peak (5pm-6pm), construction traffic includes 44 heavy vehicle movements and 106 light vehicle movements

Modelled intersection performance with construction traffic indicates that all intersections forming part of the construction vehicle route would perform at the same Level of Service compared to the scenario without construction traffic. Modelled intersection performance shows that the addition of construction traffic would result in a temporary small reduction in demand flow and/or average delay, however in reality, from an operational perspective, the performance of an intersection where the modelling results show a small reduction in demand flow and/or average delay would remain very similar with and without construction traffic.

The proposal would not increase the maximum heavy or light vehicle movements required at the Clyde stabling and maintenance facility construction site than assessed in the EIS for the approved project, and therefore the impact on the road network would remain consistent with the predictions within the EIS. To ensure construction traffic impacts are minimised and managed

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	for the project, further construction planning would be undertaken as well as the preparation of a Construction Traffic Management Plan/s in accordance with **Condition of Approval D85**. The requirement for additional parking spaces associated with the revised construction activities is expected to be minimal as the tunnel boring machine launch and support activities would effectively replace the requirement for construction worker parking at the precast activities at the site. Due to the availability of alternative parking nearby, the impact of potential lost parking spaces for nearby workers would be minimal and consistent with the approved project. **Condition D91** requires a Construction Parking and Access Strategy to be prepared to identify and mitigate impacts resulting from on- and off-street parking changes during construction. On balance, the proposal would reduce the volume of spoil being removed from the Westmead metro station construction site, reducing the number of heavy vehicle movements around the surrounding residential area significantly. Given the proximity of sensitive receivers such as Westmead Public School, this would have a reduction in impact for the community by reducing construction traffic within a residential area compared with the approved project.				
Waste	The tunnel realignment would result in an approximate 90 metre increase of tunnel length, which would not result in a significant change of overall volume of spoil removed from the approved project (about a 0.2 per cent increase on the indicative total spoil generation within the EIS).	No additional measures required.	Y	Y	
Social	**Clyde stabling and maintenance facility** Rosehill Gardens Racecourse is located directly north of the Clyde stabling and maintenance facility construction site. The shift of the services shaft (and tunnel boring machine launch and support site) further north toward the Rosehill Gardens Racecourse within the approved construction site boundary is not anticipated to increase the social and amenity impacts compared to the approved project, as the land use purposes of the construction site would remain consistent. **Westmead metro station construction site** The proposal to remove the tunnel boring machine launch and support site at Westmead would have a positive socio-economic impact on the surrounding community through the reduction of noise generating activities, vehicle movements, and dust generating activities in proximity to the sensitive receivers, including those in the health and education precinct.	No additional measures required.	Y	Y	
Economic	There are no additional economic impacts as a result of revised tunnel boring machine drive strategy. No additional works outside of the approved Clyde stabling and maintenance facility construction site are proposed.	No additional measures required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Visual	The visual impact of the works associated with the proposal are generally in accordance those for the approved project and in character with the existing and former heavy industrial character of the site. The scale of the works at the Westmead metro station construction site would be reduced as a result of the proposal. This would result in the reduction of construction related traffic, reducing the anticipated visual impacts on the surrounding residential area. The Westmead metro station construction site footprint would remain consistent with the approved project, which is required to facilitate the excavation of the Westmead metro station and turnback cavern for the approved project.	No additional measures required.	Y	Y	
Urban design	No change from approved project.	No additional measures required.	Y	Y	
Geotechnical	A detailed geotechnical and hydrogeological model for the proposal would be developed and progressively updated during design and construction.	No additional measures required.	Y	Y	
Land use	The use of this land for construction and the approved project footprint does not change as a result of this proposal.	No additional measures required.	Y	Y	
Climate change adaptation	No change from approved project.	No additional measures required.	Y	Y	
Risk	The on-site storage, use and transport of dangerous goods and hazardous substances may increase at the Clyde site, yet decrease at the Westmead site. The construction sites would be planned so that hazardous materials are stored appropriately and at a suitable distance from sensitive receivers, in accordance with the thresholds established under State Environmental Planning Policy No 33—Hazardous and Offensive Development. Environmental hazards associated with the on-site storage, use and transport of chemicals, fuels and materials as part of the modified works at the Clyde site would be managed through the mitigation measures identified for the approved project, and would include the storage and management of all dangerous goods and hazardous substances in accordance with the *Work Health and Safety Act 2011*, the Work Health and Safety Regulation 2017, the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005) and Applying SEPP 33 (Department of Planning, 2011a).	No additional measures required.	Y	Y	

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

11. Impact Assessment – Operation

Stage 1 of the planning application for Sydney Metro West (subject of this Consistency Assessment) is for major civil construction work for Sydney Metro West between Westmead and The Bays. At this stage, measures to avoid or minimise impacts have been developed only for major civil construction work for Sydney Metro West between Westmead and The Bays – which involves construction only. Impacts applicable to the operational aspects of Sydney Metro West including operation stage environmental mitigation measures would be developed when planning approval applications are made for future stages.

As such, operational impacts of the proposal are not applicable, and therefore there are no changes from the approved project are anticipated.

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

Aspect	Nature and extent of impacts (negative and positive) during operation (if control measures implemented) of the proposed activity/works, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Social	No change from the approved project.	No additional measures required.	Y	Y	
Economic	No change from the approved project.	No additional measures required.	Y	Y	
Visual	No change from the approved project.	No additional measures required.	Y	Y	
Urban design	No change from the approved project.	No additional measures required.	Y	Y	
Geotechnical	No change from the approved project.	No additional measures required.	Y	Y	
Land use	No change from the approved project.	No additional measures required.	Y	Y	
Climate change adaptation	No change from the approved project.	No additional measures required.	Y	Y	
Risk	No change from the approved project.	No additional measures required.	Y	Y	
Other	No change from the approved project.	No additional measures required.	Y	Y	
Management and mitigation measures	No change from the approved project.	No additional measures required.	Y	Y	

12. Consistency with the Approved Project

Based on a review and understanding of the existing Approved Project and the proposed modifications, is there is a transformation of the Project?	No. The proposal would not transform the project. The project would continue to undertake works to provide a new metro rail line between Westmead and The Bays as part of the approved project.
Is the project as modified consistent with the objectives and functions of the Approved Project as a whole?	Yes. The proposal would be consistent with the objectives and functions of the approved project.
Is the project as modified consistent with the objectives and functions of elements of the Approved Project?	Yes. The proposal would be consistent with the objectives and functions of the approved works for the project. The purpose of this Consistency Assessment is to assess a proposed construction sequencing change of the tunnel boring machines. Whilst the sequencing of the tunnelling program in Section 9.3 of the Environmental Impact Statement would be revised (refer Figure 1), the overall construction program timeframes would remain consistent. The construction methodology for this work has changed to shift key construction impacts from a predominantly residential area to an industrial site, and minimise program risks. The activities proposed to be undertaken are generally consistent with the activities identified for the approved project.
Are there any new environmental impacts as a result of the proposed works/modifications?	No. There would be no new environmental risks as a result of the proposal. All risks identified for the approved project and the proposal would be adequately addressed through the application of the mitigation measures provided in the Environmental Impact Statement, Submissions Report, Amendment Report and the Instrument of Approval.
Is the project as modified consistent with the conditions of approval?	Yes. The proposal would be consistent with the conditions of approval.
Are the impacts of the proposed activity/works known and understood?	Yes. The impacts of the proposal are understood and will be accounted for by implementing the existing mitigation measures provided in the Environmental Impact Statement, Submissions Report, Amendment Report and the Instrument of

	Approval for the approved project. These would be implemented through the Sydney Metro Construction Environment Management Framework, Construction Traffic Management Framework and Construction Noise and Vibration Standard.
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 proposal can be managed so as to avoid an adverse impact.

13. Other Environmental Approvals

Identify all other approvals required for the project:	N/A

Author certification

To be completed by person preparing checklist.

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 Revision; and
- Examines the consistency of the Proposed Revision with the Approved Project; is accurate in all material respects and does not omit any material information.

Name:	Jessie Strange	Signature:	
Title:	Planning Approvals Officer		
Company:	Sydney Metro	Date:	13/09/2021

This section is for Sydney Metro only.

Application supported and submitted by			
Name:	Yvette Buchli	Date:	13/09/2021
Title:	Associate Director Planning Approvals	Comments:	
Signature:			

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

Yes	The proposed activity/works are consistent and no further assessment is required.
No	The proposed works/activity is not consistent with the Approved Project. A modification or a new activity approval/ consent is required. Advise Project Manager of appropriate alternative planning approvals pathway to be undertaken.

Endorsed by			
Name:	Carolyn Riley	Date:	13 Sept 2021
Title:	Director Environment, Sustainability & Planning	Comments:	
Signature:			

Appendix A: Groundwater Impact Assessment

Jacobs

Memorandum

Level 7, 177 Pacific Highway
North Sydney, NSW 2060
PO Box 632
North Sydney, NSW 2059
Australia
T +61 2 9928 2100
F +61 2 9928 2444

Subject	**Rosehill Consistency Assessment - Groundwater**	**Project Name**	Sydney Metro West
Attention	Todd Brookes	**Project No.**	IA199800
From	Ben Rotter		
Date	26 April 2021		
Copies to	Anna Scott, Ryan Butler, Jessie Strange and Nikki Wallace		

1. Introduction

This memorandum provides assessment of the potential impacts relating to groundwater associated with the proposed development of the Sydney Metro West services facility located at Rosehill, NSW.

2. Proposed change

The Sydney Metro West Concept and Stage 1 (major civil construction work between Westmead and The Bays) (the approved project) was approved on 11 March 2020 (SSI-10038). The approved project is described as:

- The Sydney Metro West Environmental Impact Statement– Westmead to The Bays and Sydney CBD
- The Sydney Metro West Westmead to The Bays and Sydney CBD Submissions Report (Concept and Stage 1)
- The Sydney Metro West Westmead to The Bays and Sydney CBD Amendment Report (Concept and Stage 1)
- Sydney Metro West – Concept and Stage 1 Conditions of Approval.

The approved project includes the Clyde stabling and maintenance facility construction site, which would support the excavation of a dive structure and tunnel portal, as well as the excavation of a services facility shaft at Rosehill.

Since approval of the Sydney Metro West Concept and Stage 1, the tunnel alignment through the Clyde stabling and maintenance facility has been revised. Consequently, it is now proposed to both relocate the shaft and increase its excavation area.

The indicative Rosehill services facility shaft is proposed to be relocated further north within the approved Clyde stabling and maintenance facility construction site.

The Rosehill services facility shaft for the approved project was approximately 50 metres long by 23 metres wide, and approximately 27 metres deep.

The excavation footprint of the Rosehill services facility shaft is now proposed to include a cut-and-cover box that would be approximately 130 metres long by 23 metres wide, and would be approximately 31 metres deep, to allow for:

- A future crossover to allow trains to change to the other track so maintenance work can be carried out with minimal interruption to services
- Tunnel boring machine launch and support facilities.

This is an increase in excavation area compared to the Rosehill services facility shaft described in the approved project.

3. Assessment approach

The approach to the assessment of potential groundwater impacts as a result of the proposed change was consistent with that adopted for the approved project. The groundwater model developed for assessment of the approved project was updated for the proposed change. Potential impacts on groundwater were assessed by reviewing the predicted groundwater level drawdown due to the proposed excavation against the locations and conditions of existing supply bores; groundwater dependent ecosystems; acid sulfate soils; and interpreted existing groundwater recharge, flow and surface water-groundwater interaction. The presence of potential contamination at the site was also considered.

The identified potential impacts were then compared to the approved project, to assess whether the proposed change was consistent.

4. Existing environment

Excavation of the cut-and-cover box would be predominantly through fill and Hawkesbury Sandstone. It is possible that estuarine sediments may also be encountered.

The following groundwater dependent ecosystems were identified in the vicinity of the Clyde stabling and maintenance facility construction site:

- Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (high likelihood) along Duck Creek
- Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (moderate to high likelihood) along Duck Creek
- Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (low likelihood) along Duck Creek.

A number of WaterNSW-registered groundwater supply bores (groundwater users) were identified in the vicinity of the Clyde stabling and maintenance facility construction site.

The nearest surface waters to the Clyde stabling and maintenance facility construction site are:

- A'Becketts Creek, located 300 metres to the southwest
- Duck Creek, located about 80 metres south.

5. Potential impacts of the proposed change

5.1 Groundwater levels

Excavation of the cut-and-cover box as part of the proposed change is expected to intercept groundwater and, therefore, has the potential to cause groundwater related impacts.

The excavation is expected to result in drawdown in the immediate area adjacent to the site, with drawdown and depressurisation of the surrounding soils and/or rock propagating beyond the immediate cut-and-cover box area.

The drawdown will be cumulative with the drawdown induced by the dive structure that forms part of the approved project. The design details of the dive structure are provided in the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD.

Consistent with the assessment undertaken for the approved project, the groundwater modelling undertaken has adopted a conservative approach and the extent of potential drawdown is therefore a conservative estimate.

Figure 1 shows the model-predicted groundwater level drawdown from the current average water level at the end of two years of excavation for the approved project. Figure 2 shows the model-predicted groundwater level drawdown from the current average water level at the end of two years of excavation for the proposed change.

The potential groundwater level drawdown is marginally greater in magnitude and extent compared to that for the approved project, due to the increased depth and footprint of the cut-and-cover box excavation.

The tunnel realignment is not expected to change previously assessed potential impacts to groundwater.

Consistent with the approved project, the tunnel boring machines would construct a pre-cast segmental tunnel lining in the running tunnels as excavation progresses. The tunnels would therefore be tanked almost immediately following their excavation, and impacts to groundwater due to tunnel excavation are not expected.

The impacts of cross passage construction on groundwater are not likely to be significant, as the tunnel cross passages have a relatively small footprint and would likely be open for only a short period of time prior to being waterproofed. This is consistent with the potential impacts identified for the approved project.

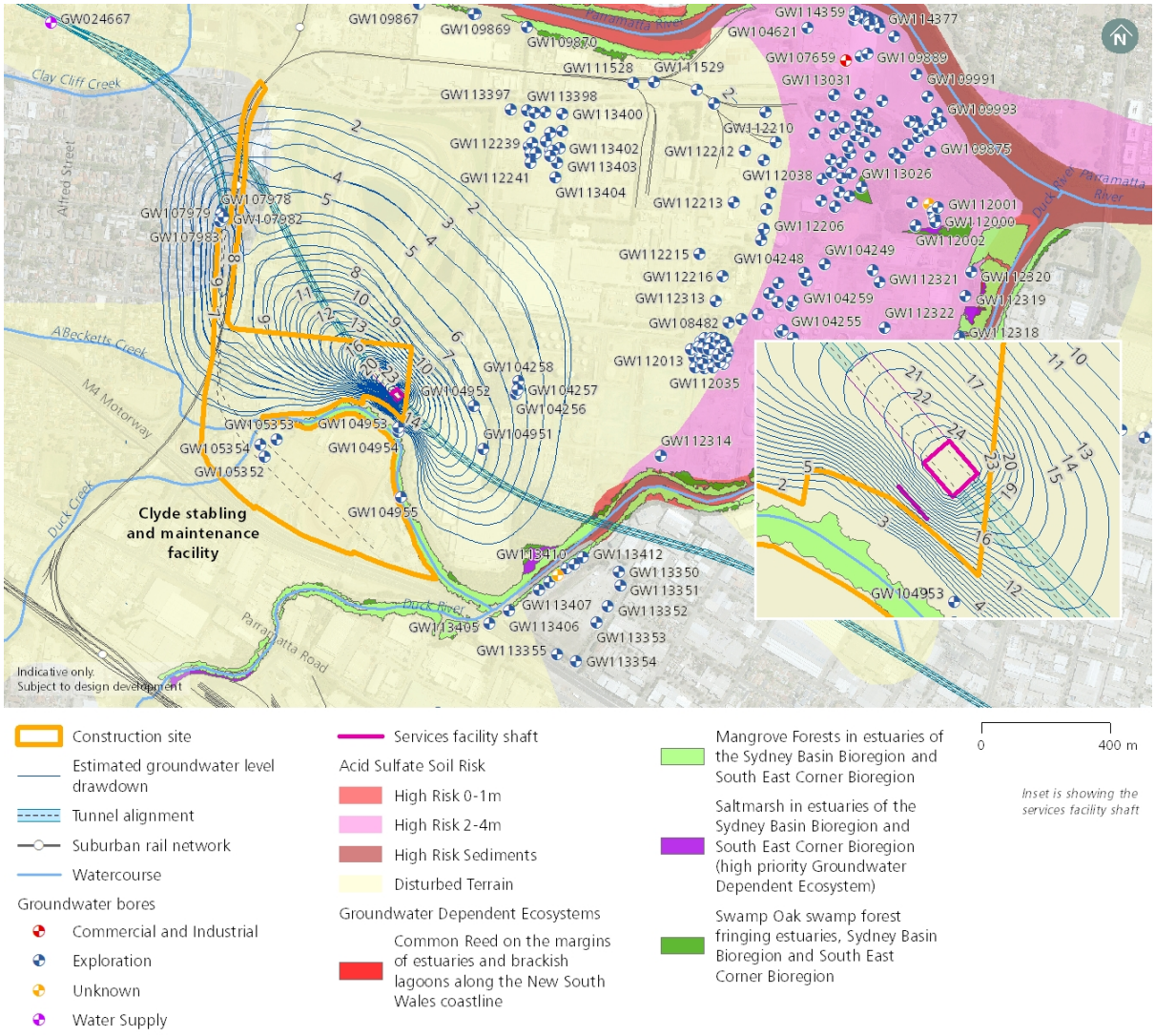


Figure 1: Modelled groundwater level drawdown from the current water level after two years due to excavation at Clyde stabling and maintenance facility construction site for the approved project

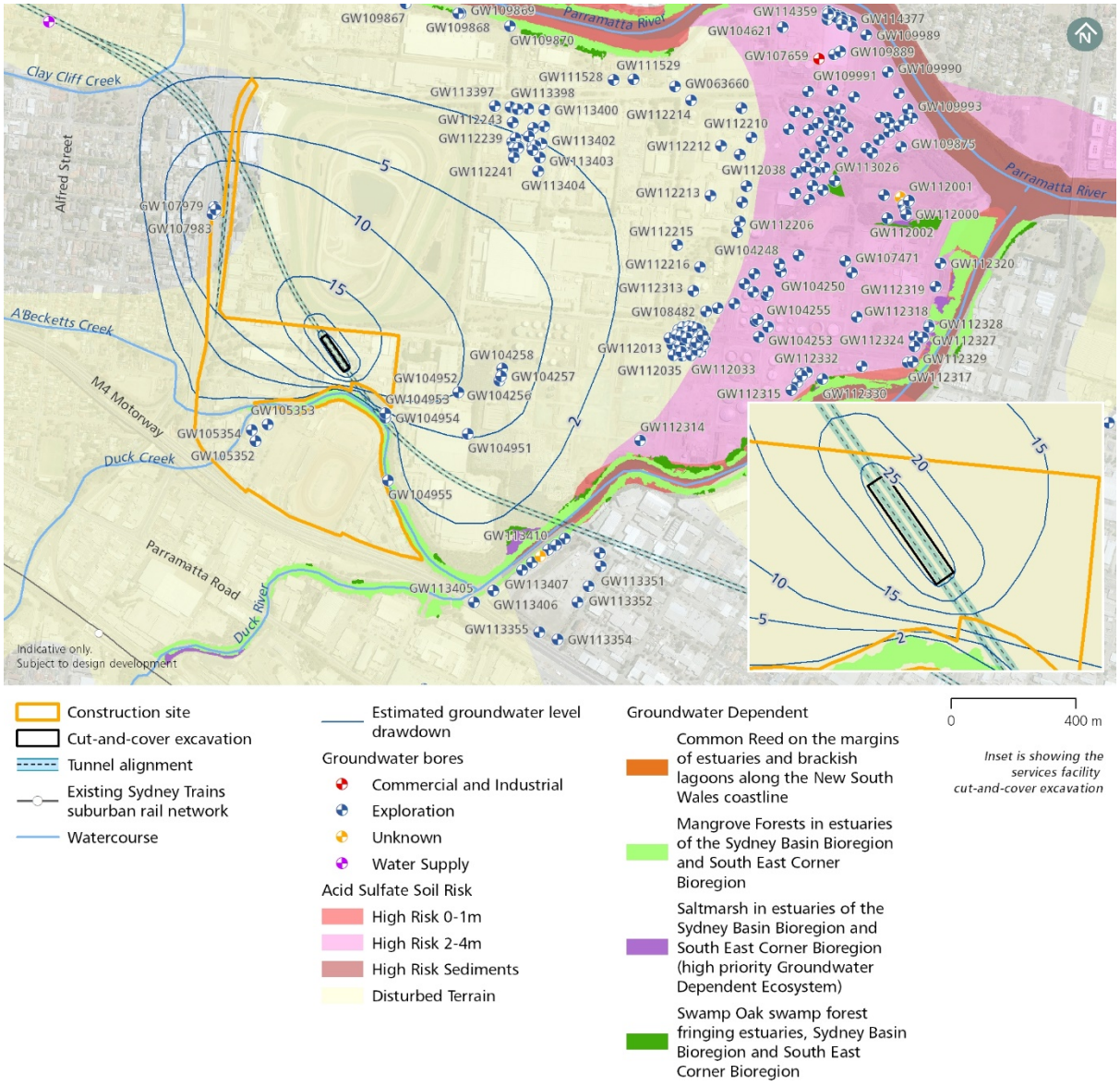


Figure 2 Modelled groundwater level drawdown from the current water level after two years due to excavation at Clyde stabling and maintenance facility construction site for the proposed change

5.2 Groundwater inflows and local flow regime

Table 5-1 provides the predicted groundwater inflow to the dive and the shaft/cut-and-cover-box excavation at both one and two years after excavation (two years being the anticipated end of Stage 1), for both the approved project and the proposed change. The proposed change is predicted to result in increased groundwater inflows to the excavation. This would be managed in accordance with the mitigation measures outlined for the approved project.

The groundwater flow regime in the vicinity of the Clyde stabling and maintenance facility construction site is expected to change due to excavation. Both the approved project and the proposed

change are predicted to result in groundwater flowing towards the excavation rather than flowing across the site in a northerly direction as per the existing environment.

Table 5-1: Predicted maximum groundwater inflows at Clyde stabling and maintenance facility construction site

	Predicted inflow rate at years after excavation (litres/second)		Predicted cumulative inflow at years after excavation (megalitres)	
	Approved project	Proposed change	Approved project	Proposed change
At one year	0.5	2.5	38	82
At two years	0.8	2.5	78	161

5.3 Groundwater recharge

The proposed change is not expected to modify groundwater recharge significantly from that identified for the approved project.

5.4 Contamination

The Rosehill services facility shaft excavation is expected to act as a groundwater sink, causing groundwater to flow towards the excavation.

The assessment of the approved project identifies the potential for groundwater at the following Areas of Environment Interest (AEI) for contamination to potentially be contaminated:

- 1 Grand Avenue, Camellia, located about 500 metres north-east of the Clyde stabling and maintenance facility construction site, potentially contaminated with zinc, phenol and polycyclic aromatic hydrocarbons (AEI 10)
- The former Shell Clyde Refinery, located about 200 metres east of the Clyde stabling and maintenance facility construction site, potentially contaminated with light non-aqueous phase liquid, hydrocarbons, lead, chromium, perfluoroctane sulfonate (AEI 14)
- The Clyde stabling and maintenance facility construction site and the current commercial/industrial sites adjacent to it, potentially contaminated with heavy metals, hydrocarbons and volatile organic compounds (AEI 15 and 16)
- The Rosehill Helipad site, potentially contaminated with hydrocarbons, volatile organic compounds and perfluorooctanesulfonic acid (AEI 18)
- The Rapid Oil Distributors site at Deniehy Street, Rosehill, potentially contaminated with hydrocarbons (AEI 19)
- The landfill located at Carnavon Road, Silverwater, potentially contaminated with perfluorooctanesulfonic acid (AEI 20).

Of these potentially groundwater-contaminated sites, AEI 14, 15, 18 and 19 lie within the predicted extent of groundwater level drawdown for the proposed change. The potential contamination impact was assessed to range from low to moderate for groundwater associated with these AEI.

These are the same sites identified in the assessment of the approved project as being within the predicted extent of groundwater level drawdown for the shaft and dive structure. The assessed potential contamination impacts due to the proposed change are the same as identified for the approved project.

Any potentially contaminated groundwater within the extent of groundwater drawdown would migrate towards the excavation. As the excavation for the Rosehill services facility is undrained across the soil horizon, there is potential for contaminated groundwater within the soils to be drawn downwards into the rock. Contaminated groundwater seeping into the excavation would be collected and treated during construction.

It is possible that construction workers and adjacent site users could be exposed to contaminated groundwater and vapours. Migration of contamination could also reduce the beneficial use of the aquifer.

Consistent with the approved project, additional desktop review and field investigation is required to confirm the presence of groundwater contamination at the site and at adjacent sites.

5.5 Saline intrusion

Groundwater level drawdown in the vicinity of saltwater bodies has the potential to cause saltwater to intrude into freshwater groundwater systems. Saline water can reduce the beneficial uses of the groundwater system, impact in-ground structures (durability), and potentially impact existing groundwater users and groundwater dependent ecosystems.

The assessment of the approved project identified that it is possible that saline water within the Duck Creek could be drawn into fresh groundwater adjacent to the river. Increased salinity in the groundwater in this area is not likely to impact these groundwater dependent ecosystems or the environmental value of the aquifer based on the following:

- Groundwater supply for primary industries/drinking water and sites with groundwater-dependent cultural or spiritual values were not identified in the area where this potential impact could occur
- The groundwater dependent ecosystems (terrestrial vegetation) identified in the area where this potential impact could occur comprise those which are tolerant of saline groundwater
- Groundwater supply bores and in-ground structures (such as deep foundations) were not identified in this area.

There would be no change to these potential impacts as a result of the proposed change.

5.6 Acid sulfate soils

As per the approved project, potential acid sulfate soils were not identified within the modelled extent of groundwater drawdown. However, disturbed soils have been identified within this area. Up to 29 metres of groundwater level drawdown is anticipated in the area where disturbed soils have been identified at two years after excavation (the anticipated end of Stage 1). It is possible that excavation

would cause oxidation of potential acid sulfate soils in the area, if they are present. Site investigation is required to confirm the presence, or not, of potential acid sulfate soils in the vicinity of the proposed excavation.

Consistent with the assessment undertaken for the approved project, the groundwater modelling undertaken has adopted a conservative approach and the extent of potential drawdown is therefore a conservative estimate. Given that the location of the excavation is at significant distance from any high risk acid sulphate soil areas (Figure 2), the likelihood of excavations at this construction site impacting acid sulfate soils is considered to be low.

Potential acid sulfate soils impacts of the proposed change would therefore be consistent with that of the approved project.

5.7 Groundwater Dependent Ecosystems

Potential groundwater dependent ecosystems (terrestrial vegetation) were identified to the immediate south and east of the cut-and-cover box along Duck Creek.

The assessment of the approved project predicted that there would be no groundwater level drawdown in the vicinity of these groundwater dependent ecosystems. As a result of the proposed change, groundwater level drawdown is predicted at two years after excavation in the vicinity of the Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion, located along Duck Creek. Therefore, the proposed change could result in a new potential impact on this ecosystem. Section 5.9 provides further discussion in relation to the potential impacts of surface water-groundwater interaction on groundwater dependent ecosystems.

5.8 Groundwater users

Twenty six WaterNSW-registered bores were identified within the predicted extent of groundwater drawdown (see Figure 2). WaterNSW reports the purpose of all of these bores as being for monitoring. WaterNSW-registered water supply bores are therefore not likely to be impacted by the proposed change. This is consistent with the impacts identified for the approved project.

5.9 Surface water-groundwater interaction

Consistent with the assessment of the approved project, groundwater level drawdown due to excavation associated with the proposed change is predicted in the vicinity of A'Becketts Creek and Duck Creek. It is not known whether groundwater contributes baseflow to these surface water features.

If there is existing groundwater baseflow contribution to A'Becketts Creek and Duck Creek, then Stage 1 has the potential to reduce that baseflow contribution and reduce stream flows. Stage 1 could potentially cause reduced baseflow to A'Becketts Creek and Duck Creek due to groundwater level drawdown within the vicinity of and at distance of the creeks, and the reduced groundwater recharge caused by converting pervious ground to impervious ground at the Sydney Speedway.

The Technical Paper 10 (Biodiversity) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays notes that estuarine and near-shore marine systems, such as coastal mangroves, are known to somewhat rely on the submarine discharge of groundwater, but that the extent of groundwater dependence is not well known. The groundwater baseflow to Duck Creek is likely to support the identified groundwater dependent ecosystems along Duck Creek, which could be

impacted if baseflows are reduced. Other aquatic ecosystems are also likely to be impacted if baseflows are reduced. However, as baseflows are likely to be a minor component of streamflow, the significance of this impact is likely to be low to moderate.

To confirm the existing baseflow contribution to A'Becketts Creek and Duck Creek, additional site investigations would be carried out during detailed design to confirm potential impacts to baseflow. Where significant reduction in baseflow is confirmed, measures would be implemented at the excavations within the Clyde stabling and maintenance facility construction site to reduce the potential for baseflow loss. These measures are detailed in the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD.

A proportion of the groundwater inflows to the cut-and-cover box comprising the proposed change may be indirectly sourced from the waters of Duck Creek, with waters from Duck Creek leaking into the underlying and adjacent ground, and this water migrating towards the excavation.

Compared to the assessment of the approved project, additional drawdown is predicted in the vicinity of the creek. The significance of potential impact to the creek from the approved project was low. The groundwater level drawdown in the vicinity of the creek is predicted to be greater for than the approved project. However, this increase is minor, and the significance of potential impacts on the creek due to the proposed change is likely to be low.

5.10 Policy compliance

There are currently about 43,353 megalitres per year that is unassigned under the long-term average annual extraction limit (LTAAEL) of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011. Inflows to the excavations at the Clyde stabling and maintenance facility construction site would potentially increase the estimated total inflow across all of the components comprising the approved project from 1,396 megalitres over both years of construction, to an estimated 1,479 megalitres over both years as a result of the proposed change. Annual inflows for Stage 1 would be less than seven per cent of the unassigned water.

Consistent with the approved project, the proposed change is therefore not likely to change the impact on the unassigned water available under the Water Sharing Plan.

6. Summary

In summary, the majority of the potential impacts on groundwater as a result of the proposed change are not expected to differ from those identified for the approved project, with the following exceptions:

- Groundwater inflows and local flow regime – The proposed change would potentially increase the groundwater inflow to the Rosehill services shaft excavations. It should be noted that the modelling is conservative. In practice, mitigation measures would be implemented to reduce groundwater inflows to the excavation. Inflows would be managed in accordance with the mitigation measures outlined for the approved project

- Groundwater dependent ecosystems – The proposed change would result in a potential increase in groundwater level drawdown in the vicinity of the Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion, located along Duck Creek.

However, the increase is relatively minor and the significance of the potential impact on these ecosystems is considered to be low

- Surface water-groundwater interaction – The proposed change would result in the potential increase in the significance of the potential impacts associated with baseflow loss to Duck Creek (from low to moderate). This potential impact would be managed in accordance with the mitigation measures outlined for the approved project.

The management and mitigation measures that form part of the approved project would be applied to the proposed change and are considered sufficient to manage the potential impacts on groundwater. No additional measures or amendment to existing measures is considered necessary.

Appendix B – Noise and Vibration Impact Assessment

Memorandum

To:	Carys Scholefield	**At:**	Jacobs Group (Australia) Pty Ltd
From:	Jordan McMahon	**At:**	SLR Consulting Australia Pty Ltd
Date:	18 May 2021	**Ref:**	GEN-SMWSDDS-JAE-GEN-000562-TBM drive noise assessment_v3
Subject:	Sydney Metro West Tunnel boring machine drive strategy and future Rosehill crossover Noise Assessment		

1 Introduction

The Sydney Metro West Concept and Stage 1 (the approved project) was approved on 11 March 2020 (SSI-10038). The approved project is as described in:

- The Sydney Metro West Environmental Impact Statement– Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a)
- The Sydney Metro West Westmead to The Bays and Sydney CBD Submissions Report (Concept and Stage 1) (Sydney Metro, 2020b)
- The Sydney Metro West Westmead to The Bays and Sydney CBD Amendment Report (Concept and Stage 1) (Sydney Metro, 2020c)
- Conditions of Approval for Sydney Metro West – Concept and Stage 1 Construction (SSI 10038) (Department of Planning and Environment, 2021).

The tunnelling strategy for the approved project involved tunnel boring machines being launched and supported from the Westmead metro station construction site and The Bays Station construction site. Tunnel boring machines were planned to be extracted from both dive sites at the Sydney Olympic Park metro station construction site. A concrete segment production facility at the Clyde stabling and maintenance facility construction site was also included to provide a pre-cast production facility and storage yard for the tunnelling works.

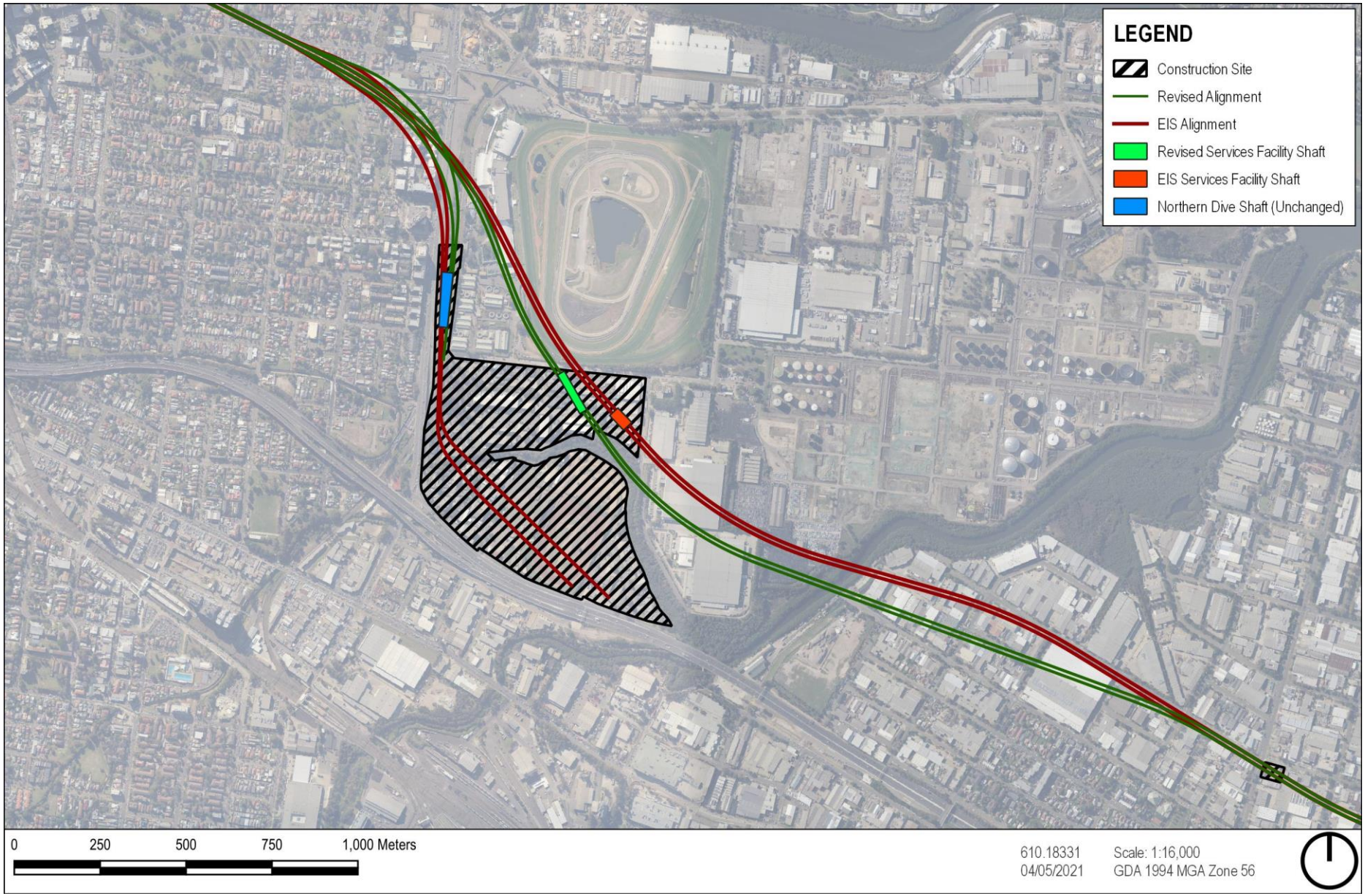
Since project approval, an alternate tunnel boring machine drive strategy has been proposed between the Westmead and Sydney Olympic Park metro station construction sites. The alternate strategy consists of tunnel boring machines being launched from the Clyde stabling and maintenance facility construction site towards both the Westmead and Sydney Olympic Park metro station construction sites. The indicative Rosehill services shaft as discussed in the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a) would be relocated further north within the approved Clyde stabling and maintenance facility construction site, and would be extended to allow for:

- A future rail crossover to allow trains to change to the other track to support more efficient operations and so maintenance work can be carried out with minimal interruption to services
- The tunnel boring machine launch and support facilities.

The concrete segment production facility has also been removed from the Clyde stabling and maintenance construction site due to the approval of the alternate Eastern Creek Precast Facilities on 11 March 2021.

This memorandum provides a technical review of the potential noise and vibration impacts associated with the changes to the construction works at the Clyde stabling and maintenance facility construction site and the tunnelling alignment. The key changes to the Clyde stabling and maintenance facility construction site layout and alternate tunnelling alignment are shown in **Figure 1**.

Figure 1 Revised Services Facility Shaft and Tunnel Alignment



2 Changes to Legislative and Policy Context

The legislative and policy context used to assess the noise and vibration impacts are discussed in Chapter 11 (Noise and Vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a). There have been no changes to this since exhibition of the Environmental Impact Statement.

3 Existing Environment

3.1 Study Area

The study area for this assessment is centred on the Clyde stabling and maintenance facility. This study area contains four Noise Catchments Areas (NCA04 to NCA07) as defined in the Technical Paper 2 (Noise and vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a). The Noise Catchment Areas are generally located to the west and east of James Ruse Drive.

The construction site is located to the east of James Ruse Drive, to the north of the M4 Motorway and to the south of Rosehill Gardens racecourse. A section of the redundant T6 Carlingford Line to the north-west of the construction site would be required for the construction of future stages of Sydney Metro West.

Existing noise levels in the study area are generally controlled by road traffic noise on the surrounding road network. The area surrounding the construction site is generally suburban residential to the west and commercial/industrial to the south and east.

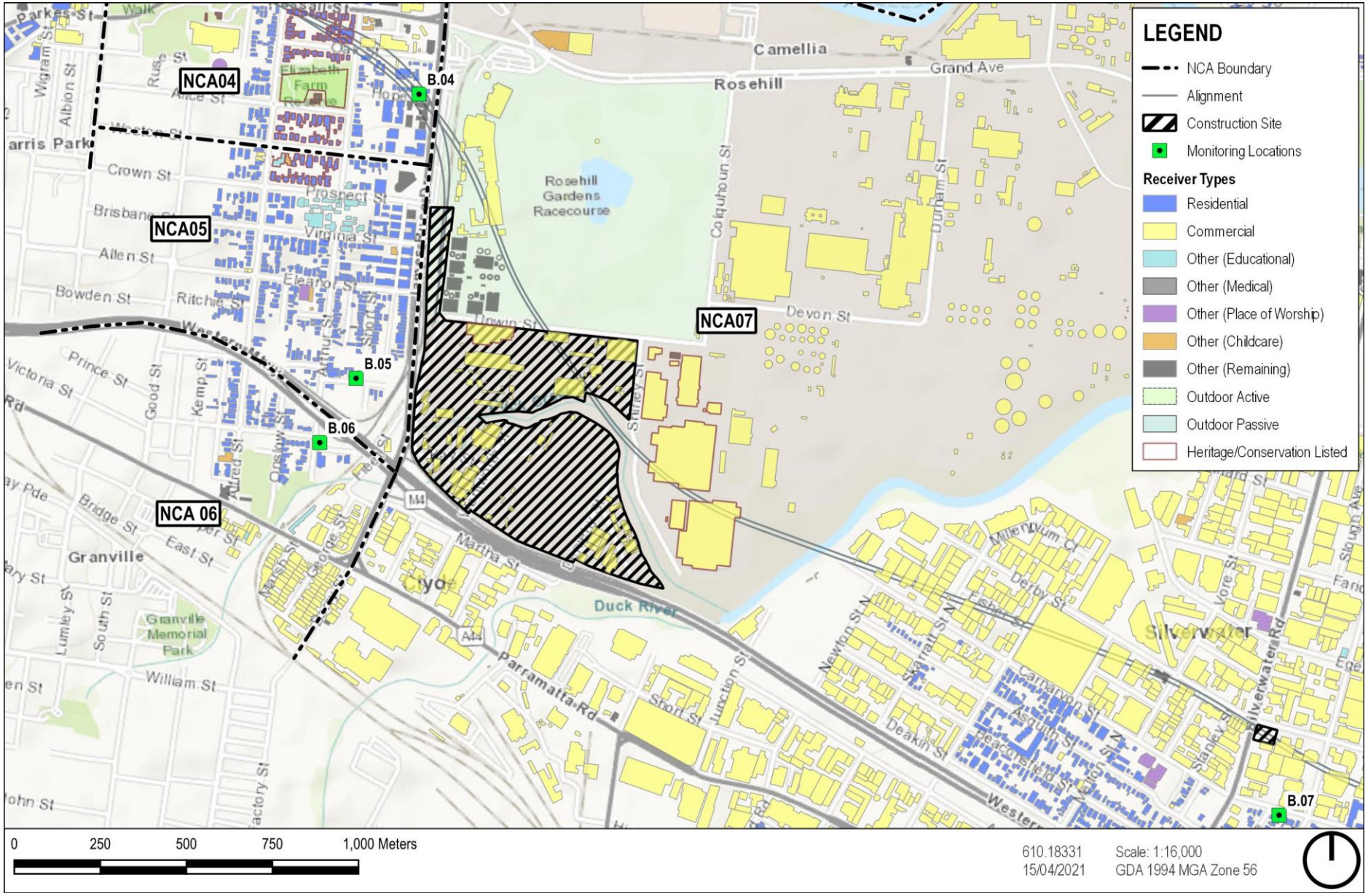
The NCAs in the study area are described in **Table 1** and shown in **Figure 2.**

Table 1 Noise Catchment Areas and Surrounding Land Uses

NCA	Minimum distance (metres)[1]	Description
NCA04	60	South of the Parramatta River and west of James Ruse Drive. The catchment is mainly residential with small areas of commercial receivers.
NCA05	60	North of the M4 Motorway and west of James Ruse Drive. The catchment is mainly residential. 'Other sensitive' receivers include Rosehill Public School and a number of hotels and child care centres.
NCA06	200	South of the M4 Motorway in Granville. The catchment is mostly residential adjacent to the motorway, with some commercial use in the south-east.
NCA07	200	East of James Ruse Drive, this catchment is mostly commercial and covers Rosehill Gardens racecourse, the Clyde commercial/industrial area, and Silverwater and Newington. Residential receivers and Newington Public School are in the south-east.

Note 1: Approximate minimum horizontal distance from the proposed Clyde stabling and maintenance facility construction site to nearest sensitive receivers.

Figure 2 Construction Site, Tunnelling Alignment and Sensitive Receivers Map



3.2 Noise Survey and Monitoring Locations

Unattended ambient noise monitoring was completed in the Clyde study area between March and July 2019, at a total of four representative monitoring locations, as shown in **Figure 2**. The measured noise levels have been used to determine the existing noise environment and to set criteria to assess the potential impacts. The monitoring results are summarised in **Table 2**.

Table 2 Summary of Unattended Noise Monitoring Results

NCA	Location ID	Address	Noise Level (dBA)[1]					
			Background Noise (RBL)			Average Noise Level (LAeq)		
			Day[2]	Evening[2]	Night[2]	Day	Evening	Night
NCA04	B.04	5 Hope Street, Rosehill[3]	51	48	41	61	58	57
NCA05	B.05	9 A'Beckett Street, Granville[3]	49	48	44	56	54	52
NCA06	B.06	4B Gray Street, Granville[3]	52	51	44	58	57	55
NCA07	B.07	10 Carnarvon Street, Silverwater	46	44	41	60	57	55

Note 1: The RBL and L_{Aeq} noise levels have been determined with reference to the procedures in the *Noise Policy for Industry* (NPfI).

Note 2: Daytime is 7.00 am to 6.00 pm, evening is 6.00 pm to 10.00 pm and night-time is 10.00 pm to 7.00 am.

Note 3: Data referenced from M4 Widening and Parramatta light rail projects, Refer to Appendix B of Technical Paper 2 (Noise and Vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD for details.

4 Construction Guidelines

4.1 Construction Airborne Noise Guidelines

The NSW *Interim Construction Noise Guideline* (ICNG) has been used for assessing and managing impacts from construction noise, as per the assessment of the approved project.

The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers. The realistic 'worst-case' noise levels from construction of a project are predicted and then compared to the NMLs in a 15-minute assessment period to determine the likely impacts.

The NMLs are not mandatory limits, however, where construction noise levels are predicted or measured to be above the NMLs, feasible and reasonable work practices to minimise noise emissions are to be investigated.

4.1.1 Residential Receivers

The residential NMLs have been determined using the results from the unattended ambient noise monitoring and are shown in **Table 3**.

Table 3 Residential Receiver Construction NMLs

Study area	NCA	Representative Background Monitoring Location	NML (LAeq(15minute) dBA)				Sleep Disturbance Screening Criteria (52 dBA or RBL +15 dB whichever is higher)
			Standard Construction (RBL +10 dB)	Out of Hours (RBL +5 dB)			
			Daytime	Daytime[1]	Evening	Night time	
Clyde	NCA04	B.04	61	56	53	46	56
	NCA05	B.05	59	54	53	49	59
	NCA06	B.06	62	57	56	49	59
	NCA07	B.07	56	51	49	46	56

Note 1: Daytime out of hours is 7 am to 8 am and 1 pm to 6 pm on Saturday, and 8 am to 6 pm on Sunday and public holidays.

Major infrastructure projects often require certain works to be completed during the night-time. Where night works are located close to residential receivers there is potential for sleep disturbance impacts. Where construction works are planned to extend over more than two consecutive nights, the ICNG recommends that an assessment of sleep disturbance impacts should be completed.

The most current method for assessing sleep disturbance from NSW transport infrastructure projects is contained in the EPA's *Noise Policy for Industry* (NPfI). Although the NPfI sleep disturbance criteria relate to industrial noise, they are considered relevant for reviewing potential impacts from construction noise.

The NPfI defined sleep disturbance criteria is 52 dBA L_{AFmax} or the prevailing background level plus 15 dB, whichever is the greater. The sleep disturbance criteria for this assessment are provided in **Table 3**.

4.1.2 Other Sensitive Land Uses and Commercial Receivers

Non-residential land uses are the same as for the approved project, and are shown on **Figure 2**. These include 'other sensitive' land uses such as educational institutes, medical facilities, outdoor recreational areas and commercial properties. The ICNG NMLs for 'other sensitive' receivers are shown in **Table 4**.

Table 4 ICNG NMLs for 'Other Sensitive' Receivers

Land Use	Noise Management Level $L_{Aeq(15minute)}$ (dBA) (Applied when the property is in use)	
	Internal	External
Classrooms at schools and other educational institutions	45	55[1]
Hospital wards and operating theatres	45	65[1]
Places of worship	45	55[1]
Active recreation areas (characterised by sporting activities and activities which generate noise)	-	65
Passive recreation areas (characterised by contemplative activities that generate little noise)	-	60
Commercial	-	70
Industrial	-	75

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

The ICNG references *AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors* for criteria for 'other sensitive' receivers which are not listed in the guideline. Neither the ICNG nor AS2107 provide criteria for child care centres so the Association of Australian Acoustical Consultants *Guideline for Child Care Centre Acoustic Assessment* (GCCCAA) has been referenced. The NMLs for 'other sensitive' receivers are shown in **Table 5**.

Table 5 NMLs for 'Other Sensitive' Receivers

Use	Period	NML Derived From	Noise Management Level $L_{Aeq(15minute)}$ (dBA)	
			Internal	External
Child care centres	Daytime	GCCCAA: Outdoor play areas	-	55
		GCCCAA: Sleeping areas	40	50[1]
Stables	When in use	ICNG: Outdoor passive recreation	-	60

Note 1: Receiver conservatively assumed to have openable windows and a 10 dB outside to inside facade performance.

4.2 Construction Traffic Noise Guidelines

The potential impacts from construction traffic travelling on public roads are assessed under the NSW *Road Noise Policy* (RNP).

An initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2.0 dB due to construction traffic. Where this is considered likely, further assessment is required using the RNP base criteria shown in **Table 6**.

Table 6 RNP Criteria for Assessing Construction Traffic on Public Roads

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

4.3 Construction Vibration Guidelines

4.3.1 Human Comfort Vibration

People can sometimes perceive vibration impacts when vibration generating construction works are located close to occupied buildings.

Vibration from construction works tends to be intermittent in nature and the EPA's *Assessing Vibration: a technical guideline* (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV). The 'preferred' and 'maximum' VDVs for human comfort impacts are shown in **Table 7**.

Table 7 Vibration Dose Values for Intermittent Vibration

Building Type	Assessment Period	Vibration Dose Value[1] ($m/s^{1.75}$)	
		Preferred	Maximum
Critical Working Areas (e.g. operating theatres or laboratories)	Day or night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

Note 1: The VDV accumulates vibration energy over the daytime and night-time assessment periods, and is dependent on the level of vibration as well as the duration.

4.3.2 Cosmetic Damage Vibration

The Sydney Metro Construction Noise and Vibration Standard (Sydney Metro, 2020d) recommends the following conservative cosmetic damage screening limits shown in **Table 8**.

Table 8 Transient Vibration Values for Minimal Risk of Cosmetic Damage

Type of Building	Peak Particle Velocity[1]
Reinforced or framed structures. Industrial and heavy commercial buildings	25 mm/s
Unreinforced or light framed structures. Residential or light commercial type buildings	7.5 mm/s

Note 1: Cosmetic damage vibration limits are reduced by 50 percent to account for dynamic loading caused by continuous vibration dynamic magnification due to resonance.

5 Methodology

The assessment of the potential noise and vibration impacts from the Clyde stabling and maintenance facility construction site included:

- Computer noise modelling to predict airborne noise levels from the amended construction sites and activities to the surrounding receivers. The model uses ISO 9613 algorithms in SoundPLAN software to predict noise levels at external building facades and outdoor recreation areas. Local terrain, receiver buildings and structures were digitised in the noise model to develop a three-dimensional representation of the construction sites and surrounding areas.
- Calculation of ground-borne noise and vibration which includes the shaft locations/tunnel alignment and elevation data for receivers above the proposed tunnelling works or near to station excavation works.

This assessment follows the same methodology as the approved project. The methodology is detailed in Technical Paper 2 (Noise and Vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD, which should be referenced where further information is required.

6 Construction Impact Assessment

The assessment uses 'realistic worst-case' scenarios to determine the potential airborne noise impacts from the noisiest 15-minute period for each work scenario, as required by the ICNG. The impacts represent construction noise levels with project specific base-case mitigation applied, as detailed in **Table 9**.

Table 9 Project Specific Base-case Mitigation Measures

Included Mitigation Measures	Description
Bored piling	The construction activities assume that bored piling would be used as opposed to impact piling, wherever possible. Bored piling is significantly less noisy than impact piling.
Acoustic perimeter hoardings	For construction concentrated in a single area, such as at station and services facility construction sites, temporary acoustic hoardings around the site perimeter would be used where receivers are potentially affected and where feasible and reasonable. On this basis, three metre high acoustic hoarding of solid construction (as opposed to standard wire mesh fence) has been included in the assessment and is shown on the study area figures in **Section 6.2**. However, in practice the same noise outcome at the receivers could be achieved through a range of mitigation measures and potentially different barrier heights.

Scenarios have been categorised into 'Peak' and 'Typical' works which have been used to define the likely range of potential noise impacts:

- '**Peak**' works represent the noisiest stages and can require noise intensive equipment, such as rockbreakers or concrete saws. While 'Peak' works would be required at times in most locations, the noisiest works would not occur for the full duration of the works.
- '**Typical**' works represent typical noise emissions when noise intensive equipment is not in use. The 'Typical' works generally include most items of equipment for a given activity except for the loudest item. These items generally support the 'Peak' works activity and are referred to as 'supporting equipment'.

6.1 Construction Site Activities

The revised construction scenarios required in the Clyde study area and proposed working hours are shown in Table 10Error! Reference source not found.. The estimated duration of each activity is also provided, noting that most activities would be intermittent during this period and would not be expected to be undertaken on a continual basis during every day of the scheduled activity.

Works at this site which are unchanged from the strategy previously assessed for the approved project are associated with construction of the stabling and maintenance facility and include site establishment, earthwork and civil works required to prepare the site for construction of the facility, road reconfigurations, and a tunnel dive in the northern extent of the construction site.

Works which are changed due to the revised tunnelling strategy are associated with the excavation of a services facility shaft at the eastern side of the construction site which would also be used as a tunnel boring machine launch and support site.

Works in this study area would generally only occur during daytime hours. Tunnel boring machine launch and support works are proposed to occur on a 24/7 basis.

A concrete batch plant facility planned to operate on a 24/7 basis was included in the assessment of the approved project. The batch plant has been removed from this revision of the construction strategy but works associated with the storage of precast concrete segments would still occur for the duration of the excavation and tunnel boring machine works.

Construction work at the Clyde stabling and maintenance facility construction site is anticipated to commence in 2021 and would continue until the completion of the tunnelling program at about 2026.

Table 10 Surface construction Activities and Period of Works

Scenario	Activity		Total Indicative Duration (Weeks)[2]	Maximum Number of Working Faces	Hours of Works[1]				Comments
					Standard Daytime	Out of Hours Works			
						Day OOH	Eve	Night	
Enabling works	'Typical'	Supporting and loading	19	1	✓	-	-	-	Rockbreaking works would only occur intermittently during a 19 week period between 7am – 6pm. Total duration of rockbreaking works would be approximately 15 days.
	'Peak'	Demolition using a rockbreaker	19	2	✓	-	-	-	
Piling	'Typical'	Supporting works	5	1	✓	-	-	-	Piling works would only occur intermittently during a five week period between 7am – 6pm. Up to two piling rigs would be active at the same time.
	'Peak'	Bored piling with support plant	5	2	✓	-	-	-	
Earthworks and civil works	'Typical'	General works	38	1	✓	✓	✓	✓	Delivery and stockpiling of spoil would be undertaken on a 24-hour basis. No noise intensive equipment would be used during out of hours periods.
	'Peak'	Noise intensive works	38	2	✓	-	-	-	
Surface construction	'Typical'	General works	13	1	✓	-	-	-	-
	'Peak'	Noise intensive works	13	2	✓	-	-	-	
Excavation	'Typical'	Mucking out	35	1	✓	-	-	-	-
	'Peak'	Through soft soil/rock	5	2	✓	-	-	-	Excavation through soil and soft rock using excavator ripper attachment.
		Through rock using rockbreaker	30	2	✓	-	-	-	Excavation through rock using rockbreaker.
TBM launch and support	'Typical'	TBM support and spoil removal	78	1	✓	✓	✓	✓	Four tunnel boring machines would be launched from the Clyde stabling and maintenance facility construction site. Two towards Westmead and two towards Sydney Olympic Park.
	'Peak'	TBM assembly and launch	2	1	✓	✓	✓	✓	

Note 1: OOH = Out of hours. During the daytime, this refers to the period on Saturday between 7am – 8am, and 1pm – 10pm.

Note 2: Durations should be regarded as indicative and represent the total estimated duration of works at a typical worksite over the entire construction period.

6.2 Airborne Noise Impacts

6.2.1 Environmental Impact Statement Assessment – Number of NML Exceedances

Some of the comparative change values (in brackets) shown in **Section 6.2.2** do not directly align with the corresponding values in Chapter 11 (Noise and Vibration) and Technical Paper 2 (Noise and Vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a). This is due to a transcription error in Table 11-32 of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a), and Table 46 to Table 48 of Technical Paper 2 (Noise and Vibration).

The corrected predicted airborne noise impacts from the construction site works assessed for the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a) in the Clyde study area are summarised in **Table 11**, **Table 12** and **Table 13** for all receiver types, residential receivers, and commercial 'other sensitive' receivers, respectively.

The Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a) presented the worst-case impacts in all cases for the assessment of the approved project however impacts for some select works were presented in the incorrect table row (i.e. a different works scenario). The comparisons made in this assessment (see **Section 6.2.2** onwards) are representative of the actual change in predicted impacts due to the revised tunnel boring machine drive strategy.

Table 11 Overview of NML Exceedances – All Receiver Types (Environmental Impact Statement Technical Paper 2 Table 46 Equivalent)

Scenario		Activity	No. Weeks[1]	Number of Receivers																
				Total	HNA[2]	With NML Exceedance[3]														
						Standard Construction Hours Daytime			Out of Hours Works [4]											
									Daytime OOH			Evening			Night time			Sleep Disturbance		
						1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB
Enabling works	'Typical'	Supporting and loading	19	2764	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Demolition using a rockbreaker	19	2764	9	212	37	10	-	-	-	-	-	-	-	-	-	-	-	-
Piling	'Typical'	Supporting works	5	2764	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Bored piling with support plant	5	2764	-	22	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Earthworks and civil works	'Typical'	General works	38	2764	-	-	-	-	3	-	-	5	-	-	6	-	-	1	-	-
	'Peak'	Noise intensive works	38	2764	-	31	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Surface construction	'Typical'	General works	13	2764	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Noise intensive works	13	2764	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Excavation	'Typical'	Mucking out	35	2764	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Through soft soil/rock	5	2764	-	21	1	-	-	-	-	-	-	-	-	-	-	-	-	-
		Through rock using rockbreaker	30	2764	5	84	14	3	-	-	-	-	-	-	-	-	-	-	-	-
Concrete batch plant	'Typical'	50 percent capacity	143	2764	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-
	'Peak'	100 percent capacity	143	2764	-	-	-	-	-	-	-	3	-	-	25	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent a typical worksite. The duration of these impacts is less than the overall duration, and depends on the rate of progress in the works areas.

Note 2: Highly Noise Affected, based on ICNG definition (i.e. predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels.

Note 4: OOH = Out of hours. During the daytime, this refers to the period on Saturday between 7am – 8am, and 1pm – 10pm.

Table 12 Overview of NML Exceedances – Residential Receivers (Environmental Impact Statement Technical Paper 2 Table 47 Equivalent)

Scenario	Activity		No. Weeks[1]	Number of Receivers																
				Total	HNA[2]	With NML Exceedance[3]														
						Standard Construction Hours Daytime			Out of Hours Works [4]											
									Daytime OOH			Evening			Night time			Sleep Disturbance		
						1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB
Enabling works	'Typical'	Supporting and loading	19	1574	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Demolition using a rockbreaker	19	1574	9	153	20	5	-	-	-	-	-	-	-	-	-	-	-	-
Piling	'Typical'	Supporting works	5	1574	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Bored piling with support plant	5	1574	-	11	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Earthworks and civil works	'Typical'	General works	38	1574	-	-	-	-	3	-	-	5	-	-	6	-	-	1	-	-
	'Peak'	Noise intensive works	38	1574	-	14	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Surface construction	'Typical'	General works	13	1574	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Noise intensive works	13	1574	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Excavation	'Typical'	Mucking out	35	1574	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Through soft soil/rock	5	1574	-	9	1	-	-	-	-	-	-	-	-	-	-	-	-	-
		Through rock using rockbreaker	30	1574	5	39	5	3	-	-	-	-	-	-	-	-	-	-	-	-
Concrete batch plant	'Typical'	50 percent capacity	143	1574	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-
	'Peak'	100 percent capacity	143	1574	-	-	-	-	-	-	-	3	-	-	25	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent a typical worksite. The duration of these impacts is less than the overall duration, and depends on the rate of progress in the works areas.

Note 2: Highly Noise Affected, based on ICNG definition (i.e. predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels.

Note 4: OOH = Out of hours. During the daytime, this refers to the period on Saturday between 7am – 8am, and 1pm – 10pm.

Table 13 Overview of Commercial and 'Other Sensitive' Receiver NML Exceedances (Environmental Impact Statement Technical Paper 2 Table 48 Equivalent)

Scenario	Activity		No. Weeks[1]	Number of Receivers																				
				Commercial			Child Care			Educational			Place of Worship			Stables			Hotel (Daytime)			Hotel (Night time)		
				1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB
Enabling works	'Typical'	Supporting and loading	19	-	-	-	1	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-
	'Peak'	Demolition using a rockbreaker	19	20	3	-	5	2	-	19	2	-	1	-	-	12	10	5	2	-	-	-	-	-
Piling	'Typical'	Supporting works	5	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
	'Peak'	Bored piling with support plant	5	-	-	-	1	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-
Earthworks and civil works	'Typical'	General works	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Noise intensive works	38	1	-	-	2	-	-	1	-	-	-	-	-	13	-	-	-	-	-	-	-	-
Surface construction	'Typical'	General works	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Noise intensive works	13	-	-	-	1	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Excavation	'Typical'	Mucking out	35	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
	'Peak'	Through soft soil/rock	5	-	-	-	1	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-
		Through rock using rockbreaker	30	6	-	-	4	1	-	14	-	-	-	-	-	19	8	-	2	-	-	-	-	-
Concrete batch plant	'Typical'	50 percent capacity	143	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	100 percent capacity	143	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent a typical worksite. The duration of these impacts is less than the overall duration, and depends on the rate of progress in the works areas.

6.2.2 Number of NML Exceedances

The predicted airborne noise impacts from the revised construction site works in the Clyde study area are summarised in **Table 14**, **Table 15** and **Table 16** for all receiver types, residential receivers, and commercial 'other sensitive' receivers, respectively. The predictions are representative of the highest noise levels that would likely be experienced at the surrounding receivers when the works are at their nearest.

The number of receivers predicted to experience exceedances of the NMLs are summarised in bands of 10 dB and are separated into day, evening and night-time periods, as appropriate. The predicted change from the approved project is shown in brackets where applicable.

Table 14 Overview of NML Exceedances – All Receiver Types

Scenario	Activity		No. Weeks[1]	Number of Receivers																
				Total	HNA[2]	With NML Exceedance[3]														
						Standard Construction Hours Daytime			Out of Hours Works [4]											
									Daytime OOH			Evening			Night time			Sleep Disturbance		
						1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB
Enabling works	'Typical'	Supporting and loading	19	2764	-	14 (0)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Demolition using a rockbreaker	19	2764	9 (0)	212 (0)	37 (0)	10 (0)	-	-	-	-	-	-	-	-	-	-	-	-
Piling	'Typical'	Supporting works	5	2764	-	8 (0)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Bored piling with support plant	5	2764	-	22 (0)	1 (0)	-	-	-	-	-	-	-	-	-	-	-	-	-
Earthworks and civil works	'Typical'	General works	38	2764	-	-	-	-	3 (0)	-	-	5 (0)	-	-	6 (0)	-	-	1 (0)	-	-
	'Peak'	Noise intensive works	38	2764	-	31 (0)	3 (0)	-	-	-	-	-	-	-	-	-	-	-	-	-
Surface construction	'Typical'	General works	13	2764	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Noise intensive works	13	2764	-	12 (0)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Excavation	'Typical'	Mucking out	35	2764	-	7 (-1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Through soft soil/rock	5	2764	-	19 (-2)	- (-1)	-	-	-	-	-	-	-	-	-	-	-	-	-
		Through rock using rockbreaker	30	2764	5 (0)	102 (+18)	16 (+2)	1 (-2)	-	-	-	-	-	-	-	-	-	-	-	-
TBM launch and support[6]	'Typical'	TBM support and spoil removal	78	2764	-	2	-	-	2	-	-	2	-	-	3	-	-	4	-	-
	'Peak'	TBM assembly and launch	2	2764	-	2	-	-	2	-	-	2	-	-	5	-	-	4	-	-

Note 1: Durations should be regarded as indicative and represent a typical worksite. The duration of these impacts is less than the overall duration, and depends on the rate of progress in the works areas.

Note 2: Highly Noise Affected (HNA), based on ICNG definition (i.e. predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels.

Note 4: OOH = Out of hours. During the daytime, this refers to the period on Saturday between 7am – 8am, and 1pm – 10pm.

Note 5: Results that have changed are shown in brackets with increases as positive values and decreases as negative values, relative to the assessment of the approved project.

Note 6: No comparable scenario was assessed in the Environmental Impact Statement assessment.

Table 15 Overview of NML Exceedances – Residential Receivers

Scenario	Activity		No. Weeks[1]	Number of Receivers																
				Total	HNA[2]	With NML Exceedance[3]														
						Standard Construction Hours Daytime			Out of Hours Works [4]											
									Daytime OOH			Evening			Night time			Sleep Disturbance		
						1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB
Enabling works	'Typical'	Supporting and loading	19	1574	-	5 (0)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Demolition using a rockbreaker	19	1574	9 (0)	153 (0)	20 (0)	5 (0)	-	-	-	-	-	-	-	-	-	-	-	-
Piling	'Typical'	Supporting works	5	1574	-	5 (0)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Bored piling with support plant	5	1574	-	11 (0)	1 (0)	-	-	-	-	-	-	-	-	-	-	-	-	-
Earthworks and civil works	'Typical'	General works	38	1574	-	-	-	-	3 (0)	-	-	5 (0)	-	-	6 (0)	-	-	1 (0)	-	-
	'Peak'	Noise intensive works	38	1574	-	14 (0)	3 (0)	-	-	-	-	-	-	-	-	-	-	-	-	-
Surface construction	'Typical'	General works	13	1574	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Noise intensive works	13	1574	-	6 (0)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Excavation	'Typical'	Mucking out	35	1574	-	4 (-1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Through soft soil/rock	5	1574	-	7 (-2)	- (-1)	-	-	-	-	-	-	-	-	-	-	-	-	-
		Through rock using rockbreaker	30	1574	5 (0)	50 (+11)	7 (+2)	1 (-2)	-	-	-	-	-	-	-	-	-	-	-	-
TBM launch and support[6]	'Typical'	TBM support and spoil removal	78	1574	-	-	-	-	-	-	-	-	-	-	1	-	-	4	-	-
	'Peak'	TBM assembly and launch	2	1574	-	-	-	-	-	-	-	-	-	-	3	-	-	4	-	-

Note 1: Durations should be regarded as indicative and represent a typical worksite. The duration of these impacts is less than the overall duration, and depends on the rate of progress in the works areas.

Note 2: Highly Noise Affected, based on ICNG definition (i.e. predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels.

Note 4: OOH = Out of hours. During the daytime, this refers to the period on Saturday between 7am – 8am, and 1pm – 10pm.

Note 5: Results that have changed are shown in brackets with increases as positive values and decreases as negative values, relative to the assessment of the approved project.

Note 6: No comparable scenario was assessed in the Environmental Impact Statement assessment.

Table 16 Overview of Commercial and 'Other Sensitive' Receiver NML Exceedances

Scenario	Activity		No. Weeks[1]	Number of Receivers																				
				Commercial			Child Care			Educational			Place of Worship			Stables			Hotel (Daytime)			Hotel (Night time)		
				1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB
Enabling works	'Typical'	Supporting and loading	19	-	-	-	1 (0)	-	-	-	-	-	-	-	-	8 (0)	-	-	-	-	-	-	-	-
	'Peak'	Demolition using a rockbreaker	19	20 (0)	3 (0)	-	5 (0)	2 (0)	-	19 (0)	2 (0)	-	1 (0)	-	-	12 (0)	10 (0)	5 (0)	2 (0)	-	-	-	-	-
Piling	'Typical'	Supporting works	5	-	-	-	1 (0)	-	-	-	-	-	-	-	-	2 (0)	-	-	-	-	-	-	-	-
	'Peak'	Bored piling with support plant	5	-	-	-	1 (0)	-	-	-	-	-	-	-	-	10 (0)	-	-	-	-	-	-	-	-
Earthworks and civil works	'Typical'	General works	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Noise intensive works	38	1 (0)	-	-	2 (0)	-	-	1 (0)	-	-	-	-	-	13 (0)	-	-	-	-	-	-	-	-
Surface construction	'Typical'	General works	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	'Peak'	Noise intensive works	13	-	-	-	1 (0)	-	-	-	-	-	-	-	-	5 (0)	-	-	-	-	-	-	-	-
Excavation	'Typical'	Mucking out	35	-	-	-	1 (0)	-	-	-	-	-	-	-	-	2 (0)	-	-	-	-	-	-	-	-
	'Peak'	Through soft soil/rock	5	-	-	-	1 (0)	-	-	-	-	-	-	-	-	11 (0)	-	-	-	-	-	-	-	-
		Through rock using rockbreaker	30	6 (0)	-	-	6 (+2)	1 (0)	-	19 (+5)	-	-	-	-	-	19 (0)	8 (0)	-	2 (0)	-	-	-	-	-
TBM launch and support[3]	'Typical'	TBM support and spoil removal	78	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
	'Peak'	TBM assembly and launch	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent a typical worksite. The duration of these impacts is less than the overall duration and depends on the rate of progress in the works areas.

Note 2: Results that have changed are shown in brackets with increases as positive values and decreases as negative values, relative to the assessment of the approved project.

Note 3: No comparable scenario was assessed in the Environmental Impact Statement assessment.

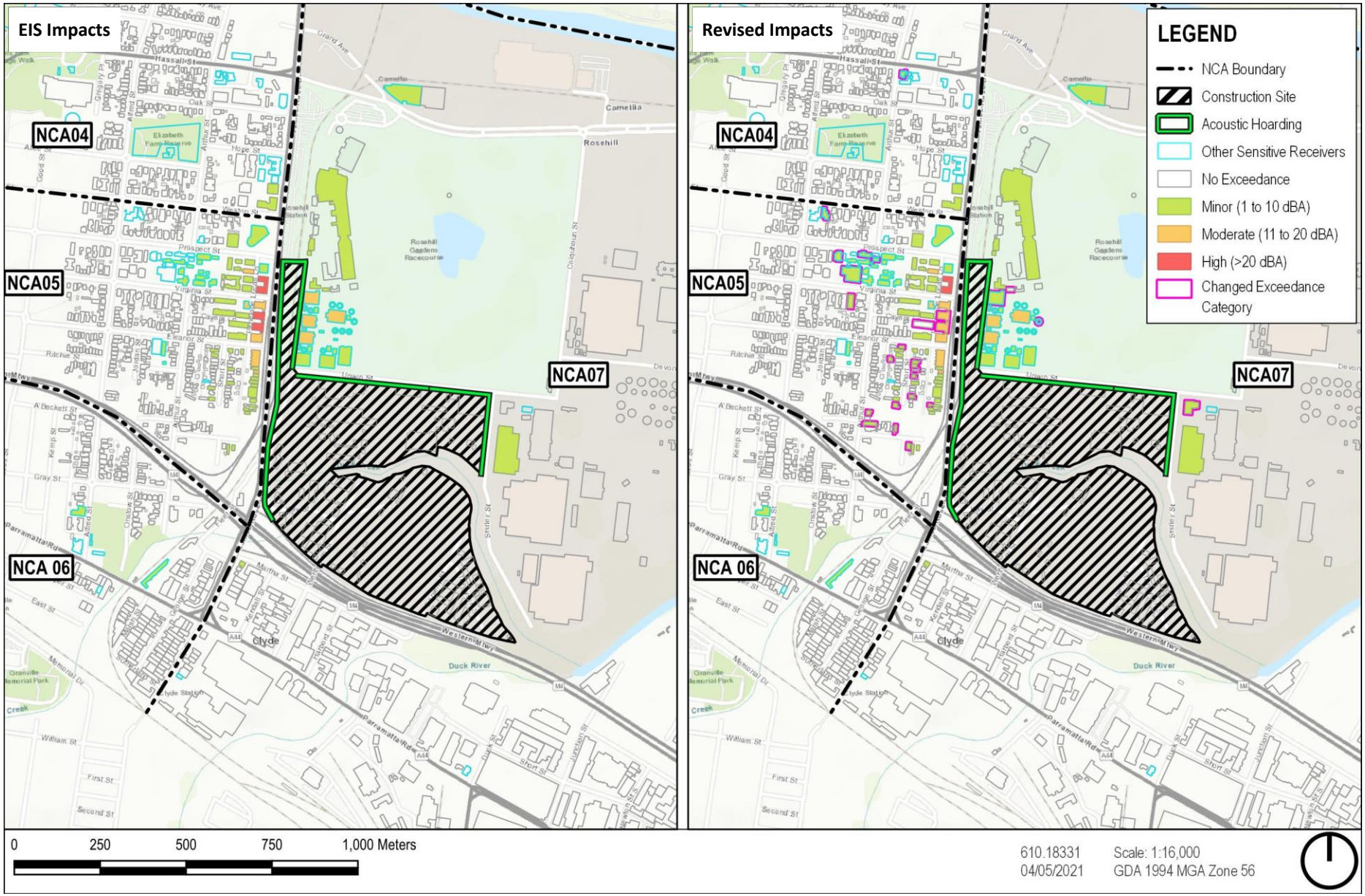
The above shows the following:

- The proposed construction works are predicted to result in 'high' worst-case noise impacts at the nearest receivers during the higher noise generating activities. The nearest receivers to the site are generally residential and 'other sensitive' receivers at Rosehill Gardens racecourse (ie stables). The worst-case impacts are predicted during *Enabling works* when a rockbreaker is in use. These works are, however, unchanged from those assessed in the Environmental Impact Statement Noise and Vibration Technical Paper and would be limited to standard construction hours.
- 'High' worst-case impacts are also predicted during *Excavation* scenarios occurring during the daytime period. These impacts are largely driven by works occurring at the northern dive which is nearby to residential receivers opposite James Ruse Drive.
- Works not using a rockbreaker generate less noise and the worst-case impacts at the nearest receivers are predicted to be 'moderate'.
- Out of hours impacts from *Excavation with shed* are significantly less than the impacts from *Excavation without shed*, with only 12 receivers predicted to have 'minor' impacts during the night-time.
- *Piling, Earthworks and civil works* and *Surface construction* works generate less noise and the worst-case impacts at the nearest receivers are predicted to be 'moderate' or 'minor'.
- Works associated with delivery and stockpiling of spoil would occur outside of standard construction hours. The worst-case impacts during the night-time are predicted to be 'minor' at the nearest receivers.
- Works associated with *TBM launch and support* would occur outside standard construction hours at the services facility shaft. The worst-case impacts during the night-time are predicted to be 'minor' at the nearest receivers.
- 'Minor' sleep disturbance impacts are predicted for up to four residential receivers during excavation using a rockbreaker.

6.2.3 Impacts During Standard Construction Hours

The worst-case impacts during standard construction hours due to new or altered works scenarios required by the proposed tunnelling strategy are predicted during main excavations works using a rockbreaker. The predicted worst-case daytime impacts from excavation works are shown in **Figure 3**, and are compared to the worst-case excavation impacts presented in Technical Paper 2 (Noise and vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a).

Figure 3 Worst-case Standard Construction Hours Airborne Noise Impacts – Excavation with Rockbreaker



The above shows the following:

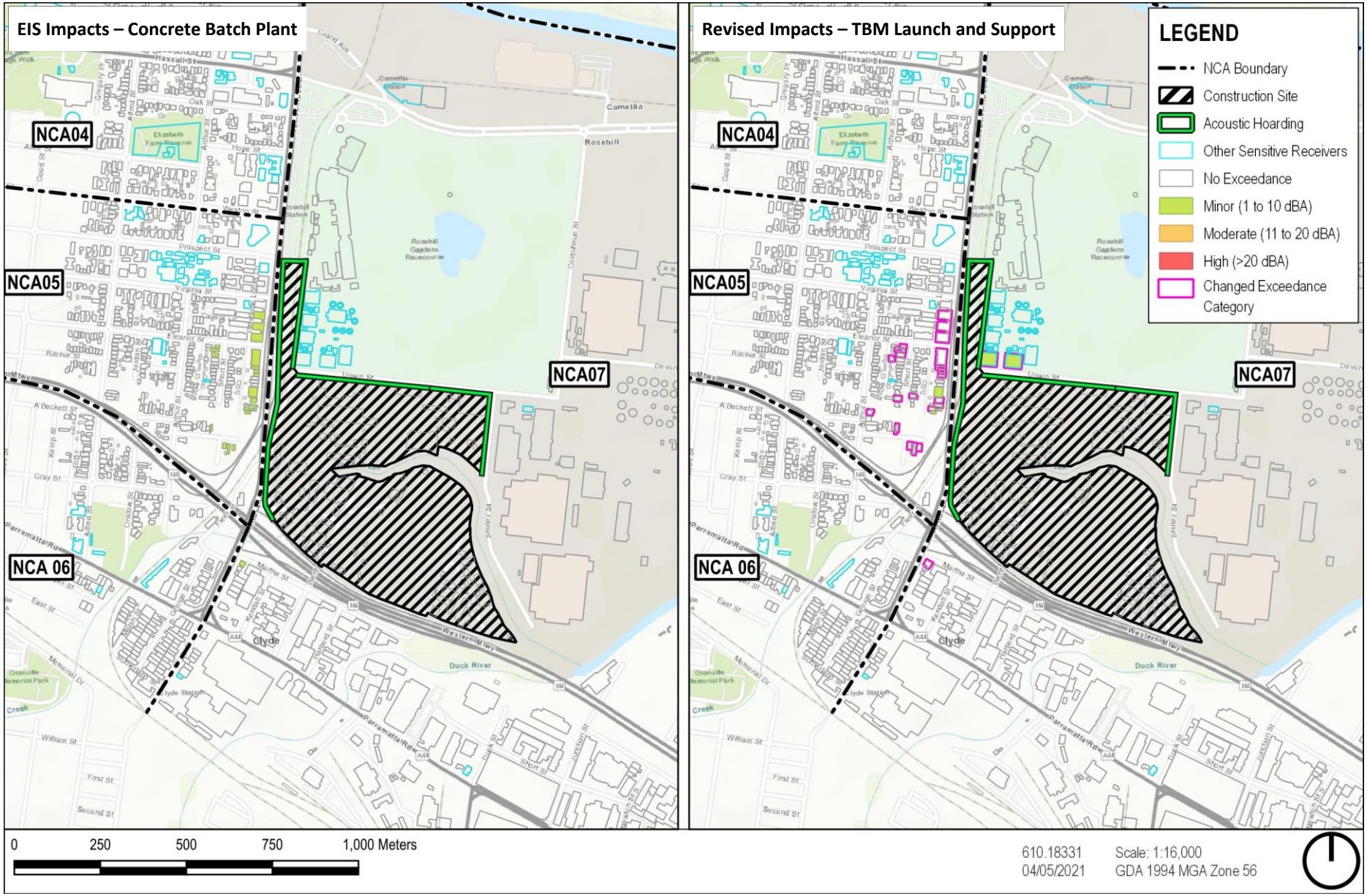
- The number of receivers with 'high' impacts due to *Excavation – Through rock using a rockbreaker* is predicted to reduce by two due to the change. This is primarily due to the removal of the concrete batch plant from the Clyde stabling and maintenance facility construction site, which was relatively near to these receivers.
- The number of receivers with 'minor' impacts due to *Excavation – Through rock using a rockbreaker* are predicted to increase by 18 due to the change. This is primarily due to the change in position and size of the eastern services facility shaft.
- The change in worst-case impacts from *Excavation – Through rock using a rockbreaker* at 'other sensitive' receivers are predicted to be:
    - 'Minor' impacts at five additional buildings at Rosehill Public School.
    - 'Minor' impacts at Rainbow Village Child Care and Rosehill Community Preschool.

The impacts presented above are based on all equipment working simultaneously in each assessed scenario. There would be periods when construction noise levels would be much lower than the worst-case levels predicted and there would be times when no equipment would be in use and no impacts occur.

6.2.4 Impacts During the Night-time

The worst-case impacts during the night-time due to new or altered works scenarios required by the proposed tunnelling strategy are predicted during tunnel boring machine launch and support works. The predicted worst-case night-time impacts from tunnel boring machine launch and support works are shown in **Figure 4**, and are compared to the removed concrete batch plant works which were the worst-case night-time impacts presented in Technical Paper 2 (Noise and vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a).

Figure 4 Worst-case Night-time Airborne Noise Impacts – Concrete batch plant and TBM launch and support



The above shows the following:

- The worst-case night-time noise levels from *TBM launch and support* are predicted to result in 'minor' impacts at the five nearby receivers.
- Three residential receivers are predicted to have 'minor' night-time impacts from to *TBM launch and support*. Several distant residential receivers which previously had 'minor' impacts from the removed concrete batch plant works assessed in the Environmental Impact Statement Noise and Vibration Technical Paper are not predicted to be impacted from the *TBM launch and support* work.
- Two stables buildings at Rosehill Gardens are predicted to have 'minor' night-time impacts from to *TBM launch and support*. No stables receivers were previously identified to be impacted by the worst-case night-time works assessed in the Environmental Impact Statement Noise and Vibration Technical Paper. 'Minor' impacts are predicted at these receivers due to their proximity to the revised eastern services shaft location where tunnel boring machine launch and support works are to occur.

6.2.5 Sleep Disturbance

The approved project was predicted to result in 'minor' sleep disturbance impacts at one residential receiver to the west, during delivery and stockpiling of spoil.

A sleep disturbance screening assessment has been completed for the proposed tunnelling strategy and is summarised in **Table 14.**

'Minor' sleep disturbance impacts are predicted at the four nearest residential receivers during noisy works as part of *TBM launch and support*. Sleep disturbance impacts from within the construction site are generally controlled by heavy vehicle movements in the outdoor areas of the site.

The potential awakenings from heavy vehicles would be influenced by the number of trucks accessing the site during the night-time and the way in which the vehicles are operated. The number of heavy vehicles at the construction site during the night-time is expected to be around 22 heavy vehicles per hour, consistent with the number of heavy vehicles assessed for the approved project.

6.2.6 Highly Noise Affected Residential Receivers

The receivers predicted to be Highly Noise Affected during the worst-case impacts are summarised in **Table 17** and shown in **Figure 5**. The table shows the number of residential receivers separated by works activity and NCA.

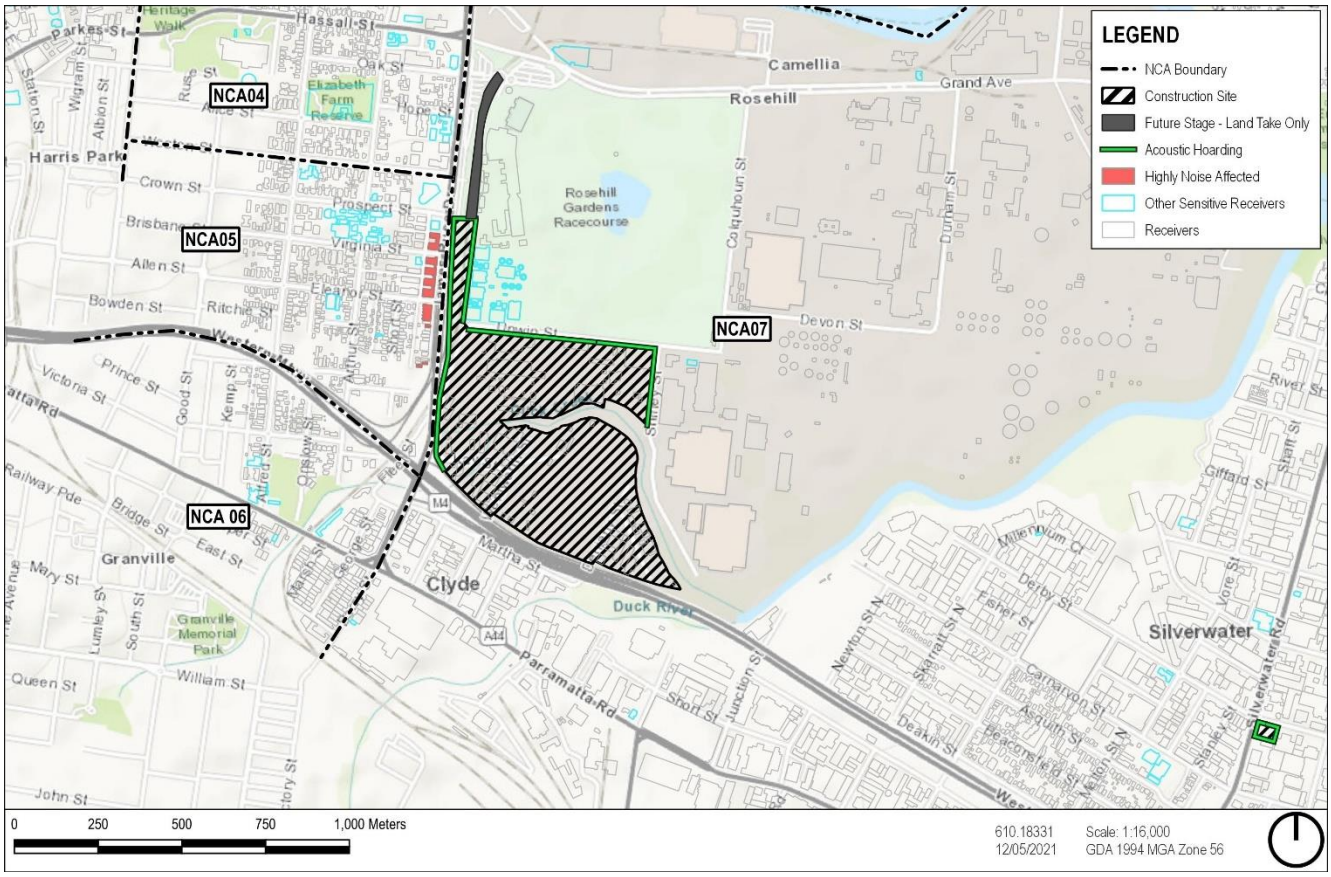
The receivers predicted to be Highly Noise Affected are the same as those identified in the Technical Paper 2 (Noise and vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a).

Table 17 Predicted Number of Highly Noise Affected Residential Receivers by Works

Scenario	Activity		NCA04, NCA05, NCA06 and NCA07		
			Day	Eve	Night
Enabling works	'Typical'	Supporting and loading	-	n/a	n/a
	'Peak'	Demolition using a rockbreaker	9	n/a	n/a
Piling	'Typical'	Supporting works	-	n/a	n/a
	'Peak'	Bored piling with support plant	-	n/a	n/a
Civil and Earthworks	'Typical'	General works	-	-	-
	'Peak'	Noise intensive works	-	n/a	n/a
Surface Construction	'Typical'	General works	-	n/a	n/a
	'Peak'	Noise intensive works	-	n/a	n/a
Excavation	'Typical'	Mucking out	-	n/a	n/a
	'Peak'	Through soft soil/rock	-	n/a	n/a
		Through rock using rockbreaker	5	n/a	n/a
TBM launch and support	'Typical'	TBM support and spoil removal	-	-	-
	'Peak'	TBM assembly and launch	-	-	-

Note 1: 'n/a' represents where works would not be performed during the evening or night-time periods

Figure 5 Highly Noise Affected Residential Receivers (During Any Works)



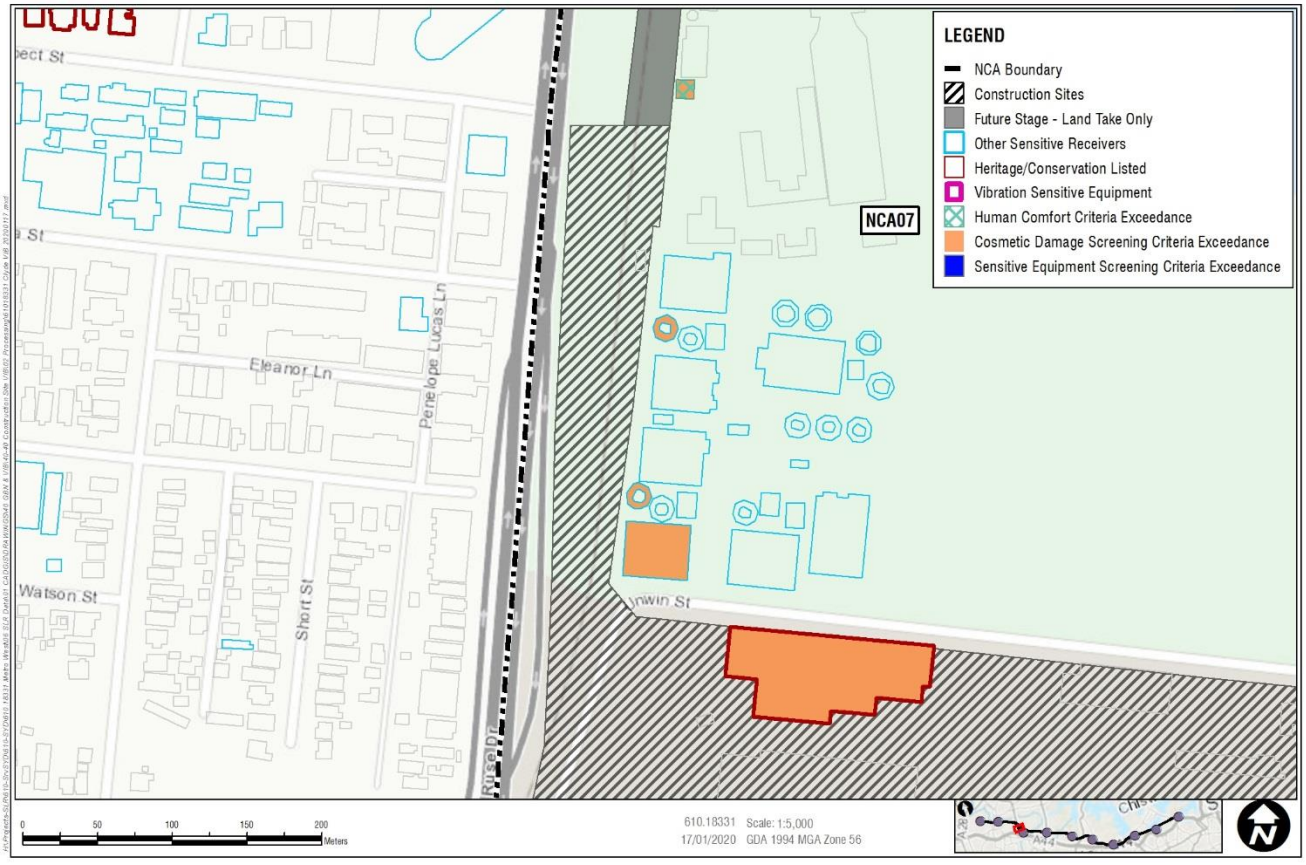
6.3 Ground-borne Noise Impacts

Vibration intensive works during shaft excavation at this construction site would not be completed in an acoustic shed meaning airborne noise levels at the nearest receivers would likely be higher than the corresponding internal ground-borne noise levels. Where airborne noise levels are higher than ground-borne noise levels it is not necessary to evaluate potential ground-borne noise impacts and they have not been considered further for this site.

6.4 Vibration Impacts from Construction Site

Worst-case vibration impacts from the site would occur from excavation at the northern dive site and the potential use of rockbreakers required across the site during the *Enabling works*. The predicted impacts during vibration intensive works are shown in **Figure 6**. The predictions are representative of the highest vibration levels that would likely be experienced by the nearest receivers when works are at their closest.

Figure 6 Worst-case Vibration Impacts



The above shows the following:

- The cosmetic damage screening criteria are predicted to be exceeded at:
  - One heritage listed building at 1 Unwin Street, Rosehill, located to the north of the site. This building is a heritage listed free-standing building facade and is not occupied.
  - Four commercial buildings at Rosehill Gardens racecourse located east of the existing rail corridor section of the site.

- The human comfort criteria are also predicted to be exceeded at one of the nearest commercial buildings located to the north of the site, meaning occupants of affected buildings may be able to perceive vibration impacts at times when vibration intensive equipment is in use nearby.
- There are no predicted exceedances of the sensitive equipment screening criteria.

No additional receivers are predicted to be impacted by vibration from the construction site due to the changes in site layout from the proposed tunnelling strategy. The receivers predicted to be impacted by vibration from the Clyde stabling and maintenance construction site are the same as those identified for the approved project.

7 Tunnelling

The following sections present an assessment of the predicted ground-borne noise and vibration impacts from the tunnelling works in the Clyde study area due to a minor tunnel realignment as part of the proposed tunnelling strategy. Comparison is made to the tunnelling predictions in the Environmental Impact Statement Noise and Vibration Technical Paper.

7.1 Ground-borne Noise Impacts from Tunnel Boring Machines

The ground-borne noise assessment is based on the worst-case predicted internal ground-borne noise levels for sensitive receivers above the proposed tunnel alignment. The predictions represent the likely highest noise levels when the tunnel boring machine tunnelling works are directly below each receiver.

A summary of the predicted ground-borne noise levels from tunnel boring machine works in each NCA is shown in **Table 18**. The predicted change from the approved project due to the alternate alignment is shown in brackets.

Table 18 Overview of Tunnel Boring Machine Tunnelling Ground-borne NML Exceedances – All Receiver Types

NCA	Number of Receivers								
	Total	With NML Exceedance [1, 2]							
		Tunnelling with Tunnel Boring Machine							
		Daytime			Evening			Night time		
		1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB	1 10 dB	11 20 dB	>20 dB
NCA04	392	41 (-10)	-	-	86 (-5)	3 (+2)	-	87 (-7)	40 (-9)	-
NCA05	477	-	-	-	-	-	-	-	-	-
NCA06	207	-	-	-	-	-	-	-	-	-
NCA07	553	-	-	-	-	-	-	-	-	-

Note 1: Based on worst-case predicted noise levels in each NCA.

Note 2: Results that have changed are shown in brackets with increases as positive values and decreases as negative values, relative to the assessment of the approved project.

The above assessment shows that:

- The worst-case ground-borne noise impacts from TBM tunnelling during the daytime are predicted to generally be compliant with the NML or result in only 'minor' impacts.
- During the night-time, the worst-case impacts are more wide-spread due to a lower and more stringent NML. The worst-case impacts are predicted to be 'moderate' at receivers near to the construction site, as this is where the tunnel depth is shallowest.

- The ground-borne noise predictions are based on the nearest sensitive receivers and most exposed floor (ie ground floor for commercial and assumed lowest habitable floor for residential). The ground-borne noise impacts would reduce for sensitive receivers which are further away from the alignment or for receivers higher up in buildings.

7.2 Vibration Impacts from Tunnel Boring Machines

The ground-borne vibration assessment is based on the worst-case predicted ground-borne vibration level for sensitive receivers above the proposed tunnel alignment. The predictions represent the likely highest vibration level when the tunnelling works are directly below each receiver.

A summary of the predicted ground-borne vibration levels from tunnel boring machine works in each NCA is shown in **Table 18**. The predicted change from approved project due to the alternate alignment is shown in brackets.

Table 19 Overview of Vibration Criteria Exceedances – All Receiver Types

NCA	Number of Receivers				
	Total	With Vibration Criteria Exceedance[1]			
		Tunnelling with Tunnel Boring Machine			
		Cosmetic Damage	Human Comfort		Sensitive Equipment
		Day / Night	Day	Night	Day / Night
NCA04	392	-	3 (+3)	13 (-4)	-
NCA05	477	-	-	-	-
NCA06	207	-	-	-	-
NCA07	553	-	-	-	-

Note 1: Based on worst-case predicted vibration levels.

Note 2: Results that have changed are shown in brackets with increases as positive values and decreases as negative values, relative to the assessment of the approved project.

The above shows the following:

- No receivers are predicted to be subject to vibration levels during TBM tunnel which exceed the cosmetic damage or sensitive equipment screening criteria.
- Potential exceedances of the human comfort criteria are likely at the nearest receivers, meaning perceptible levels of vibration may occur when tunnelling works are below these areas. These impacts are typically at receivers which surround the construction site, as this is where the tunnel depth is shallowest.
- The above predictions assume the TBM is in use for 50 percent of the assessment period. If this is reduced to 20 percent, the number of human comfort criteria exceedances would notably decrease. The TBM boring duty would depend on several factors and may vary throughout the alignment.

8 Management of Impacts

Where impacts remain after the use of 'standard mitigation measures', the Sydney Metro *Construction noise and Vibration Strategy* (CNVS) requires 'additional mitigation measures' to be applied, where feasible and reasonable, as described for the approved project.

The proposed change would not require any changes to, or additional, noise and vibration mitigation measures than those provided for the approved project.

Mitigation and management measures which would be applied to minimise impacts associated with the proposed change are provided in Section 8 of Technical Paper 2 (Noise and vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD. Noise impacts from any noisy works undertaken during out of hours works period would be managed in accordance with the requirements of the Sydney Metro Construction Noise and Vibration Standard.

9 References

Association of Australian Acoustical Consultants (2020) *Guideline for Child Care Centre Acoustic Assessment*

Australian Standards (2016) *AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors*

Department of Environment and Climate Change NSW (2009) Interim Construction Noise Guidelines

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Environment Protection Authority (2006) *Assessing Vibration: a technical guideline*

Environment Protection Authority (2011) Road Noise Policy

Environment Protection Authority (2017) Noise Policy for Industry

ISO (1993) ISO 9613-1993 Acoustics — Attenuation of sound during propagation outdoors — Part 1: Calculation of the absorption of sound by the atmosphere

Sydney Metro (2020a) The Sydney Metro West Environmental Impact Statement– Westmead to The Bays and Sydney CBD

Sydney Metro (2020b) The Sydney Metro West Westmead to The Bays and Sydney CBD Submissions Report (Concept and Stage 1)

Sydney Metro (2020c) The Sydney Metro West Westmead to The Bays and Sydney CBD Amendment Report (Concept and Stage 1)

Sydney Metro (2020d) Sydney Metro Construction Noise and Vibration Standard

Checked/
Authorised by: AW