# 7 Environmental assessment

This chapter provides an environmental assessment of the proposed modification to Stage 2 of the project. The assessment identifies potential issues and provides a comparison with the impacts assessed in the EIS and the SPIR for the approved project. The assessment has been prepared to address the relevant environmental assessment requirements for the modification as described in Appendix A - Secretary's Environmental Assessment Requirements (SEARs).

## 7.1 Environmental scoping

A scoping assessment has been completed to identify the likely potential environmental impacts associated with the proposed modification. The proposed modification is described in Chapter 5 (Proposed modification). The relevant SEARs were considered when completing this assessment.

Under the proposed modification, the additional excavation works to underground the electrical substation and ventilation facilities require the construction of new ventilation tunnels and two new caverns that would be supported from the Iron Cove civil site (C8), with the potential for some tunnelling to be supported from the Rozelle tunnelling site (C5).The proposed modification would reduce the extent of permanent surface works required at Iron Cove to construct the MOC4 and in particular avoid the need to construct a shaft connecting the surface facilities to the tunnels.

Potential environmental impacts associated with the proposed modification that require assessment are identified in Table 7-1.

**Table 7-1 Scoping summary of the environmental assessment of the proposed modification**

| Environmental issue | Proposed changes |
|---|---|
| Construction traffic and transport | See section 7.2.1 |
| Operational traffic and transport | See section 7.2.2 |
| Construction air quality | See section 7.3.1 |
| Operational air quality | See section 7.3.2 |
| Construction noise and vibration | See section 7.4 |
| Operation noise and vibration | See section 7.4 |
| Human health | The identified potential impacts on human health are related to operational air quality and construction noise and vibration. Refer to section 7.3.2 (Operational Air Quality) and section 7.4 (Construction Noise and Vibration) for further assessment. |
| Groundwater drawdown and potential surface settlement | See section 7.5 |
| Socio-economic, land use and property | See section 7.6 |
| Urban design and visual amenity | See section 7.7 |
| Construction water | See section 7.8.1 |
| Operational water | See section 7.8.2 |
| Contamination | The surface activities required to construct the proposed modification are located within the footprint assessed in the EIS. While the proposed modification would slightly increase the total volume of spoil to be extracted for the project, this spoil would be predominantly sandstone. Contamination impacts expected as a result of the proposed modification are consistent with those presented in the EIS. |

| Environmental issue | Proposed changes |
|---|---|
| Flooding and drainage | No additional flooding and drainage impacts are expected a result of the proposed modification. The proposed modification would decrease the surface footprint of the permanent works required for the Iron Cove ventilation facilities and therefore work to increase the extent of permeable surface area. Flooding and drainage impacts are considered consistent with those presented in the EIS. |
| Biodiversity | The surface activities required to construct the proposed modification are located within the footprint assessed in the EIS. No additional impacts on biodiversity are expected a result of the proposed modification. Biodiversity impacts are considered consistent with those presented in the EIS. |
| Non-Aboriginal heritage | The surface activities required to construct the proposed modification are located within the footprint assessed in the EIS. No items of non-Aboriginal heritage significance would be impacted by the proposed modification. The proposed changes are considered consistent with the non-Aboriginal impacts assessed in the EIS. |
| Aboriginal heritage | The surface activities required to construct the proposed modification are located within the footprint assessed in the EIS. No additional impacts are predicted to occur as a result of the proposed modification. The proposed changes are considered consistent with the Aboriginal impacts assessed in the EIS. |
| Greenhouse gas | The proposed modification would not alter the road tunnels to be provided under the approved project and would not generate additional operational traffic volumes. Construction of the proposed modification would not result in significant changes to emissions generating activities assessed in the EIS. The proposed modification is considered consistent with the greenhouse gas assessment in the EIS. |
| Resource use and waste minimisation | See section 7.9. |
| Climate change risk and adaption | The proposed modification would not result in changes to the climate change risk assessment presented in the EIS. |
| Hazard and risk | See section 7.10. |
| Cumulative impacts | The proposed modification reduces the extent of surface infrastructure required to the west of Victoria Road adjacent to the tunnel portals at Iron Cove and involves the construction of a new ventilation tunnel and two caverns. The surface activities required to construct the proposed modification are located within the footprint assessed in the EIS. The new ventilation tunnel and caverns would equate to about 425 metres of additional tunnels and caverns. This calculation is based on a length of about 340 metres for the ventilation tunnel alignment and the ventilation fan cavern, 65 metres for the substation cavern and about 20 metres of access tunnel connecting the two caverns. It is important to note that the Rozelle Interchange (stage 2) of the project includes excavation of approximately 22 kilometres of tunnels and that the proposed modification represents a very small increase in the extent of tunnelling. Construction impacts would be minimised through further consideration during detailed design and construction planning and consultation with affected residents and stakeholders. |

A number of issues for the proposed modification would be generally consistent with the EIS and do not require further assessment. Impacts that do not require further assessment include:

- Human health risk
- Contamination
- Flooding and drainage
- Biodiversity
- Non-Aboriginal heritage

- Aboriginal heritage
- Greenhouse gases
- Climate change risk and adaption.

## 7.2 Traffic and transport

### 7.2.1 Construction Traffic and transport

A detailed construction traffic and transport assessment has been prepared by The Transport Planning Partnership (TTPP) to address the proposed modification and is included in Appendix B.

The EIS indicates that all plant, equipment and materials required to construct the proposed ventilation facilities would be supported from the Iron Cove civil site (C8). The associated environmental impact assessment included in the EIS was limited to key plant and equipment likely to be used for these surface construction works but does not provide detailed traffic information on the construction of this ventilation infrastructure.

Construction of surface works on the western side of the realigned Victoria Road within the Iron Cove civil site (C8) would typically involve five light vehicles per day and fewer than three trucks per day, and a peak of 10 trucks per day is anticipated during peak construction activities for the surface works on the western side of Victoria Road associated with the proposed modification. The traffic volumes associated with surface construction works under the proposed modification would be reduced compared to the approved project due to the extent of the above-ground ventilation infrastructure works required on the western side of Victoria Road being limited to the construction of the switch room, high voltage regulators, alternative Operational Motorway Control System (OMCS) room and separate access stairs. No traffic modelling was undertaken for these surface works due to the reduction to construction traffic volumes associated with the proposed modification.

As noted in section 5.4, excavation of the proposed new ventilation tunnel and cavern works would be supported from the Iron Cove civil site (C8) with the potential for some tunnelling to be supported from the Rozelle civil and tunnel site (C5) later in the construction program. As such this assessment has been completed assuming the worst-case impacts of all deliveries and spoil transportation occurring from either:

- Iron Cove civil site (C8) or
- Rozelle civil and tunnel site (C5).

Undertaking the assessment in this manner also considers the impacts of excavating the ventilation tunnel from the Iron Cove civil site (C8) with the potential for some tunnelling to be supported from the Rozelle civil and tunnel site (C5) later in the construction program.

The assessment considers the traffic impacts of the proposed modification and provides a comparison with the impacts assessed as part of the approved project.

The proposed new Iron Cove ventilation tunnel and cavern can be easily accessed from within the Iron Cove cut and cover using a single roadheader. Construction traffic would use the approved routes shown in Figure 7-1. North of Iron Cove Bridge, the haulage route continues north along Victoria Road, Church Street, Concord Road and Homebush Bay Drive towards the M4 Motorway.

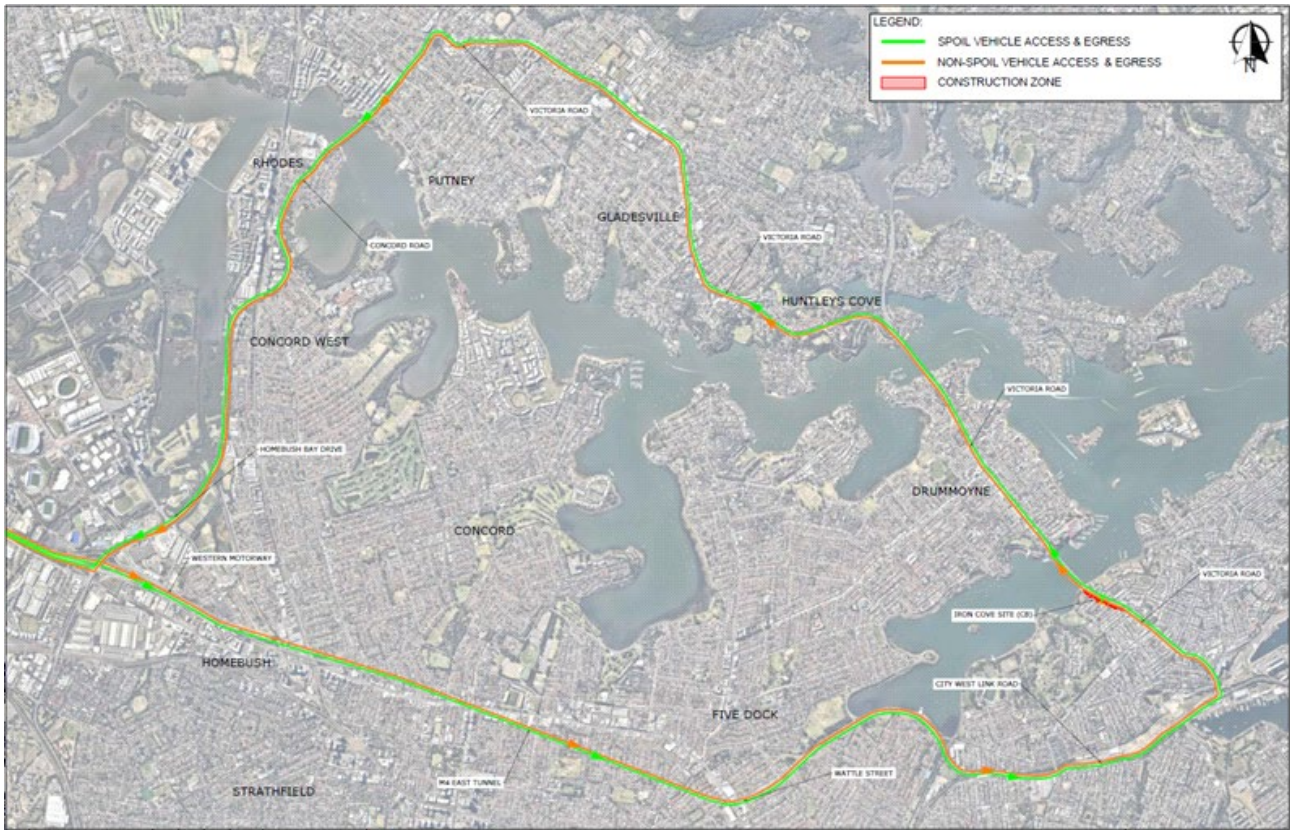


**Figure 7-1 Haulage routes via the Iron Cove Civil Site (C8)**

Additional workforce required for tunnelling operations from the Iron Cove tunnelling site would typically range from six to 10 people at any one time, made up of supervision, workforce and maintenance personnel.

Additional spoil excavated from the proposed ventilation tunnel and caverns would be transported underground to the Iron Cove cut and cover site. This would involve a total of up to 61,000 bank cubic metres to be removed, resulting in an increase of up to 4800 truck and trailer loads exiting the project from the Iron Cove cut and cover over 15 months.

The daily traffic volumes anticipated during peak construction activities involving spoil load out and concrete works to support tunnelling from Iron Cove would typically be:

- 3 light vehicles per hour
- 3 spoil truck and trailers per hour during standard daytime hours in accordance with Planning Approval Conditions E68 and E69. The EIS identified 145 heavy vehicles per hour use Victoria Rd during the day and evening
- Six shotcrete deliveries by agitator trucks per day, with two concrete deliveries in the evening (6pm to 10pm) with an infrequent maximum of three and typically one truck at night (10pm to 7am) with an infrequent maximum of three
- Six additional heavy vehicles per day.

Tunnelling works using a roadheader launched from Iron Cove would commence once the southern half of the cut and cover structure has been constructed and have been scheduled to occur over about 15 months between about Q3 2020 and the end of 2021. Surface tunnel support from within the Iron Cove cut and cover would therefore overlap with peak construction activities associated with the overall Rozelle Interchange project, which are scheduled to occur in March 2021. Peak truck numbers associated with spoil haulage for the excavation of Iron Cove Link entry ramps at Iron Cove civil site (C8) are forecast to occur around the second quarter of 2021 over a 3 month window. Modelling has been undertaken to represent this peak in conjunction with traffic from the proposed modification. Either side of the short peak forecast truck numbers taper off significantly. Table 7-2 shows a comparison of the approved project and the forecasted construction traffic volumes for the proposed modification during the AM peak hour and PM peak hour.

**Table 7-2 Peak Hour Construction Traffic Volumes at the Iron Cove Civil Works Site (C8) for Approved Project and Proposed Modification**

| Design | Daily | | AM Peak Hour (7:30am-8:30am) | | | | | PM Peak Hour (4:15pm-5:15pm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Heavy Vehicles | Light Vehicles | Heavy Vehicles | | Light Vehicles | | Total | Heavy Vehicles | | Light Vehicles | | Total |
| | One-way | One-way | In | Out | In | Out | 2-Way | In | Out | In | Out | 2-Way |
| Approved project | 102[1] | 60 | 13 | 13 | 18 | 0 | 44 | 13 | 13 | 0 | 18 | 44 |
| Approved project plus proposed modification | 144[1] | 90 | 18 | 18 | 27 | 0 | 63 | 18 | 18 | 0 | 27 | 63 |
| Difference (proposed modification) | 42 | 30 | 5 | 5 | 9 | 0 | 19 | 5 | 5 | 0 | 9 | 19 |

Note: 1 – These peak heavy vehicle numbers represent a short duration at the peak of spoil removal from the Iron Cove Link entry ramps, approximately 3 months, with truck numbers tapering off significantly either side of this peak.

Table 7-2 indicates that the peak hourly traffic volumes associated with the proposed modification would increase by 10 two-way heavy vehicle movements in the AM peak hour and PM peak hour, as compared with the approved project.

To assess the impacts of the increased construction traffic volumes from the approved project, traffic modelling was undertaken to assess the traffic impacts during peak construction activities (March 2021). Roads and Maritime Services provided TTPP with the LinSig models developed as part of the EIS. LinSig is a modelling package that assesses traffic signal intersections individually and in a network of several junctions.

For the purposes of this assessment, TTPP has updated the LinSig models to accommodate the changes in road network and traffic signal phasing, and construction traffic volumes based on detailed construction traffic planning to enable a like-for-like comparison with the approved project modelling results.

The additional construction traffic generated by the proposed modification would not impact the operational performance of Victoria Road intersections with Evans Street, Darling Street and Wellington Street when compared with the performance of the intersections generated by the approved project.

In terms of mid-block traffic volumes, the proposed modification would result in no additional traffic during the AM peak hour and three additional light vehicles (construction workers) during the PM peak hour along Victoria Road in the eastbound direction. The proposed modification would result in an additional five heavy vehicles and four light vehicles in the AM peak hour, and five heavy vehicles in the PM peak hour along Victoria Road in the westbound direction. The additional traffic volumes associated with the proposed modification are minimal and therefore the volume/capacity (V/C) ratio and mid-block Level of Service (LoS) would remain consistent with the approved project.

Any tunnelling of the proposed new ventilation tunnel and caverns supported from the Rozelle civil and tunnelling site (C5) would commence from within the Iron Cove Link Tunnel once it is excavated. Excavation of the ventilation tunnel and caverns would occur from about Q2 2021 if required. The total volume of construction traffic generated by the proposed modification would occur following peak construction activities in March 2021 and be less than the approved project during the peak construction activities. As such, it is concluded that the intersection and mid-block LoS during the construction of the proposed modification would not impact the road network along City West Link.

It is important to note that surface tunnel support for the proposed modification entirely from within the Iron Cove cut and cover or the Rozelle tunnel and civil site (C5) represent two worst case scenarios for haulage route options. However, traffic impacts associated with these worst cases are consistent with the modelling results for the approved project, indicating that either option is acceptable. Notwithstanding this, the additional tunnelling required under the proposed modification would be supported predominantly from the Iron Cove civil site (C8) with the potential for some tunnelling to be supported from the Rozelle civil and tunnel site (C5) later in the construction program. Utilising both the Iron Cove civil site (C8) and the Rozelle civil and tunnel site (C5) to support this tunnel excavation would disperse impacts on the road network.

Appropriate measures to reduce the potential for construction traffic impacts, such as limiting heavy vehicles to approved routes, GPS tracking of spoil trucks and driver training, have been included in the project Construction Traffic and Transport and Access Management Plan prepared in accordance with the Planning Approval. The proposed modification would not require any changes or additions to the Planning Approval or environmental management measures for construction traffic impacts.

### 7.2.2 Operational Traffic and transport

As indicated in section 5.7, heavy maintenance vehicles would access the underground ventilation facilities and substation via an approved breakdown bay adjacent to the westbound lanes within the Iron Cove Link tunnel.

Access would be required to the switch room for scheduled meter readings, monitoring of the equipment and in the event of an incident. The alternative Operational Motorway Control System (OMCS) room is not expected to be frequently used and would only be operated as a backup measure. Maintenance would be undertaken in accordance with the asset management schedule. Access for maintenance personnel to the ventilation tunnels would also be possible from the access stairway structure located near Callan Street.

EIS Table 5-7 indicates that parking would be provided at MOC4 but the location and extent of parking is not shown. Under the proposed modification, personnel attending the surface site at Iron Cove for scheduled maintenance and monitoring would park in the designated parking with access off Clubb Street and within the switch room site with access off Toelle Street.

The High Voltage regulator would be maintained in accordance with manufacturer's specifications and be replaced about every 25 years. The replacement of the High Voltage regulators would likely involve removal by skating them out onto Toelle Street and loading them onto a truck using a small crane. The proposed modification would reduce the extent of operational traffic impacts in Callan, Toelle and Springside Streets as the majority of maintenance operations for the underground ventilation fans and substation would be accessed from within the tunnel. The proposed modification would not require any changes or additions to the Planning Approval or environmental management measures for operational traffic impacts.

## 7.3 Air quality

### 7.3.1 Construction air quality

Construction air quality impacts of the proposed modification have been reviewed by EMM Consulting Pty Ltd (EMM) and their assessment is included in Appendix C.

The EIS identified that the main air quality risks during construction would be associated with dust soiling and the effects of airborne particles on human health and amenity. Several 'high risk' activities were identified including demolition and earth works.

The proposed modification does not require any demolition works. Construction of surface works on the western side of the realigned Victoria Road within the Iron Cove civil site (C8) are limited to the construction of the switch room, high voltage regulators, alternative Operational Motorway Control System (OMCS) room and access stairs and the construction of extensive building foundations and an access shaft are no longer required. As such, potential construction air quality impacts in the location are substantially reduced in the proposed modification.

As noted in section 5.3.2, excavation of the proposed new ventilation tunnel and caverns would be completed using the methodology presented in the EIS and require the excavation of an additional 61,000 bank cubic metres of spoil. Tunnelling works using a roadheader launched from Iron Cove would commence once the southern half of the cut and cover structure has been constructed and the chamber beneath the roof of the cut and cover structure would be temporarily converted into a shed that would assist in minimising dust. Any tunnelling of the proposed new ventilation tunnel and caverns supported from the Rozelle civil and tunnelling site (C5) would be commenced from within the Iron Cove Link Tunnel once it is excavated. This would not require the installation of any additional temporary surface support infrastructure at the Rozelle civil and tunnelling site (C5). Tunnel support works required for the proposed modification would occur within enclosed areas that would work to minimise potential dust impacts on surrounding land uses. The proposed modification would not alter the construction phase vehicle emission and dust impacts assessed in the EIS and would not require any changes or additions to the Planning Approval or environmental management measures for construction air quality impacts.

### 7.3.2 Operational air quality

Operational air quality impacts of the proposed modification have been reviewed by EMM and their assessment is included in Appendix C.

The proposed modification would relocate the MOC4 underground within caverns housing the electrical substation and ventilation facilities and a ventilation tunnel connecting to the ventilation outlet, which would remain above ground in the same location illustrated in the EIS.

The proposed new ventilation tunnel and fan and substation caverns would operate as the ventilation facilities are described in the EIS. That is, the road tunnels would comprise longitudinally ventilated tunnels, which rely on the movement of air through the tunnels in the same direction as the flow of traffic. Air would be extracted from near the Iron Cove Link tunnel exit portal, and conveyed to the ventilation cavern, where the four ventilation fans would push the air towards the ventilation outlet facility (located between the eastbound and westbound carriageways of Victoria Road). As described in the EIS, the ventilation outlet facility would be in operation 24 hours a day, seven days a week.

Assessment of operational air quality impacts in Section 9.7.1 of the EIS confirmed that the tunnel ventilation system would be able to maintain in-tunnel air quality well within operational limits for all scenarios assessed, including congestion and incidents within the tunnel.

The proposed modification would not alter the potential air quality impacts reported in the EIS. The proposed modification would be designed to operate to meet the relevant Planning Approval or environmental management measures. The position of air quality monitoring equipment would also remain unchanged, so the measure of performance of the ventilation system would also remain unchanged.

During detailed design, dispersion modelling will be undertaken to confirm the ventilation system is designed to meet operational limits. The dispersion modelling being completed for the MOC4 outlet uses the exit ventilation flow rate, traffic pollution emission rates, air temperature and ventilation outlet dimensions (release height and exit diameter) as input into the model.

The change from an above-ground facility to a subterranean facility would have no tangible effects on the emissions to be released from the outlet. In both cases, the tunnel ventilation system is required to capture all of the vehicle emissions generated within the entire tunnel carriageway area. The factors that impact the in-tunnel pollutant concentrations (e.g. traffic volumes, tunnel grades, flow rates, vehicle pollutant generation rates, etc) would be the same for either facility configuration.

There would be no change to the likely traffic pollution emission rates, or the ventilation flow rates due to the modification. Further, the proposed modification would not alter the shape, size (release height or exit diameter) or location of the MOC4 ventilation outlet. The proposed modification would therefore not alter any of the parameters used in the dispersion modelling for the MOC4 ventilation outlet (dimensions or emission characteristics).

It is therefore concluded that the proposed modification would have no material effect on the dispersion performance of the MOC4 ventilation outlet and would not alter the potential air quality impacts. The proposed modification would not require any changes or additions to the Planning Approval or environmental management measures for air quality impacts.

## 7.4 Noise and vibration

### 7.4.1 Overview

A detailed noise and vibration assessment has been prepared by Renzo Tonin and Associates to address the proposed modification and is included in Appendix D.

The noise and vibration assessment was undertaken to assess the proposed change to the ventilation ancillary facility at Iron Cove Link during the construction and operational phases.

As stated in the EIS, appropriate measures to reduce the potential for ground-borne noise, ground-borne vibration and airborne noise impacts have been included in the project Construction Noise and Vibration Management Plan. All feasible and reasonable mitigation and management measures would be considered and implemented to minimise and manage potential noise and vibration impacts.

### 7.4.2 Assessment methodology

The technical assessment was undertaken in accordance with the assessment process documented in the EIS.

For the construction ground-borne noise and vibration assessment, it is noted that Appendix J of the EIS does not consider ventilation tunnels at Iron Cove, therefore a direct comparison could not be undertaken to compare impacts with the EIS design.

The methodology used to assess the ground-borne noise and vibration impacts of the modification proposal was the same as the assessment process used in the EIS. Ground-borne noise predictions were based on the empirical algorithm presented in the M4-M5 Link EIS, APPENDIX J, Figure 4-2 and the ventilation tunnel alignment. The assessment of potential construction vibration impacts during roadheader tunnelling excavation was based on the minimum working distances established for cosmetic damage presented in M4-M5 Link EIS, Appendix J, Table 4-12.

All plant, equipment and materials required to construct the proposed new ventilation tunnel and caverns would be supported from the Iron Cove civil site (C8), with the potential for some tunnelling to be supported from the Rozelle civil and tunnel site (C5) later in the program. The noise and vibration assessment compares the predicted noise levels in each of the NCAs from the tunnel support activities at the Iron Cove cut and cover site with the predicted noise levels from the EIS Iron Cove civil works site (C8) based on the EIS construction noise assessment scenario ICL-11 and ICL-12. Impacts of the peak construction support have been already included in the assessment of the operation of the Rozelle Rail Yard civil and tunnel site (C5) and suitable mitigation measures have been identified such as acoustic enclosures and limiting activities at night.

The assessment includes a comparison of potential construction airborne noise impacts associated with the MOC4. The airborne noise assessment for the construction of the facility (scenario ICL-14) was based on the three typical items of plant (mobile crane, concrete trucks/agitator and concrete pump) that would likely be used for construction. The proposed modification substantially reduces the extent of permanent surface works required at Iron Cove.

For the operational noise and vibration assessment, it is noted that the EIS used a sound power level of 105dB(A) at the top of the ventilation outlet, which assumes attenuators have been included on the outlet side of the fans. Based on this noise source level the EIS predicted non-compliances at receivers in NCA 33 by up to 12dB(A). The modification assessment is based on further development of the detailed design and has determined appropriate attenuator requirements to meet the noise criteria at all relevant NCAs.

Operational noise from the High Voltage regulators has been considered by modelling regulator noise and considering noise reduction from the blockwork walls around the regulators. The total noise from the ventilation outlet plus the High Voltage regulators should not exceed the controlling intrusive noise criteria of 48dB(A) at the nearest receivers. The design will include noise mitigations to meet the requirements of the NSW Industrial Noise Policy 2000.

Operational noise mitigation measures would be confirmed in the Operational Noise and Vibration Review to be prepared in accordance with Planning Approval Condition E92.

### 7.4.3 Construction noise and vibration

#### Construction ground-borne noise from tunnelling

The EIS predicted that, during the excavation of the mainline tunnels, up to 29 receivers in NCA 32 and NCA 33 may experience noise levels above the GBNML criteria in the vicinity of the Iron Cove Link tunnel portals (south of Victoria Road between Toelle Street and Cambridge Street), where the mainline tunnel ramps climb to meet Victoria Road. Noise levels are predicted to exceed the night-time GBNML of 35dB(A) over of a period of about 17 days for each roadheader pass at the most noise affected receivers. Typically, 2 passes will be required to excavate the ventilation tunnel, with a gap of 3-5 weeks between each pass. Ground-borne noise (GBN) levels were predicted up to 42dB(A) $L_{Aeq(15\ minute)}$ when tunnelling equipment is located at the shortest distance to the receiver.

Assessment of construction ground-borne noise for the proposed modification found up to 78 residential properties may be above the night-time GBNML as a result of ventilation tunnel excavation in NCA32 and NCA33, as shown in Figure 7-2. Ground-borne noise levels greater than 45 dB(A) $L_{Aeq(15\ minute)}$ are predicted when tunnelling equipment is located at the shortest distance to the receiver.

Consistent with the EIS, this impact would be relatively short term in duration (i.e. approximately 2-3 weeks for each roadheader pass) due to the progression rate of the road header works (proposed to be around 20-25 metres per week). In accordance with CoA E82, mitigation measures would be implemented when predicted GBN levels are above relevant GBN management levels.

Table 7-3 and Figure 7-2 present the residential receivers where predicted ground-borne noise levels are above the night-time GBNML in each Noise Catchment Area (NCA) ground-borne noise affected as a result of the ventilation tunnel excavation works.

**Table 7-3 Worst predicted ground-borne noise levels during excavation of the proposed ventilation tunnel and caverns**

| NCA | Worst-case ground-borne noise level at a residential receiver (dB(A) LAeq,15min) | Number of residential receivers predicted to be within | | |
|---|---|---|---|---|
| | | 35-40 dB(A) | 40-45dB(A) | >45 dB(A) |
| NCA31 | <35 | 0 | 0 | 0 |
| NCA32 | 39 | 21 | 0 | 0 |
| NCA33 | 47 | 40 | 14 | 3 |
| NCA34 | <35 | 0 | 0 | 0 |
| NCA35 | <35 | 0 | 0 | 0 |
| NCA36 | <35 | 0 | 0 | 0 |
| Total number per GBN intervals | | 61 | 14 | 3 |
| **Total number** | | 78 | | |
| Percentage (%) over total | | 78% | 18% | 4% |

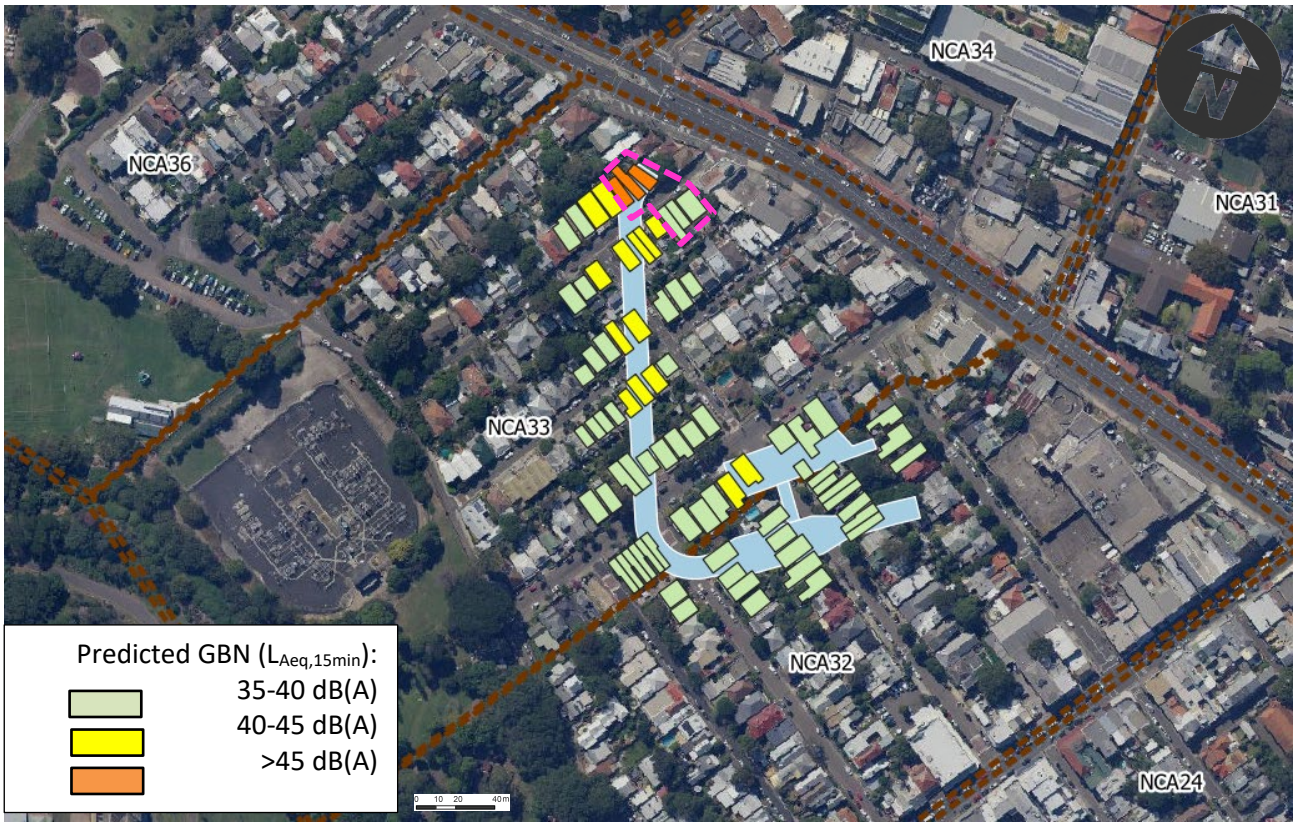


**Figure 7-2 Maximum predicted GBN levels (ventilation tunnel and caverns in light blue). Properties within dashed pink area will also receive GBN from Iron Cove link tunnel excavation.**

Note that GBN from excavation of the ventilation tunnel and cavern would be the same whether the tunnels are excavated from the Iron Cove cut and cover site (C8) or the Rozelle Rail Yard civil and tunnel site (C5).

As noted from Table 7-3 and Figure 7-2, there are 78 residential receivers along the ventilation tunnel alignment who are expected to experience maximum GBN levels above the night-time ground-borne noise management levels (GBNML) of 35dB(A) during roadheader excavation works. These properties are coloured green, yellow and orange. Residential properties where GBN levels are expected to be above the evening GBNML of 40 dB(A) are also shown as properties coloured yellow and orange. Properties not highlighted are not affected by ground-borne noise in the modification.

More than two thirds of the receivers affected by ground-borne noise (i.e. 78 per cent) are predicted to be exposed to maximum GBN levels between 35 and 40 dB(A). Only a small portion of these receivers (i.e. 18 per cent) is expected to be between 40 and 45 dB(A). Three receivers in NCA33 are predicted to be more than 45 dB(A). The maximum GBN level is predicted to be 47 dB(A).

The six properties identified within the pink dotted line in Figure 7-2 above may also be impacted by ground-borne noise between 35-40 dB(A) from the mainline tunnel excavation, based on information provided in the M4-M5 Link EIS Annexure I.

### Construction ground-borne vibration from tunnelling

There were no sensitive receivers identified in the EIS located within the minimum working distances for road-headers during tunnelling works for the mainline tunnel alignment. As such, vibration impacts associated with tunnelling works are expected to be negligible.

Consistent with the EIS, assessment of construction ground-vibration for the proposed modification did not identify any sensitive receivers located within the minimum working distances established for cosmetic damage or human annoyance during roadheader tunnelling excavation of the proposed modification.

It is noted that ground-borne vibration levels from tunnelling works at or below the threshold of human perception would generally result in noise levels above the GBNML for residential and commercial premises. Therefore, management and mitigation measures triggered by the exceedance of GBNMLs would appropriately address and manage potential vibration impacts.

### Construction airborne noise – tunnel support works from Iron Cove cut and cover

All plant, equipment and materials required to construct the proposed new ventilation tunnel and caverns would be supported from the Iron Cove civil site (C8), with the potential for some tunnelling to be supported from the Rozelle civil and tunnel site (C5) later in the program. Plant and equipment required to support tunnelling from the Iron Cove cut and cover site (C8) would access the tunnel from the cut and cover structure, which would be temporarily converted into a spoil shed. Noise mitigation has been incorporated into the proposed Iron Cove tunnel support site design following standard construction features, in accordance with the M4-M5 Link EIS and Planning Approval.

The noise assessment presents a comparison of noise impacts from the tunnel support activities at the ICL cut and cover site with impacts from the EIS Iron Cove civil works site (C8) based on the EIS construction noise assessment scenario ICL-11 and ICL-12.

Table 7-4 presents a summary of the predicted impacts by comparing the number of receivers above night-time EIS noise management levels (NMLs) for the EIS Iron Cove civil works site (EIS C8) and the contractor's ICL tunnel support site, with noise mitigation measures in place.

**Table 7-4 EIS and JHCPB comparison – number of receivers above EIS NMLs for ICL cut and cover**

| Activity ID (from EIS) | Activity | Time period | Number of receivers above EIS NMLs (with mitigation*) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | EIS1 | | | Contractor | | |
| | | | 1 to 10 dB(A) | 11 to 20 dB(A) | >20 dB(A) | 1 to 10 dB(A) | 11 to 20 dB(A) | >20 dB(A) |
| ICL-11 | Earthworks general and drainage | Day | 119 | 38 | 3 | - | - | - |
| ICL-12 | Concrete works | Day | 92 | 17 | 4 | - | - | - |
| ICL-12 | Concrete works | Night | 158 | 149 | 87 | - | - | - |
| N/A | Cut and cover tunnel support | Day | - | - | - | 0 | 0 | 0 |
| N/A | Cut and cover tunnel support (single skin | Night | - | - | - | 0 | 0 | 0 |

| Activity ID (from EIS) | Activity | Time period | Number of receivers above EIS NMLs (with mitigation*) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | EIS1 | | | Contractor | | |
| | | | 1 to 10 dB(A) | 11 to 20 dB(A) | >20 dB(A) | 1 to 10 dB(A) | 11 to 20 dB(A) | >20 dB(A) |
| | Wavebar wall) | | | | | | | |

Notes: Source: M4-M5 Link EIS, APPENDIX J, Table 5-98

* Mitigation includes at-property treatments identified in PPA Condition E87 (see Appendix D**).**

Predicted noise levels from the tunnel support works at the ICL cut and cover site would be below NMLs at all receivers during the day. At night-time, with a single skin Wavebar shed wall construction at the end of the cut and cover structure, no receivers are predicted to be above the NML at night. Furthermore, the assessment found cumulative noise from the addition of noise generated by the tunnel support site to the noise from civil works would be negligible. The likelihood of sleep disturbance impact is assessed as low as the site would be mitigated and managed to comply with the NMLs at night.

### Construction airborne noise – tunnel support works from Rozelle civil and tunnel site

Plant and equipment required to construct the ventilation tunnel would access the tunnel from the Rozelle Rail Yard civil and tunnel site (C5) and progress towards Iron Cove. If required, the additional tunnelling to construct the underground ventilation facilities would result in a minor increase in spoil trucks and deliveries at Rozelle Rail Yard civil and tunnel site (C5). This has been included in the assessment of the operation of the Rozelle Rail Yard civil and tunnel site (C5).

No additional mitigation measures are proposed beyond those required in the Planning Approval, including the approved Construction Environmental Management Plan (CEMP) and associated sub-Plans, to manage the slight increase of spoil trucks and deliveries from the construction of the proposed new ventilation tunnel and caverns.

### Construction airborne noise – permanent surface works

The EIS described an electrical substation and ventilation exhaust facility located in separate buildings on the surface that together would comprise the MOC4. The associated construction activities were presented in M4-M5 Link EIS, Appendix J, Table 5-89 under the work activity ICL-14 (i.e. ventilation station and substation) with a total duration of 144 weeks.

The proposed modification would only require the construction of a switch room, High Voltage regulator bays, an alternative Operational Motorway Control System (OMCS) room and a stair access on the surface, substantially reducing the extent and duration of permanent surface works required at Iron Cove compared to the EIS. This would result in a reduced construction program (see section 5.4) and a reduction in construction personnel (see section 5.5) and construction traffic (see section 7.2.1) at the Iron Cove site. Due to the substantially reduced extent of the permanent surface works, there are fewer potentially noise affected receivers compared to the EIS. Furthermore, the proposed modification would reduce the duration of airborne noise impact from construction of the permanent surface works from 144 weeks down to about 40 weeks. The outcomes are summarised in the table below.

**Table 7-5 EIS and contractor comparison – number of receivers above EIS NMLs for ICL-14 (daytime)**

| Activity ID (from EIS) | Activity | Estimated duration | | Number of receivers above EIS NMLs (with mitigation) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | EIS1 | | | Contractor | | |
| | | EIS1 | JHCPB | 1 to 10 dB(A) | 11 to 20 dB(A) | >20 dB(A) | 1 to 10 dB(A) | 11 to 20 dB(A) | >20 dB(A) |
| ICL-14 | Ventilation station and substation | 144 weeks | 40 weeks | 24 | 4 | - | 11 | - | - |
| Notes: | 1. Source: M4-M5 Link EIS, Appendix J, Table 5-98 | | | | | | | | |

### 7.4.4 Operational noise and vibration

#### Operational airborne noise

Noise emissions from fixed facilities in the Iron Cove area were predicted to exceed the criteria by up to 12dB(A) based on the EIS design at the most-affected receivers either side of Callan Street.

During development of the proposed modification design, consideration was given to a selection of fans and attenuators to ensure compliance with operational noise criteria.

A comparison of the predicted operational noise levels for Iron Cove ventilation facilities in the EIS against the proposed modification is shown in Table 7-6. The criteria of 45dB(A) is consistent with the EIS and was established according to the NSW Industrial Noise Policy (INP), based on the night-time amenity criteria for residences in urban areas. The assessment assumes a conservative ventilation fan sound power level of 123dB(A) and three fans in operation.

**Table 7-6 Operational noise levels at the closet residential receivers – Iron Cove fixed facilities**

| Receiver | NCA | Criteria | EIS predicted operational noise levels, dB(A) | Proposed modification predicted operational noise levels, dB(A) |
|---|---|---|---|---|
| Closest residential receivers | NCA33 | 45 | 57 | 44 |
| | NCA34 | 45 | 40 | 40 |
| | NCA35 | 45 | 42 | 38 |
| | NCA36 | 45 | 39 | 41 |

The proposed attenuator on the outlet side of the fans has been selected such that the predicted non-compliance at NCA33 from the EIS has been mitigated. Compliance is now predicted at all surrounding NCAs. Although noise levels at the closest receiver in NCA36 are expected to be 2dB higher than in the EIS, compliance with the noise criteria of 45dB(A) is still achieved. Therefore, noise impacts at the closest receivers associated with the operation of the Iron Cove fixed facilities are consistent with or less than the EIS.

Locating equipment underground also reduces potential noise impacts as noise breakout through ventilation building walls, roof and doors is no longer an issue. Similarly, for the substation, transformer noise and building services noise impact is reduced as the substation is located underground.

Under the proposed modification, a switch room, high voltage regulators, an alternative Operational Motorway Control System (OMCS) room and a separate stair access leading down to the ventilation tunnel would be required on the surface. The only element of this surface infrastructure which requires noise assessment are the High Voltage regulators, as the other elements are contained within buildings and do not generate noise.

The high voltage regulators are electrical transformers and would be surrounded by core-filled blockwork on all sides. The operational noise levels of the High Voltage regulators, including the On Load Tap Changers (OLTC) attached to the regulators, are expected to be approximately 66dB(A) at one metre, assuming the OLTC operation occurred for 15 seconds within a 15 minute assessment period. The aim is to mitigate High Voltage regulator noise to 45dB(A), so that the combination of high voltage regulator noise and ventilation outlet noise would not exceed 48dB(A) at any nearby property. A range of mitigation measures would be considered during the detailed design so that the combination of high voltage regulator noise and ventilation outlet noise would comply at nearby properties, including:

- During the procurement process for the high voltage regulators, the aim would be to procure equipment less than 65dB(A) at full load, and less than 62dB(A) at typical night-time loads
- Blockwork walls around the transformers would be as high as practical (minimum four metres high), particularly on southern and eastern sides to maximise noise reductions
- If additional noise reduction is required, installing a partial pitched roof would be investigated. A full roof is not practical due to cooling requirements
- If further reduction is required, the underside of the pitched roof and the inner face of the walls would be lined with acoustic absorption material where practical.

Operational noise mitigation measures would be confirmed in the Operational Noise and Vibration Review to be prepared in accordance with Planning Approval Condition E92.

### Operational vibration

Operational vibration impacts are predicted to be negligible for the following reasons:

- Operational sources are relocated underground as part of this proposed modification and there are relatively large distances to buildings at the surface
- Ventilation fans would be installed with appropriate vibration isolation mounts such that vibration is not transmitted from the fan cavern to the surrounds
- The substation is also relocated underground, and substations do not generally contain plant or machinery that generates significant levels of vibration.

### Change in traffic noise levels

Modelling for traffic noise levels in the EIS did not include the ventilation facility between Springside Street and Callan Street or the substation between Callan Street and Toelle Street. This conservative approach to traffic noise modelling reflects the uncertainty related to the detailed design of operational infrastructure. As these surface operational buildings did not influence the EIS traffic noise model the proposed removal of the ventilation facility will have no impact on the traffic noise predictions. The proposed construction of operational buildings between Callan Street and Toelle Street will provide some traffic noise shielding to residents adjacent to these structures, potentially improving operational traffic noise relative to the EIS predictions.

All properties impacted by traffic noise would be mitigated in accordance with the RMS Noise Mitigation Guideline as part of the operation noise and vibration review required by the PPA.

### Sleep disturbance from operation

The operational noise sources are generally fairly constant noise sources and are unlikely to cause sleep disturbance as they would be mitigated to meet the INP criteria. The item that has the most potential to cause sleep disturbance is the OLTC, which is attached to the High voltage regulator and located inside the concrete blockwork walls. The OLTC operates for periods of 10 -15 seconds at a time. This operation generates noise levels of approximately 72dB(A) at one metre. Taking into consideration the noise reduction from the blockwork walls, maximum noise levels from this operation could be up to 54dB(A) at the nearest receivers.

The INP does not contain sleep disturbance criteria. Taking guidance from the Noise Policy for Industry (EPA, 2017), sleep disturbance screening criteria is either LAFmax 52dB(A), or the prevailing RBL plus 15dB, whichever is the greater. Based on a night-time RBL of 43dB(A), the sleep disturbance screening criteria is 43 + 15 = 58dB(A). As the predicted maximum noise level of 54dB(A) is below the screening criteria of 58dB(A), sleep disturbance impacts are unlikely.

## 7.4.5 Conclusions

Based on the noise and vibrations assessment conducted for the proposed modification, the following conclusions can be made:

- Up to 78 residential properties may exceed night-time ground-borne noise management levels in NCA33 and NCA32 during construction of the ventilation tunnel and caverns. However, more than two thirds of these receivers (i.e. 78 per cent) are predicted to be exposed to maximum GBN levels between 35 and 40 dB(A). Only a small portion of these receivers (i.e. 18 per cent) are expected to be exposed to GBN levels of between 40 and 45 dB(A). Finally, only three receivers in NCA33 are predicted to be exposed to GBN levels of more than 45 dB(A). The maximum GBN level is predicted to be 47dB(A). Due to the advance rate of roadheader works, this impact is expected to be relatively short-term in duration (i.e. approximately 2-3 weeks per roadheader pass). In accordance with MCoA 82, mitigation measures would be implemented when predicted ground-borne noise levels are above relevant management levels in accordance with the approved NVMP
- There are no sensitive receivers located within the minimum working distances for roadheaders during tunnelling works for the proposed ventilation tunnels, therefore the risk of disturbance due to vibration from roadheader excavation works is considered low
- Tunnel support from within the cut and cover at the Iron Cove civil works site (C8) would result in no properties affected by construction noise associated with the tunnel support site operation. As tunnel support would be a 24-hour operation, noise impacts at night were also predicted and found to be below the NML at receivers nearby the worksite. A detailed construction noise and vibration assessment will be prepared for the proposed activities at the proposed Iron Cove tunnel support site in accordance with the

approved Construction Noise and Vibration Management Plan to document the outputs of detailed noise and vibration modelling and confirm the optimum suite of noise and vibration mitigation measures

- Should any tunnelling be supported from Rozelle Rail Yard civil and tunnel site (C5) there would be a slight increase in spoil trucks and deliveries at worksite, however this would occur outside the peak construction activities associated with the overall Rozelle Interchange project and would not require additional mitigation measures
- The proposed modification would result in a shorter duration of surface works to the west of Victoria Road than the EIS concept design and greatly reduce the scope of works at Iron Cove as only a switch room, High voltage regulator bays, alternative Operational Motorway Control System (OMCS) room and stair access need to be built
- Potential construction noise and vibration impacts would be managed in accordance with the processes set out in the Construction Noise and Vibration Management Plan prepared in accordance with Planning Approval Condition C4(b)
- The proposed relocation of the ventilation fans and substation underground would have a long-term acoustic benefit by reducing the operational noise impacts compared to the EIS. The predicted noise exceedance at NCA33 identified in the EIS would be avoided through selection of appropriate noise attenuators and noise compliance would be achieved at all surrounding NCAs. The High voltage regulators would comply with the required noise criteria, subject to the implementation of mitigation measures, which would be confirmed during detailed design so that the combination of High voltage regulator noise and ventilation outlet noise would comply at nearby properties
- Noise impacts from the operation of the Iron Cove fixed facilities are consistent with or less than the potential impacts identified in the EIS. Operational noise mitigation measures would be confirmed in the Operational Noise and Vibration Review to be prepared in accordance with Planning Approval Condition E92.

## 7.5 Potential groundwater drawdown and surface settlement

An assessment of potential settlement impact on existing buildings and structures has been prepared by the contractor to address the proposed modification and is included in Appendix E.

The EIS identifies two causes of potential ground movement associated with the construction of the project, namely:

- Tunnel-excavation-induced ground movement, which is the slight movement of the soil and rock around the tunnel as a result of the tunnel excavation removing material; this is a short-term effect, which happens as soon as the tunnel is excavated and can cause heave and/or settlement
- Soil consolidation (soil shrinkage) and rock compression due to the groundwater draw down due to inflow into underlying tunnels; this is a longer-term effect, which may take some time to occur and causes settlement only.

The EIS noted that cumulative settlement impacts include the combined impacts of settlement from tunnel-excavation-induced ground movement and groundwater drawdown. The EIS identified that risks associated with groundwater drawdown and induced settlement within Hawkesbury Sandstone are considered low because of the geotechnical properties of the rock.

The new ventilation tunnel and caverns would equate to a total length of about 425 metres and would be excavated below residences not identified in the EIS as being near the tunnel alignment. This calculation is based on a length of about 340 metres for the ventilation tunnel alignment and the ventilation fan cavern, 65 metres for the substation cavern and about 20 metres of access tunnel connecting the two caverns. It is important to note that Rozelle Interchange (Stage 2 of the M4-M5 Link Project) includes excavation of approximately 22 kilometres of tunnels and that the proposed modification represents a very small increase in the extent of tunnelling.

Areas most likely to be affected by settlement are where tunnelling is closest to the ground surface (shallowest), and where soils are more likely to be compressible because they have more voids that can compress. In Iron Cove, the depth to Hawksbury Sandstone is very shallow, with overlaying soils generally less than two metres in depth.

The depth of the proposed new ventilation tunnel and caverns would vary from about eight metres (from ground level to tunnel crown) at its shallowest to about 25 metres (from ground level to tunnel crown) at its deepest (see Figure 5-3).

The proposed new ventilation tunnel and caverns would be located within Hawksbury Sandstone, which is a highly competent bedrock. A cross-section of the geotechnical profile in Iron Cove which illustrates the proposed tunnel and ventilation cavern is provided in Figure 7-3. The crown (top) of the tunnel and ventilation cavern is marked in orange and the base is marked in blue.

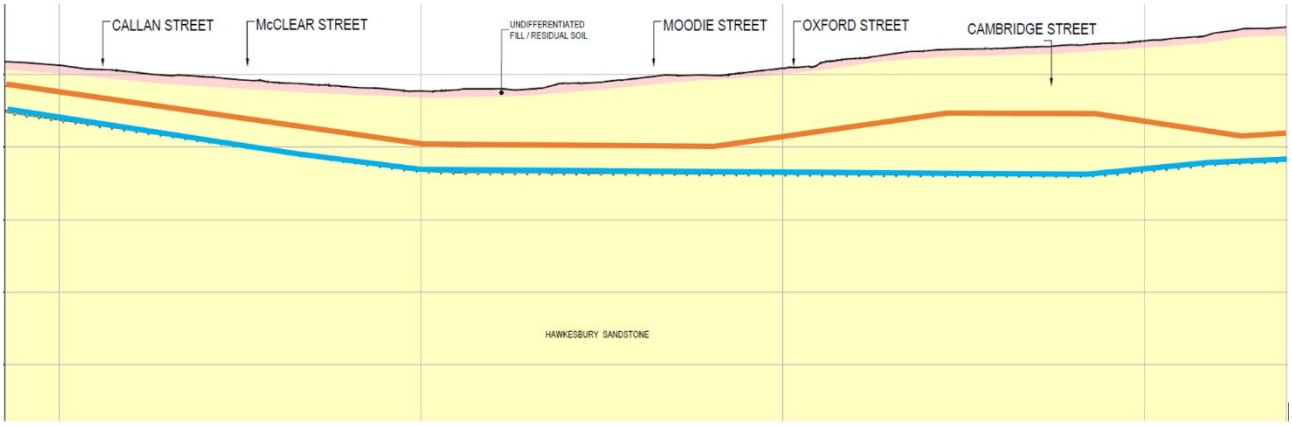


**Figure 7-3 Iron Cove ventilation tunnel geological cross-section. Orange represents the top of the tunnel and blue represents the base of the tunnel.**

The shallowest section of the proposed new tunnel would have substantial rock cover above the crown of the tunnel. It is noted that the wider cavern excavations are generally located at depths greater than 15 metres. The ventilation tunnel and caverns connect to the Iron Cove Link road tunnel alignment and are therefore located at similar depths.

Consistent with the EIS findings, tunnel-excavation-induced ground movement is anticipated to be the prevalent mechanism causing ground movement. Risks associated with groundwater drawdown and associated induced settlement within Hawkesbury Sandstone is considered low because of the geotechnical properties of the rock. As groundwater is removed from this rock type the structural integrity and strength of the rock remains due to its competent nature. As a result, the cumulative settlement impacts are not anticipated to be an issue for tunnels excavated in the Hawkesbury Sandstone, which would include the proposed new ventilation tunnel and caverns at Iron Cove.

The findings of the EIS described in Chapter 19 regarding groundwater would be consistent with the implementation of the proposed modification. Tunnel groundwater inflow criteria would not be altered. The proposed new ventilation tunnel and caverns, as noted above, are located in Hawksbury Sandstone. Hawksbury Sandstone has low permeability and predicted groundwater inflows and groundwater induced settlement associated with the proposed modification would be minimal.

Planning Approval Condition E190 of the Planning Approval requires all practicable measures be undertaken to limit operational groundwater inflows into each tunnel to no greater than one litre per second per km length of tunnel. Based on the preliminary analysis completed to date on the concept design, the total groundwater inflow that would be expected for the proposed modification in steady state would be about 0.4 litre per second per kilometre length. During construction this may increase by about 0.1 litre per second to about 0.5 litres per second per kilometre length.

With respect to potential impacts on existing groundwater users, there are no registered bores within two kilometres of the footprint of the proposed modification and no impacts are therefore anticipated for existing groundwater users as a result of the proposed modification.

The preliminary settlement analysis completed to date, which combines both predicted excavation induced, and short and long-term groundwater drawdown settlement, is shown in Figure 7-4. This assessment is based on the concept design and the predicted ground settlement ranges from 0 to 20 millimetres, which is consistent with settlement screening criteria set out in Planning Approval Condition E103 (see Table 7-7).

**Table 7-7 Comparison of preliminary settlement analysis against the screening criteria in MCoA E103**

| Surface and Sub-Surface Structures | Maximum Settlement | Maximum Angular Distortion | Limiting Tensile Strain (percent)* | Compliance |
|---|---|---|---|---|
| Buildings – Low or non-sensitive properties (ie ≤ 2 levels and carparks) | 30 mm | 1 in 350 | 0.1 | ✓ |
| Buildings and pools – High or sensitive properties (ie ≥ 3 levels and heritage items) | 20 mm | 1 in 500 | 0.1 | ✓ |
| Roads and parking areas | 40 mm | 1 in 250 | n/a | ✓ |
| Parks | 50 mm | 1 in 250 | n/a | ✓ |

* As defined in Burland et al. 'Building response to tunnelling – Case studies from construction of the Jubilee Link Extension', London, Thomas Telford (2001)

Based on the preliminary settlement analysis and building and structure impact assessment undertaken to date that has taken into consideration rock type, tunnel depth and building types (number of storeys and basement and foundation extents), it is not anticipated that the settlement screening criteria set out in Planning Approval Condition E103 would be triggered during excavation of the proposed new ventilation tunnel and caverns at Iron Cove.

As a result of the proposed modification, the subsurface stratum acquisition requirements and areas potentially subject to surface settlement would alter accordingly. The potential excavation-induced and groundwater-drawdown impacts of the proposed ventilation tunnel and caverns would be consistent with those already identified in the EIS as:

- The proposed ventilation tunnels and caverns would be excavated in Hawkesbury Sandstone
- The proposed ventilation tunnels and caverns are being constructed at a similar depth to the main road tunnel alignment for the Iron Cove Link
- The same tunnelling methodology is proposed for the construction of the proposed ventilation tunnel and caverns.

Potential settlement along the alignment associated with the proposed modification would continue to be assessed as part of the project-wide settlement modelling and impact assessment processes and will be finalised during detailed design.

The Planning Approval sets in place comprehensive requirements to ensure the potential impacts of the detailed design and construction methodology of the project, including the proposed modification, are assessed and potential impacts on property are minimised.

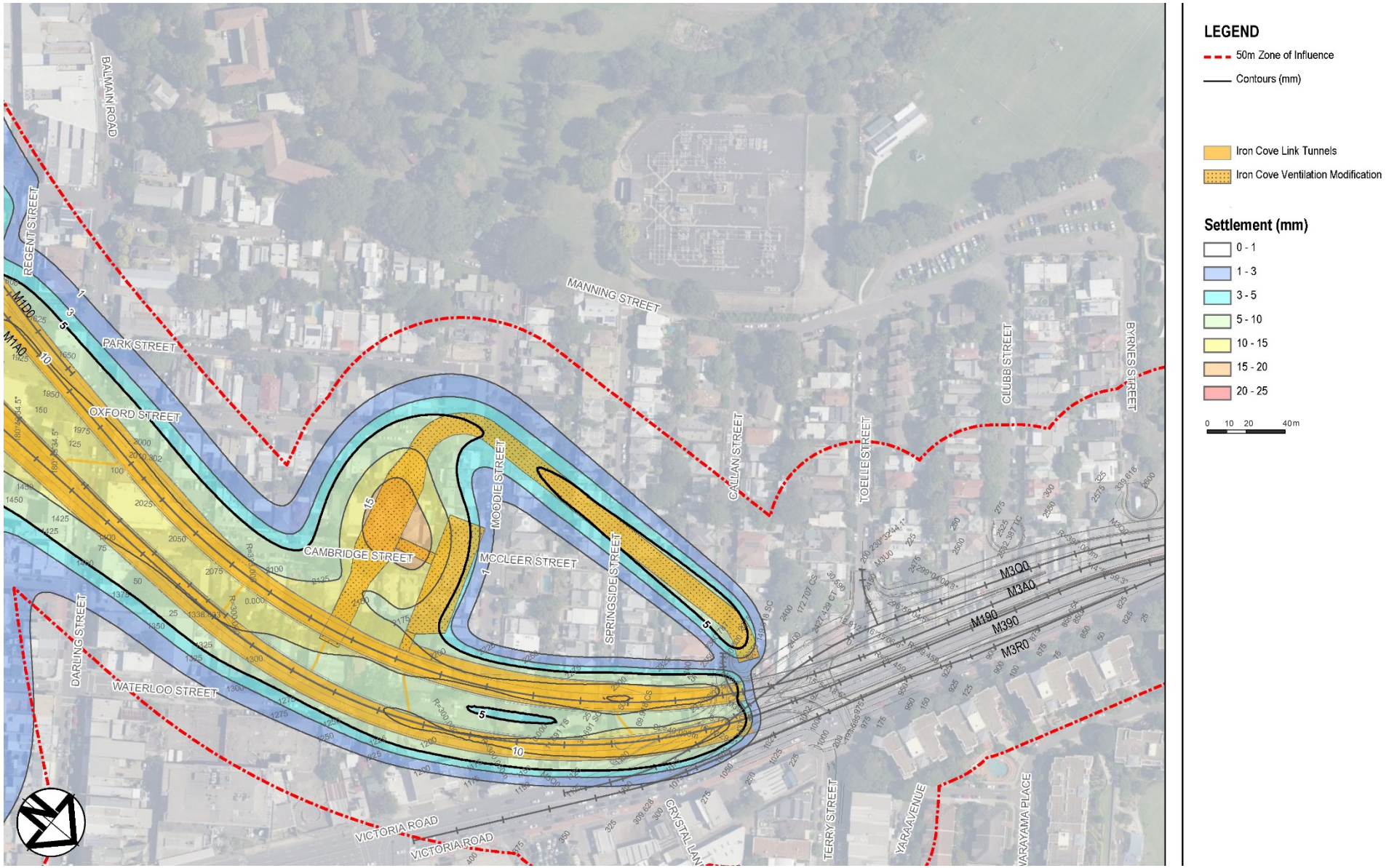


**Figure 7-4 Preliminary settlement analysis of proposed modification (note this is subject to design development)**

The settlement criteria adopted for the project and the assessment and monitoring processes are in accordance with the Conditions of Approval and include:

- Review of ground conditions and natural ground water parameters
- Calculation of predicted ground movement as a result of the tunnel construction
- Development of a detailed ground settlement model which addresses the short-term and long-term settlement expected
- Identification of buildings and infrastructure that may be considered as sensitive and potentially at risk, based on the expected settlement.

The design will be reviewed as it is developed and approved by the Independent Certifier prior to construction.

Comprehensive ground movement predictions that consider the cumulative impacts of potential excavation-induced ground movements and groundwater-drawdown will be undertaken during design development in accordance with the Planning Approval. The findings of this modelling will be used to identify and assess buildings adopting a risk based approach as required under the Planning Approval.

The settlement monitoring program will identify trigger values to ensure that if the monitoring data indicates changes in what was predicted, then processes will be put in place to ensure review of the data is undertaken. For each aspect being monitored the trigger level would vary, but a common approach ensures that any changes to expected ground behaviour is captured early with an appropriate level of response implemented. This will include review by appropriately qualified specialists. Contingency actions may include additional monitoring, assessment of potential causes and if required design and/or construction methodology refinement.

Combined with other Planning Approval requirements including building condition surveys and the Independent Property Impact Assessment Panel, the Planning Approval sets in place comprehensive requirements to ensure the potential impacts of the detailed design and construction methodology are assessed and impacts on property are minimised. The proposed modification would not require any changes or additions to the Planning Approval or environmental management measures to successfully manage potential settlement or groundwater drawdown impacts.

## 7.6 Socio-economic, land use and property

Socio-economic impacts associated with the proposed ventilation tunnel alignment changes relate to construction noise, land use and subsurface acquisition. Construction noise is discussed in section 7.4. Potential land use and property impacts are further discussed below.

The existing land use adjacent to the proposed surface infrastructure and above the alignment of the proposed new ventilation tunnel and caverns consists of residential dwellings of varying densities, comprising primarily detached dwellings. There are also commercial land uses (e.g. car dealership and retail stores) along Victoria Road.

Surface activities for the construction of the proposed modification including tunnelling support would be carried out within the footprint assessed in the EIS. Therefore, as no additional land is required, the surface land use and property impacts during construction of the proposed changes are consistent with the EIS.

As noted in section 7.5 the proposed modification would add to the subsurface stratum acquisition requirements of the project. RMS will acquire a subsurface stratum to provide for the proposed modification under the *Land Acquisition (Just Terms Compensation) Act, 1991*.

With respect to future development, Chapter 12.3.3 of the EIS states that in most cases, subsurface acquisition would not affect the future use of property at the surface. The EIS concludes that, subject to council regulations and approvals, landowners would generally be able to:

- Carry out improvements, such as installing a swimming pool
- Dig deeper foundations for a new building or second storey additions
- Undertake property development.

Consistent with the EIS, the proposed modification would not affect the future use of property at the surface.

The proposed modification would decrease the surface footprint of the permanent works associated with the Iron Cove ventilation facilities. This has the potential to increase the amount of residual land available following

the completion of the project. The final use of this land will be subject to the finalisation of the Residual Land Management Plan (RLMP) required under Planning Approval Condition E112 in consultation with Inner West Council.

Impacts on land use and property under the proposed modification are considered consistent with the EIS and would not require any changes or additions to the Planning Approval or environmental management measures.

## 7.7 Urban design and visual amenity

### 7.7.1 Impacts during construction

Chapter 13 of the EIS includes a landscape character and visual impact assessment undertaken in accordance with *Environmental Impact Assessment Practice Note – Guidelines for Landscape Character and Visual Impact Assessment* (NSW Roads and Maritime Services 2013). The existing landscape character and visual setting around the Iron Cove civil site (C8):

- Victoria Road corridor east of Iron Cove Bridge
- Single storey residential buildings on small lots to the south of Victoria Road
- Areas of open space including active and passive recreation facilities such as King George Park along the foreshore area south of Iron Cove Bridge.

The EIS notes that receivers with views of construction ancillary facilities and construction activities could include:

- Residents who adjoin and/or have views of the project
- Workers in commercial properties that adjoin and/or have views of the project
- Road users and pedestrians
- Users of recreation areas/reserves with views of the project.

As noted in section 5.3.3, all plant, equipment and materials required to construct the proposed new ventilation tunnel and caverns would be supported from the Iron Cove civil site (C8), with the potential for some tunnelling to be supported from the Rozelle civil and tunnel site (C5) later in the construction program.

The establishment and operation of the tunnel support site within the Iron Cove cut and cover under the proposed modification would not alter the layout of the Iron Cove civil works site (C8) or require any additions to temporary ancillary facilities located to the west of Victoria Road to be jointly used by the tunnelling personnel. The tunnel support site would be established within the cut and cover, with the majority of plant and equipment being located under the completed concrete structure. The plant and equipment located within the dive area would also be shielded from view by this cutting. As such, the establishment and operation of this tunnel support site would not contribute to or alter the overall visual impact of this worksite.

Any tunnelling of the proposed new ventilation tunnel and caverns supported from the Rozelle civil and tunnelling site (C5) would not require the installation of any additional temporary surface support infrastructure and as such the proposed modification would not alter temporary visual impacts at this worksite.

The EIS concluded that the overall impact rating for construction visual impacts on sensitive receivers surrounding the Iron Cove civil works site (C8) ranged from moderate-low through to moderate, with a high rating for residents in Callan Street, Springside Street, Toelle Street and Clubb Street.

The proposed modification would decrease the surface footprint of the permanent works required for the Iron Cove ventilation facilities. Reducing surface infrastructure would also have improved temporary visual impacts to some receivers during construction compared to the EIS, however the residents on Toelle and Callan Streets close to the switch room, high voltage regulators, alternative Operational Motorway Control System (OMCS) room and the separate stair access would still experience a high impact consistent with the EIS assessment.

Temporary visual impacts during construction of the proposed modification would not require any changes or additions to the Planning Approval or environmental management measures.

### 7.7.2 Permanent urban and landscape concept

A visual assessment and concept urban design has been prepared to address the proposed modification and is included in Appendix F.

The proposed modification aligns with the aspirations and objectives of the WestConnex Urban Design Framework, specifically:

*'The WestConnex Motorway will be a sustainable, high quality and transformational project for the people of Sydney and NSW. Exhibiting design excellence as a whole and in all constituent parts, it shall be sensitively integrated into the built and natural environments and help build local communities. It will enhance the form, function, character and liveability and contribute to the future liveability of the city.*'

The proposed modification would decrease the surface footprint of the permanent works required for the Iron Cove ventilation facilities. An indicative layout is shown in Figure 5-4. This has the potential to increase the amount of residual land available following the completion of the project (see section 6.7). The landscape character impact of the proposed modification would be the same as compared to the landscape character associated with the concept design as assessed in the EIS.

As was undertaken in the EIS, landscape character impacts were assessed, including ratings for sensitivity and magnitude at each nominated Landscape Character Zone (LCZ) related to the proposed modification. These LCZs are shown in Appendix F in the EIS.

Although the proposed modification would provide a reduction in operational facilities located above ground, the assessment results did not change to such a degree that would alter these overall LCZ conditions as assessed in the EIS.

The proposed modification would improve amenity adjacent to the new shared path located next to Victoria Road westbound due to increased areas offered with the reduction in operation facilities located above ground.

In regard to visual impact, the overall impact of the proposed modification would be slightly improved with the reduction in visible facilities, compared to comparable visual impacts as assessed in the EIS.

The major visual change from what was assessed at the EIS is the removal of the MOC4 facility from the corner of Springside Street and Victoria Road. This results in residents that were to be impacted under the EIS concept design no longer being impacted under the proposed modification in this location.

The ventilation facility building and substation shown in the EIS is now proposed to be underground, with a new switch room, high voltage regulators, and an alternative Operational Motorway Control System (OMCS) located at the corner of Victoria Road and Toelle Street.

This residual infrastructure which cannot be located underground is required to support the fans and substations underground. This infrastructure has been placed on the southwestern side of Victoria Road between Toelle and Callan Streets as this is the location closest to which the ventilation tunnel will pass and can fit the structures. At this point above and below ground infrastructure can be connected. No buildings are proposed to remain on Victoria Rd between Springside St and Callan St as there is no connectivity to the tunnel at this location.

A separate small above ground structure in the vicinity of Callan Street would contain an access door and a stairway to the ventilation tunnel. The visible mass of this new building is noticeably smaller than the EIS assessed MOC4 ventilation facility.

Although the location and form of the visible structures at Iron Cove Link is reduced, there is still a number of structures adjacent to Victoria Road when compared to the existing condition, and what was assessed at EIS. Figure 7-5, Figure 7-6 and Appendix F provides artists' impressions and photomontages of the proposed modification combined with the residual elements of the approved project looking from Toelle Street eastward and Victoria Road median looking south.


**Figure 7-5 Artist's impression at 10 years of operation, looking east along Toelle Street toward the proposed ancillary facilities. Note: Operation infrastructure subject to detailed design. This modification does not alter the ventilation outlet from the approved project. Exterior design of the ventilation outlet is subject to the Urban Design and Landscape Plan. Pedestrian traffic lights on Victoria Rd will be included in detailed design.**


**Figure 7-6 3D Artist's impression at 10 years of operation looking south along Victoria Road toward the proposed ancillary facilities. Note: Pedestrian traffic lights will be included in detailed design.**

Overall, the visual impact is generally similar, while the overall visible scale and size of the structure has been reduced from what was assessed in the EIS.

As undertaken in the EIS, visual impacts on receivers were assessed, including ratings for sensitivity and magnitude at each nominated viewpoint related to the proposed modification.

Artists' impressions, photomontages and cross-sections of the relevant viewpoints to the Iron Cove Link, including MOC4, were prepared to reflect the proposed modification and are included in Appendix F. A typical cross-section of the proposed modification is shown in Figure 7-7.

Impacts were re-assessed for the proposed modification using the method outlined in the EIS, including the production of updated photomontages. The assessment resulted in the same visual impacts as recorded in the EIS and shown in the EIS Table 13-17 (see Appendix F), as the slight improvement associated with the proposed modification does not alter the overall rating category.


**Figure 7-7 Typical cross-section AA location of proposed modification**


**Figure 7-8 Iron Cove Link - Typical section AA**

Given the minor change in visual impacts, and that the size and form of the facilities and locations at Iron Cove Link assessed during the EIS are generally consistent with those shown in the proposed modification, the environmental management measures included in the EIS and SPIR are adequate to achieve the overall project outcomes.

With reference to LV8 visible elements of operational facilities will be designed to satisfy functional requirements and adopt the design principles detailed in the M4-M5 Link Urban Design Report. The proposed designs will be documented in the relevant Urban Design and Landscape Plan for the project.

REMM LV19 will be complied with through the use of vegetation to reduce the visual impact associated with the ventilation outlet, where possible. Through detailed design, the design of Iron Cove Link facilities will consider the height, bulk, scale and landscape setting in accordance with the design principles detailed in the M4-M5 Link Urban Design Report to satisfy REMM LV22.

The detailed design of the Iron Cove Link will be managed under the existing Planning Approval Conditions. The Urban Design and Landscape Plan(s) will be prepared under Planning Approval Conditions E133 to E137. Overshadowing will be assessed with a Solar Access and Overshadowing Report under Planning Approval Condition E138. Indicative overshadowing modelling is shown in Figure 7-9 and Figure 7-10 for 21 June when the sun is low in the sky and shadows cast the furthest. Review of the proposed concept design shows the shadowing from operational buildings affects less properties and to a smaller extent than the EIS design as the height of the proposed structures is lower than the EIS ventilation facility. As a result of relocating structures relative to the EIS different properties are affected. The Urban Design and Landscape Plan(s) and Overshadowing will be reviewed by the Design Review Panel and the Urban Design and Landscape Plan(s) will be approved by the Secretary of the Department of Planning, Industry and Environment.

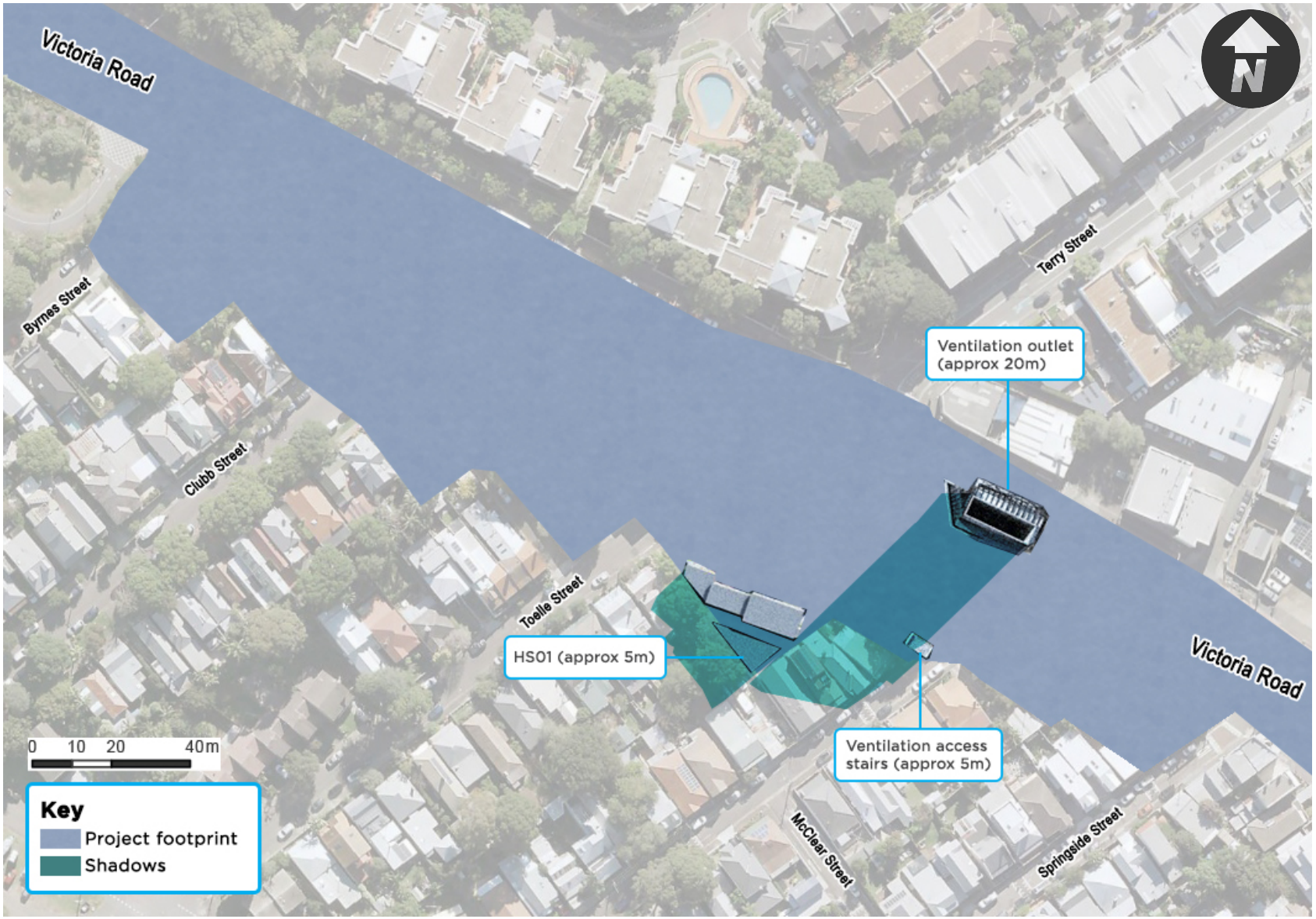


**Figure 7-9 Indicative Overshadowing diagram 9am 21 June. Note: No change is proposed to the ventilation outlet in the approved project.**

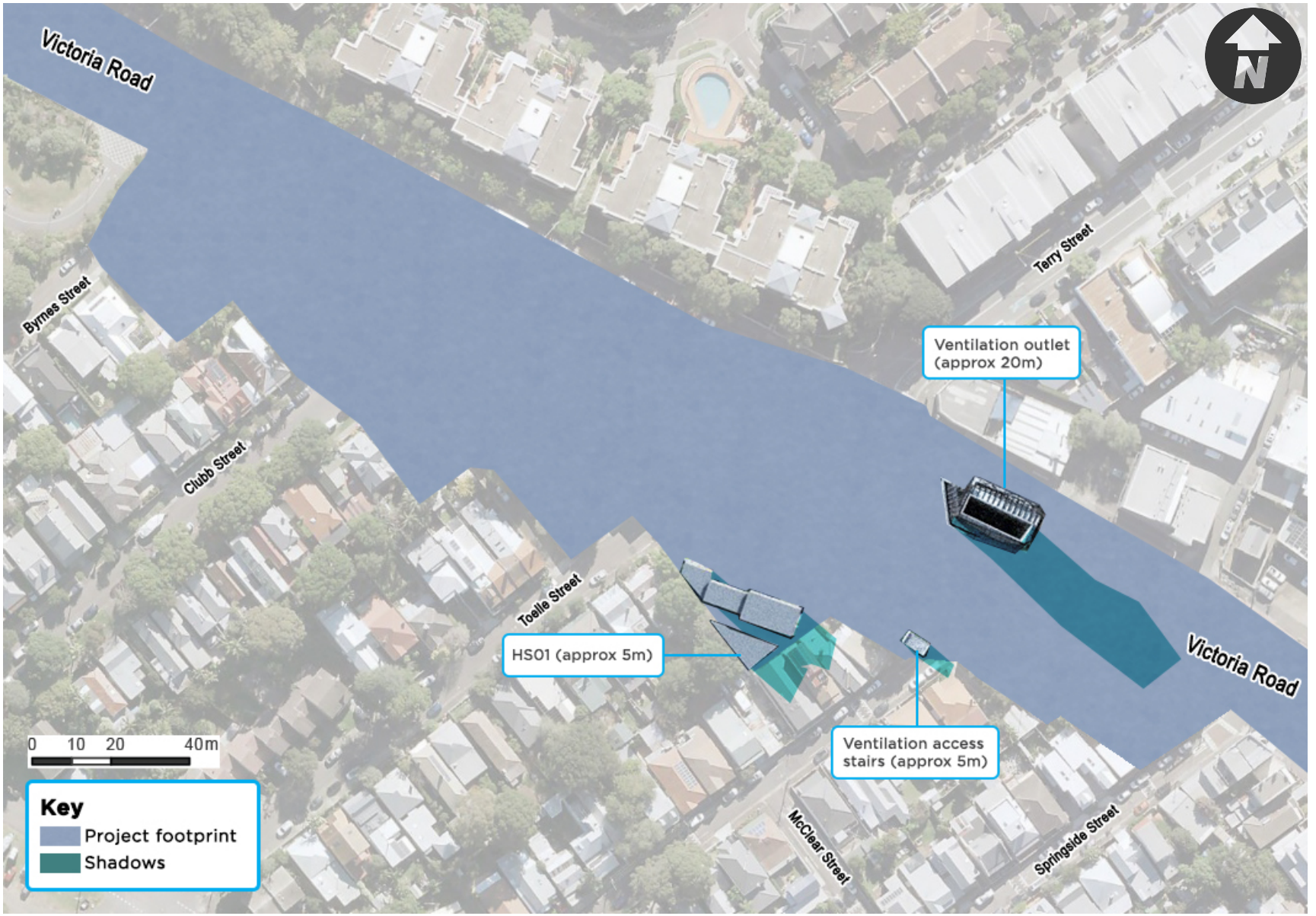


**Figure 7-10 Indicative Overshadowing diagram 3pm 21 June. Note: No change is proposed to the ventilation outlet in the approved project.**

## 7.8 Water management

### 7.8.1 Construction water management

The project is located within the Sydney Harbour and Parramatta River and Cooks River catchments. Existing water quality in all waterways is generally poor, indicative of a highly urbanised catchment. However, a number of waterways are considered to be sensitive receiving environments, including Iron Cove at Rozelle.

The EIS notes that the short-term groundwater inflow during construction would depend on a number of factors including tunnelling progress, tunnelling construction methodology, fractured zones intersected, localised groundwater gradients and storability (the volume of water released from storage per unit decline in hydraulic head in the aquifer, per unit area of the aquifer).

The EIS states that initial groundwater inflows to tunnels can be large, because of the large hydraulic gradients that initially develop near the tunnel walls; however, these gradients would be reduced in time as drawdown impacts extend to greater distances from the tunnels and inflows approach steady state conditions. The EIS identifies that higher inflow rates are likely from zones of higher permeability, where saturated geological structural features are intersected by the tunnels.

Initial groundwater inflows to the tunnels during construction are estimated in the EIS to range between 0.45 megalitres per day and 2.87 megalitres per day. As noted in section 7.5, the proposed ventilation tunnel and caverns are located within Hawksbury Sandstone, which has low permeability and inflows of about 0.1 litre per second to about 0.5 litres per second per kilometre length have been predicted. During construction, high permeability zones that are likely to have higher inflows over the longer term would be grouted to reduce the inflow rate. Grouting is the process of pumping grout into the rock mass by drilling and injecting cement to reduce the permeability of the rock.

The surface activities required to construct the proposed modification are located within the footprint assessed in the EIS. The proposed modification would:

- Reduce the extent of earthworks required to construct surface infrastructure on the south-western side of Victoria Road near the Iron Cove Link portals
- Require the establishment and operation of a surface tunnel support site within the Iron Cove civil site (C8) within the southern half of the cut and cover once the concrete structure has been constructed.

The EIS identified that a Water Treatment Plant (WTP) would be provided at Iron Cove civil site (C8) in Table 6-5 but noted that facilities may change when the contractor is engaged, and detailed construction methodologies are developed.

Appropriate measures to reduce the potential for construction water impacts have been included in the project Construction Soil and Surface Water Management Plan and the Construction Groundwater Management Plan prepared in accordance with the Planning Approval. In accordance with these plans the contractor is currently assessing water management requirements including:

- Maximising water re-use on site
- The need for a WTP, considering the very low predicted groundwater inflow rate (note space for a WTP is shown on the indicative site layout on Figure 5-5)
- Discharge to sewer under a Trade Waste Agreement
- If required, a discharge impact assessment for tunnel support from Iron Cove would be prepared during detailed construction planning.

The type, arrangement and performance of construction water treatment facilities would be further refined during detailed design. The proposed modification would not require any changes or additions to the Planning Approval or environmental management measures for construction water quality impacts.

### 7.8.2 Operational water management

The proposed ventilation tunnel and caverns would be drained, and a sprayed shotcrete lining would generally be used, consistent with the other ventilation tunnels and caverns to be constructed as part of the approved project (see section 7.5). Any groundwater seeping into the tunnel would drain towards the Iron Cove Link tunnel drainage system, where it would be pumped to the operational water treatment plant at Rozelle Rail Yards, as described in Section 5.9.1 of the EIS.

The new ventilation tunnel and caverns would be about 425 metres in length which represents a very small increase in the extent of tunnelling. This calculation is based on a length of about 340 metres for the ventilation tunnel alignment and the ventilation fan cavern, 65 metres for the substation cavern and about 20 metres of access tunnel connecting the two caverns.

As noted in section 7.5, Planning Approval Condition E190 requires all practicable measures to be undertaken to limit operational groundwater inflows into each tunnel to no greater than one litre per second per km length of tunnel across any given kilometre. Based the preliminary on analysis completed to date on the concept design, the total groundwater inflow that would be expected for the proposed modification in steady state would be about 0.4 litre per second per kilometre length which is well within the requirements of Planning Approval Condition E190. As such, the proposed modification would not require any changes or additions to the Planning Approval or environmental management measures for operational water quality impacts.

## 7.9 Resource use and waste minimisation

### 7.9.1 Spoil volumes and classification

As stated in section 5.3.2, about 61,000 bank cubic metres of spoil would be excavated to construct the ventilation tunnel at Iron Cove. This increase in spoil volume is negligible in the context of the entire project.

The majority of excavated spoil material would be uncontaminated crushed sandstone, classified as virgin excavated natural material (VENM). This would consist of mixed size crushed rock ranging from shale and sand to lumps of rock. As noted in section 7.1, while the proposed modification would increase the total volume of spoil to be extracted for the Project, there would be no additional contamination impacts expected as a result of the proposed modification as the surface activities required to construct the proposed modification are located within the footprint assessed in the EIS.

The classification of spoil will be undertaken in accordance with the Waste Classification Guidelines, Part 1: Classifying Waste (NSW EPA November 2014)

In accordance with the EIS, the project aims to re-use or recycle around 95 per cent of uncontaminated spoil, either within the project or at other locations. Where feasible and reasonable, spoil would be managed according to the following hierarchy:

- Minimisation of spoil generation through design and management
- Re-use of spoil within the project
- Beneficial reuse of spoil outside the project
- Where reuse is not possible, disposal of spoil would be the last resort.

Potential spoil removal impacts including traffic impacts are assessed in section 7.2.1, construction air quality impacts are assessed in section 7.3.1 and construction noise impacts are assessed in 7.4.3. The proposed modification would not require any changes or additions to the Planning Approval or environmental management measures for spoil management.

### 7.9.2 Waste minimisation and management

Construction of the proposed modification would generate a number of waste streams that would require management and disposal in accordance with relevant legislation and government policies. All wastes generated onsite will be classified in accordance with *Waste Classification Guidelines, Part 1: Classifying Waste* (NSW EPA November 2014).

Waste would be managed in accordance with the waste hierarchy established under the *Waste Avoidance and Resource Recovery Act 2001*. Avoiding the generation of waste would be the first preference. Waste re-use and recycling strategies would be considered and implemented, where practical and cost-effective. Onsite reuse opportunities would be maximised, with efforts made to implement re-use and recycling initiatives onsite. The contractor would reduce waste and ensure efficient resource use where practicable by:

- Using water-efficient fixtures and fittings to reduce water usage from the demand side and increase self-sufficiency from non-potable water supplies
- Using recycled or re-used steel
- Using standardised modular construction methods where practicable
- Re-using formwork

- Using recycled material or waste materials, e.g. recycled aggregate and cement replacement materials (ie fly ash) where relevant technical requirements can be achieved.

Waste generated during construction of the proposed modification would be managed in accordance with the project Construction Waste Sub Plan.

The proposed modification would not require any changes or additions to the Planning Approval or environmental management measures for waste management.

## 7.10 Hazard and risk

Chapter 25 of the EIS identifies potential hazards associated with the project, assesses risks and confirms mitigation measures to be implemented. The proposed modification involves a small increase in the extent of tunnelling to be undertaken as part of the project and would reduce the extent of surface construction works required to the west of Victoria Road adjacent to the tunnel portals at Iron Cove. The hazards and risks associated with the proposed modification are consistent with those addressed in the EIS.

The additional High voltage regulators to be installed as part of the proposed modification are electrical transformers and are required for the project as a whole to maintain the voltage fluctuations from the high voltage source of supply to prevent damage to equipment and injury to personnel. Transformers suitable in terms of capacity for Rozelle Interchange are only available in oil filled type – they are not available in encapsulated dry type configuration. Transformers must comply with the Electricity Supply Authority requirements AS 2374 and AS 60076. There would be a bund, oil separator and a flame trap within the transformer bay to contain any leaks. The transformer walls would be rated to a 4-hour fire rating.

The proposed modification has been designed to minimise the likelihood of incidents and risks to public safety. The storage, transportation, handling and use of dangerous goods and hazardous substances would be undertaken in accordance with the *Work Health and Safety Act 2011* (NSW), the Storage and Handling of Dangerous Goods Code of Practice (Workcover NSW 2005), the Dangerous Goods (Road and Rail Transport) Regulation 2014 (NSW) and relevant Australian Standards and codes.

The proposed modification would not require any changes or additions to the Planning Approval or environmental management measures for hazard and risk.