Chapter 7 - Construction

7 Construction

7.1 Construction strategy

Construction of the project would utilise the following six key construction sites:

- Arncliffe construction ancillary facility (C1) within Kogarah Golf Course, currently being used for New M5 construction
- Rockdale construction ancillary facility (C2) at Rockdale, within a Roads and Maritime depot at West Botany Street
- President Avenue construction ancillary facility (C3) at Rockdale, north and south of President Avenue within Rockdale Bicentennial Park and part of Scarborough Park North, and a site west of West Botany Street
- Shared cycle and pedestrian pathways construction ancillary facilities (C4 and C5) at Brighton-le-Sands, within the recreation area between West Botany Street and Francis Avenue, near Muddy Creek
- Princes Highway construction ancillary facility (C6), on the north-east corner of the President Avenue and Princes Highway intersection.

The location of these construction ancillary facilities is shown in Figure 7-1.

The method of construction presented in this EIS represents the concept design for the project. If approved, a further detailed design process would follow which may include refinements to the concept design. Any changes would be reviewed for consistency with the assessment contained in this EIS including relevant mitigation measures, performance outcomes and any future conditions of approval.

7.1.1 Construction program

The project would take around four years to build, including commissioning. For the purposes of this EIS, the project is expected to be completed towards the end of 2024, however this is subject to change depending on when a construction contractor is engaged. Detailed construction timing, staging and sequencing details would be confirmed when construction contractors have been engaged.

The duration of project delivery is mostly determined by the extent of soft ground tunnelling and the complexity of the interfaces between tunnelling activities and the construction of the surface infrastructure. The indicative construction program is shown in Figure 7-2.

7.1.2 General principles of the construction strategy

The strategy would be developed in accordance with the following general principles:

- Construct the project generally in accordance with the description of the approved project
- Manage community and environmental issues including noise, access and amenity, in consultation with those potentially affected
- Design and plan efficient site layouts that ensure the safety of project staff and the public
- Make construction staging and sequencing as safe and efficient as possible, providing a simplified construction process, where practical
- Minimise the length of the construction period and the duration of construction activities
- Minimise disruptions to traffic on the existing road network
- Where possible, locate temporary construction facilities on sites where permanent works are proposed
- Achieve safe, efficient and convenient access for construction vehicles, plant and equipment, while minimising impacts on the local road network
- Minimise adverse changes to the safety, efficiency and accessibility of road and related transport networks and ensure ongoing community access and connectivity
- Minimise interdependencies between disciplines to allow construction activities to occur in parallel
- Manage risks to existing infrastructure including roads, railways, utilities and service
- Minimise impacts on parking by providing off-street parking where possible for the construction workforce and by encouraging the use of public transport.
C1
- Tunnelling and spoil handling
- Construction of MOC1 (Water treatment plant, substation)
- Fitout, testing and commissioning of tunnels and MOC1

C2
- Construction of the decline tunnel
- Tunnelling and spoil handling
- Pavement works for internal access road
- Construction of MOC2
- Reconfiguration of the site to enable ongoing/future use for maintenance activities

C3
- Demolition of buildings and vegetation clearing and removal
- Relocation of utilities
- Temporary stockpiling of spoil and fill materials
- Management of any contaminated land, including acid sulphate soils
- Construction of cut-and-cover structures
- Construction of MOC3 (Rockdale ventilation facility and substation)
- President Avenue intersection upgrade works
- Construction of shared pedestrian and cyclist path and overpass

C4/C5
- Site establishment
- Vegetation clearing and removal, topsoil stripping areas and landform shaping
- Temporary stockpiling of materials
- Construction of the shared pedestrian and cyclist path
- Finishing works including lighting, line marking and signage installation

C6
- Property adjustment and demolition
- Relocation of utilities, stormwater infrastructure, underground storage tanks and substation
- Laydown and parking of construction vehicles and equipment
- Reinstatement of site

**LEGEND**
- Surface works
- Construction boundary
- Cut-and-cover structures
- Underground construction
- Construction ancillary facility
- Permanent power supply line
- Permanent power supply construction route

**Figure 7-1 Overview of construction boundary and construction ancillary facilities**
## Construction Program

<table>
<thead>
<tr>
<th>Construction activity</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
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<td>Site establishment</td>
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<td><strong>C3 President Avenue construction ancillary facility</strong></td>
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<td>Site establishment</td>
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<tr>
<td>Excavation and construction of cut-and-cover structure</td>
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<td>Rehabilitation and landscaping</td>
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<td>President Avenue widening works</td>
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<tr>
<td>Construction of shared cycle and pedestrian bridge</td>
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<tr>
<td><strong>C4/C5 Shared cycle and pedestrian pathways</strong></td>
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<td>Site establishment</td>
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<td>Construction of shared cycle and pedestrian pathways</td>
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<td>Rehabilitation and landscaping</td>
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<td><strong>C6 Princes Highway construction ancillary facility</strong></td>
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<tr>
<td>Property demolition, rehabilitation and adjustment</td>
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<tr>
<td>Relocation of utilities, stormwater infrastructure and substation</td>
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<td>Pavement works along Princes Highway and President Avenue</td>
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<td>Rehabilitation and landscaping</td>
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</tbody>
</table>

*Figure 7-2 Indicative construction program*
7.2 Construction boundary

The area required to construct the project is defined by the ‘construction boundary’. This comprises the surface construction works area, and construction ancillary facilities (refer to Figure 7-1). Utility work to support the project would occur mostly within and sometimes outside the construction boundary (refer to section 7.5). In addition to these works, the underground construction boundary (including mainline tunnel construction and temporary access tunnels) is also shown on Figure 7-1.

7.3 Construction ancillary facilities

7.3.1 Overview

Construction ancillary facilities would be used to support a combination of civil surface works, tunnelling and tunnelling support, parking and administrative purposes, as summarised in Table 7-1 and described in more detail in the following sections.

The location, layout and access arrangements for the construction ancillary facilities are based on the concept design and would be confirmed and refined during detailed design. They have also taken into account the following amenity criteria:

- Where practicable, temporary buildings and structures would be used to provide a noise barrier between the construction site and adjacent sensitive receptors
- The location of temporary buildings and structures would have regard to overlooking and overshadowing impacts on adjacent sensitive receptors
- Acoustic sheds would be provided where required to ensure that spoil handling undertaken outside standard construction hours comply with relevant noise guidelines
- Lighting would be designed to minimise light spill onto adjoining properties
- Spoil stockpiles would be located away from adjacent sensitive receptors where possible and would be managed to avoid adverse impacts on land and water quality
- Vehicle access points would be located to minimise the need for heavy vehicles to travel on local roads
- Construction sites would provide sufficient area for the storage of raw materials to minimise, to the greatest extent practical, the number of deliveries or the need to haul material outside of standard construction hours.

Temporary water treatment plants would be constructed at most construction ancillary facilities to treat construction wastewater, including:

- Tunnel groundwater ingress
- Rainfall runoff in tunnel portals and ventilation shaft construction areas
- Dust suppression water
- Wash down runoff.

It is expected that the majority of construction wastewater will be treated and disposed to stormwater. In instances where the discharge criteria cannot be met, the wastewater would be captured and tankered offsite for disposal at a licenced facility.
Table 7-1 Proposed construction ancillary facilities and indicative activities

<table>
<thead>
<tr>
<th></th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
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</tr>
</tbody>
</table>

7.3.2 Arncliffe construction ancillary facility (C1)

The Arncliffe construction ancillary facility (C1) would be located at Kogarah Golf Course at Marsh Street. This facility would utilise the land currently used as a construction ancillary facility for the New M5 Motorway project, which is around 78,000 square metres. This site would be used to support the tunnel fitout; including loading of spoil, spoil removal and haulage off-site, as well as to construct a substation and water treatment plant for operation of the project.

The construction site for the New M5 Motorway would be demobilised prior to being made available for construction of this project.

An indicative site layout for the Arncliffe construction ancillary facility is shown in Figure 7-3.

Key construction activities to be carried out at and supported by the Arncliffe construction ancillary facility include:

- Establishment of temporary noise attenuation measures, including construction of an acoustic shed
- Tunnel excavation and other tunnelling works
- Stockpiling of excavated material and spoil haulage
- Civil tunnel fitout works (including pavement and drainage works)
- Mechanical and electrical services within the tunnel and fitout of the tunnel with additional infrastructure
- Mechanical and electrical fitout of the Arncliffe ventilation facility, being constructed as part of the New M5 Motorway project
- Construction of a substation and water treatment facility
- Finishing works including asphalting, lighting, line marking, utilities and signage installation
- Rehabilitation and/or landscaping of areas that will not be occupied by permanent operational infrastructure.

Access to the site would be provided via traffic signals at the Marsh Street / Flora Street intersection that were installed as part of the New M5 Motorway project.

Tunnelling and spoil management within C1 would occur 24 hours a day, seven days a week. The majority of spoil removal and haulage would occur during 7am – 6pm on weekdays and between 8am – 1pm on Saturday. Where practical, spoil would be removed outside of peak periods. Some night time spoil haulage would be required. Further details about spoil haulage routes are included in section 7.6.4 and details on construction hours are included in section 7.7.2.
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Laydown
Temporary water treatment plant

Construction decline
Buildings
Carpark
Spoil site
Spoil shed

Temporary access tunnel
Access route
Sediment basin
Vehicle access

Figure 7-3 Arncliffe construction ancillary facility (C1) indicative layout

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Legend:
- Construction decline
- Construction boundary
- Underground construction
- Construction ancillary facility
- Underground construction - Temporary access tunnel
- Water treatment plant
- New M5 Permanent facilities
- New M5 Defects and maintenance facility
- New M5 Motorway permanent facilities
- New M5 Motorway defects and maintenance facility

Office and amenities

New M5 Motorway-
Spill site

Laydown
Temporary water treatment plant

Spill shed
Workshop
7.3.3 Rockdale construction ancillary facility (C2)
The Rockdale construction ancillary facility (C2) would be located at Rockdale, east of West Botany Street and south of Bay Street, on land currently occupied by a Roads and Maritime depot. This construction ancillary facility would require about 12,000 square metres of the existing depot. This site would be used to support the tunnel fitout, including loading of spoil and spoil removal, as well as to construct the operational infrastructure.

An indicative site layout for the Rockdale construction ancillary facility is shown in Figure 7-4.

Key construction activities to be carried out at and supported by the Rockdale construction ancillary facility include:

- Support of the ongoing investigation and survey to inform design and construction
- Establishment of temporary noise attenuation measures, including construction of an acoustic shed
- Construction of the decline tunnel
- Civil tunnel fitout works (including pavement and drainage works)
- Mechanical and electrical services within the tunnel and fitout of the tunnel with additional infrastructure
- Tunnel excavation and other tunnel works, as well as stockpiling of excavated material and spoil haulage
- Pavement works including asphalting, lighting, line marking and signage installation for the internal access road
- Construction of operational infrastructure including the Motorway Control Centre
- Reconfiguration of the site to enable ongoing/future use for maintenance activities
- Rehabilitation and landscaping.

To access the mainline tunnels for excavation, it is proposed to excavate a decline tunnel from within C2 and join the mainline tunnels in the vicinity of where the entry and exit ramps rise up from the mainline tunnel.

This decline will commence in a slot structure and then progress into a cut-and-cover structure through the site. As the decline meets West Botany Street, it would progress into a tunnel dive structure.

Access to C2 would be gained from West Botany Street.
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**Construction decline**

- Permanent power supply line
- Underground construction - Temporary access tunnel

**Construction ancillary facility**

- Building
- Carpark
- Spoil shed
- Spoil handling
- Access route
- Vehicle access

**Figure 7-4** Rockdale construction ancillary facility (C2) indicative layout

© Nearmap 2017
7.3.4 President Avenue construction ancillary facility (C3)

The President Avenue construction ancillary facility (C3) would be located above ground at Rockdale Bicentennial Park and on the western side of West Botany Street. It would be around 151,000 square metres. Vehicle access to C3 would be gained from West Botany Street and President Avenue.

The site would be used to support construction of:
- The cut-and-cover structures for the entry and exit ramps and the tunnel portal
- The new intersection with President Avenue
- The Rockdale Motorway Operations Complex (south) (MOC3) including the Rockdale ventilation facility
- The shared cycle and pedestrian pathways in Rockdale Bicentennial Park and over President Avenue
- The upgraded intersection at President Avenue / Princes Highway
- The reinstatement of Rockdale Bicentennial Park, water body and facilities.

An indicative site layout for the President Avenue construction ancillary facility is shown in Figure 7-5.

Key construction activities to be carried out and supported by C3 include:
- Demolition of houses around the O’Neill Street and President Avenue intersection
- Demolition of commercial buildings on west side of West Botany Street
- Removal of sporting facilities within the construction boundary
- Establishment of vegetation exclusion zones within the construction footprint, followed by vegetation clearing and removal (including around one hectare of native vegetation)
- Establishment of temporary noise attenuation measures, such as noise barriers or hoarding
- Relocation of utilities along West Botany Street and President Avenue
- Temporary stockpiling of spoil and fill materials for later re-use, where possible, within the project or prior to off-site removal
- Management of any contaminated land, and treatment of acid sulphate soil
- Construction of the cut-and-cover structures including excavation, piling, concrete works, installation of diaphragm walls and installation of mechanical and electrical services
- Construction of the Rockdale ventilation facility
- President Avenue intersection upgrade works
- Construction of the shared cycle and pedestrian pathways, including the President Avenue shared cycle and pedestrian bridge and abutments
- Construction of new and upgraded drainage infrastructure and water treatment basin
- Finishing works including asphalting, lighting, line marking and signage installation
- Rehabilitation and landscaping of areas that will not be occupied by permanent operational infrastructure, including Rockdale Bicentennial Park.
A large area is required to support the diaphragm wall works for the cut-and-cover structures. This area would be located on the northern side of the alignment adjacent to West Botany Street, within Rockdale Bicentennial Park North (refer to Figure 7-5).

During construction of the cut-and-cover structures the existing waterbody within Rockdale Bicentennial Park would be temporarily diverted to maintain surface water flow to the wetlands south of President Avenue (refer to Chapter 18 (Surface water and flooding)).

West Botany Street would also require a temporary diversion to maintain traffic flow (refer to Chapter 8 (Traffic and transport)).

Some works along President Avenue and works associated with the cut-and-cover structure would need to be undertaken at night. These include utility relocation and protection works, traffic management works, erection of dedicated shared bridge or if construction of the diaphragm wall extends beyond normal construction hours.

Spoil at C3 would be removed during the day and outside of peak traffic periods where possible. Feasible and reasonable management strategies would be investigated to minimise the number of heavy vehicle movements at night. Further details about construction hours are included in section 7.7.2.
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- Surface works
- Embankment
- Construction boundary
- Cut-and-cover structures
- Underground construction
- Construction ancillary facility
- Underground construction - Temporary access tunnel
- Diaphragm wall support site

- Building
- Carpark
- Sediment basin
- Soil treatment area
- Carpark and facilities
- Waterbody diversion

- Vehicle access
- Vegetation exclusion zone
- Permanent power supply line
- Permanent power supply construction boundary
- Through traffic maintained during construction
- Temporary flood detention
- Temporary Water treatment plant
- Temporary haulage access
- Temporary diversion of the waterbody
- Office and amenities

Figure 7-5 President Avenue construction ancillary facility (C3) indicative layout
7.3.5 Shared cycle and pedestrian pathways construction ancillary facilities (C4/C5)

Construction of the shared cycle and pedestrian pathways between Bestic Street and Bruce Street would be supported by C4 and C5, including the following key construction activities:

- Vegetation clearing and removal, topsoil stripping areas and landform shaping
- Excavation of spoil and removal off-site
- Provision of utilities for lighting
- Concrete formation and concrete pathway pouring
- Finishing works including lighting, line marking and signage installation.

C4 and C5 are shown on Figure 7-6. The shared cycle and pedestrian pathways would be constructed during standard working hours at this location.

Figure 7-6 Shared cycle and pedestrian pathways construction ancillary facilities (C4 and C5) indicative layout
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7.3.6 Princes Highway construction ancillary facility (C6)

The Princes Highway ancillary facility (C6) would be located at Kogarah, on the north-east corner of Princes Highway and President Avenue. This land is currently occupied by 7-Eleven service station Kogarah.

This construction ancillary facility would be around 1,500 square metres and would support the construction of the Princes Highway and President Avenue intersection upgrade. The site would include offices and amenities. Key construction activities to occur at this site would include:

- Property adjustment and demolition of the existing 7-Eleven service station including the removal of tanks and rehabilitation of site to treat contaminants
- Relocation of utilities, stormwater infrastructure and substation
- Laydown and parking of construction vehicles and equipment
- Pavement works along Princes Highway and President Avenue
- Rehabilitation and landscaping.

A construction water treatment plant may also be located at C6 during the rehabilitation of the site to treat contaminants.

An indicative site layout for the Rockdale construction ancillary facility is shown in Figure 7-7. Access to C6 would be gained from President Avenue.

Figure 7-7 Princes Highway construction ancillary facility (C6) indicative layout
7.3.7 Other construction sites

Additional construction sites would be required. These would include sites located:

- Between Bruce Street and the President Avenue construction ancillary facility for the construction of the on-road cycleway
- Access from Bestic Street would be required for construction workers, delivery of materials and removal of spoil for the shared cycle and pedestrian pathways. Refer to section 7.6 for indicative construction vehicle numbers accessing the sites from Bestic Street
- South of President Avenue, east of Civic Avenue for the construction of the shared cycle and pedestrian pathways and dedicated shared bridge

7.3.8 Potential additional construction sites

Although every endeavour has been made to identify the land required for the construction of the project, the construction contractor(s) may require additional construction sites and/or compounds to those detailed in section 7.3.2 to section 7.3.6. For example, construction methodologies may require mid tunnel access shafts for materials delivery and for safety reasons during construction such as fresh air ventilation and emergency egress. Alternative or additional sites would be assessed against the following environmental criteria, and the impacts assessed in accordance with relevant legislation:

- Be located more than 50 metres from a waterway, unless an erosion or sediment control plan is developed and implemented
- Be located within or adjacent to the project
- Have ready access to the road network, and be located to minimise the need for heavy vehicles to travel on local streets and/or through residential areas
- Be located on relatively level land
- Be separated from the nearest residences by at least 200 metres, unless feasible and reasonable noise and light spill mitigation measures are implemented
- Not require native vegetation clearing beyond that already required for the project
- Not have any more than a minor impact on heritage items beyond those already required for the project
- Not unreasonably affect the land of adjacent properties
- Be above the 20 year average recurrence interval flood level, unless a contingency plan to manage flooding is prepared and implemented
- Provide sufficient space for the storage of soil, raw materials and other construction materials to minimise the number of deliveries required outside of standard daytime construction hours.

7.4 Project construction activities

Construction activities for the project are discussed in this section and would include:

- Preparatory investigations
- Site establishment and enabling work
- Tunnelling
- Surface earthworks and structures
- Construction of permanent operational infrastructure
- Drainage and water management infrastructure
- Road pavement works
- Finishing works.
7.4.1 Preparatory investigations

The project would require preparatory investigations and survey activities to inform the detailed design prior to the main construction activities. These activities include test drilling, test excavations, geotechnical or contamination investigations or other tests, utility location identification or surveys, sampling or investigations for the purposes of the design of the project. These activities would be required within the construction boundary, including areas within Rockdale Bicentennial Park wetland and Scarborough Park north. These areas are identified as coastal wetlands under the State Environmental Planning Policy (Coast Management) 2018 (Coastal Management SEPP).

These activities would inform design and construction and would be expected to be carried out before the start of substantial construction works within the area of the tunnel dive and cut-and-cover structures and construction access tunnels at the President Avenue intersection and for the bridge approaches and structures for the shared pedestrian and cycle pathway.

Typically, preparatory investigations to inform the design may involve:

- Installation of site environment management controls
- Boreholes and tests pits to determine soil and ground conditions
- Ground and utility surveys including excavation to confirm depths of location of utilities
- Installation of piezometers to allow for ongoing groundwater monitoring.

Boreholes would be advanced through soils and extended into rock at bridge piers and abutments. The clear site area required for each borehole would typically be eight metres by three metres. Where an external water supply is required, this would be provided from approved sources including water hydrants. Water would be the principle drilling fluid, although a biodegradable oil-based polymer may also be used depending on the subsurface conditions encountered. After drilling has been completed, the sites would be reinstated to pre-works condition. This would involve stabilising the site with the original removed turf if possible.

Test pits would be excavated using a backhoe for sampling of sub-grade materials and excavation conditions at regular intervals. At each test pit location, dynamic cone penetration tests may be conducted to assess the in-situ strength and relative density of the underlying soils. Test pits would be typically three metres deep, 0.5 metres wide and three to four metres long.

Ground disturbance would occur at the test pit location and immediately adjacent where excavated spoil is temporarily stockpiled prior to backfilling. Material extracted from test pits would be returned in the reverse order to which it was removed.

It is anticipated that piezometers would be used as part of an ongoing program of groundwater monitoring to inform the design. The piezometers would be closed with a locked cover, to be flush with the ground surface for all public footpaths, cycle ways, roads and public recreational areas. Following installation, piezometers would be periodically monitored as part of an ongoing groundwater-monitoring program.

These investigations would not result in significant adverse environmental or socio-economic impacts with any potential environmental impacts considered minor. In particular, the investigations within coastal management areas will not significantly impact on the biophysical, hydrological or ecological integrity of the adjacent coastal wetland, or the quantity and quality of surface and ground water flows to the coastal wetland.

Standard environmental management measures would be implemented to avoid, minimise and mitigate potential adverse impacts from the investigation works. These measures include:

- Avoiding or minimising impacts on biodiversity, in particular coastal management areas
- Implementing appropriate erosion and sediment controls
- Implementing appropriate waste, dust and noise controls.

A management plan would be prepared to describe safeguards and management measures identified. This plan will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.
7.4.2 Site establishment and enabling works
These works would be initial works, managed through a site establishment and enabling works management plan. Site establishment works are expected to include:

- Installation of site fencing and hoarding
- Provision of access and parking areas
- Installation of site offices and crib rooms
- Construction of acoustic sheds
- Installation of sediment and erosion control measures
- Installation of traffic management measures and changes
- Establishment of temporary pedestrian and cyclist diversions
- Installation of other environmental controls (such as screening and noise attenuation)
- Installation of temporary utility services to support construction (including construction power)
- Installation of temporary water treatment facilities
- Utility works including protection and/or adjustment of existing utilities, removal of redundant utilities, and the installation of new utilities
- Vegetation clearing and removal. A total of 449 trees were identified within the construction boundary which may need to be removed for the project. A tree management strategy would be prepared and implemented for the project. Trees would be retained wherever possible
- Demolition and clearing of structures, including buildings.

Demolition
Construction of the project would require demolition or partial demolition of around 20 surface properties (subject to the conditions of the project approval). Table 7-2 provides an indicative list of the number of buildings and their current primary use proposed to be demolished for the project.

Table 7-2 Indicative number and types of buildings proposed for demolition

<table>
<thead>
<tr>
<th>Land use type</th>
<th>Buildings to be demolished</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>Five industrial buildings and one service station</td>
</tr>
<tr>
<td>Roads and Maritime depot</td>
<td>Up to five large sheds/ small buildings</td>
</tr>
<tr>
<td>Residential</td>
<td>Nine single dwelling houses</td>
</tr>
<tr>
<td>Other</td>
<td>Substation</td>
</tr>
</tbody>
</table>

Typically, access and egress to and from the site of demolition would use existing driveways; however, alternative access may be required. Demolition would be carried out by licensed demolition contractors and in stages where possible.

An asbestos survey will be undertaken of buildings to be demolished as part of the project in accordance with a Hazardous Building Materials Management Plan developed for the project. The survey will be conducted by a suitably qualified person. Recyclable resources generated during demolition will be segregated for recycling and sent to an appropriate recycling facility for processing.
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7.4.3 Tunnelling

Tunnel excavation
The project would involve tunnel excavation for the mainline tunnels, entry and exit ramp tunnels, and various connected ancillary tunnels and cross passages.

The depth of the tunnels below ground level would vary according to localised geological conditions, and they would be located underneath the New M5 Motorway tunnels in the vicinity of the underground connection with the New M5 Motorway. The deepest point of the tunnel crowns (top of the tunnels) would be greater than 80 metres below ground level, with shallower sections approaching the connection to the surface road network at the President Avenue intersection. The shallower sections would be along the entry and exit ramp tunnels.

It is anticipated that the tunnels would be excavated using a combination of roadheader excavation and drill and blast methods. Using roadheaders and drill and blast methods would speed up the excavation process. The drill and blast method would likely involve the excavation of the heading (top section of the tunnel) and bench (bottom section of the tunnel).

The bench (lower section of the tunnel) would then be removed using a roadheader, surface miner, drill and blast or conventionally by excavators with rock hammers. Profilers would only be used for the last 200-300 millimetres of the floor. Another technique that would be available to the construction contractor for excavating the bench is controlled blasting which would reduce the reliance on roadheaders and reduce the time taken for the tunnel excavation. The controlled blasting method involves a sequence of:

- Drilling holes and charging them with explosives
- Carrying out controlled blasts
- Removing loosened material ('mucking out').

Roadheaders would be launched from tunnelling sites (refer to section 7.3). An indicative tunnel excavation method using roadheaders is illustrated in Figure 7-8. The tunnel excavation methods would be confirmed by the contractors engaged to construct the project.

Blasting methods can significantly reduce exposure to noise and vibration for residents and businesses above the tunnels. Blasting would also shorten excavation timeframes. A Blast Management Strategy will be prepared in accordance with relevant guidelines before blasting begins. Blast patterns would be designed and sequenced to minimise impacts of vibration on properties above the tunnels and on existing below ground infrastructure such as utilities. Blasting would only be undertaken at depths of 30 metres or greater underground and only in locations where the geology is suitable (i.e. not soft ground). Chapter 11 (Noise and vibration) provides an assessment of the underground blasting impacts on surface receptors during construction.
Ground support, including rock bolting and shotcrete, would be installed as the tunnelling face is advanced. There would be progressive installation of tunnel lining following tunnel excavation. Tunnel lining would typically consist of rock bolts and shotcrete with additional water resisting treatments provided based on the local geology and groundwater inflows.

In addition to the mainline tunnels and entry and exit ramp tunnels, the following tunnel infrastructure would be constructed using either roadheaders, excavators with rock hammers, or blasting (unlikely to be used in soft ground conditions):

- Temporary access tunnels to access the road and ventilation tunnels from construction ancillary facilities
- Ventilation shafts and tunnels
- Niches for underground substations
- Breakdown and maintenance bays.

The indicative depths of the mainline tunnel below ground level are shown in Figure 7-9.

**Spoil management**

Excavated spoil from tunnelling would be stockpiled within each of the construction ancillary facilities, within spoil handling sheds. Any excess spoil that cannot be reused within the project would require off-site reuse/disposal. Estimated volumes of spoil generated at each construction ancillary facility are provided in Table 7-3.
Table 7-3 Estimated spoil generated at each construction ancillary facility

<table>
<thead>
<tr>
<th>Site</th>
<th>Volume of spoil (m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>612,650</td>
</tr>
<tr>
<td>C2</td>
<td>347,900</td>
</tr>
<tr>
<td>C3</td>
<td>195,950</td>
</tr>
</tbody>
</table>

Civil finishing works for the tunnels

On completion of the tunnel excavation works, there would be a variety of civil finishing works, including:

- Installation of stormwater and groundwater drainage systems, including sumps
- Installation of water resistant treatments (where required)
- Finishing of:
  - Cross-passages and longitudinal egress passages
  - Substation niches
- Pavement construction and line marking
- Installation of:
  - Electrical and communication conduits and cable trays
  - Deluge and hydrant fire mains
  - Road furniture (e.g. safety barriers, lighting and signage)
  - Architectural panels
- Painting.

Tunnel fitout and testing

Following tunnel excavation and civil finishing works, the tunnels would be fitted out with operational infrastructure including power, ventilation systems, fire safety systems, communications, traffic control device and systems, tunnel lighting, tolling infrastructure and other operational management and control systems.

This would be followed by a comprehensive commissioning process to validate the operation and integration of tunnel systems before the tunnels are opened to traffic.
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Figure 7-9 Indicative tunnel depths - mainline tunnels

 Depths are based on an assumed 8m tunnel height. Calculations are based on top of tunnel depth from existing ground level and are indicative for illustrative purposes only.
7.4.4 Surface earthworks and structures

Earthworks would be required for the construction of above ground sections of the project, including work in Bicentennial Park, the President Avenue intersection upgrade and Princes Highway/President Avenue intersection upgrade, and within the shared cycle and pedestrian pathways.

The work would be completed using conventional methods of construction and may include:

- Vegetation clearing, topsoil stripping areas and landform shaping, including construction of retaining walls and reinforced soil walls to design levels.
- Treatment of contaminated excavated materials or groundwater, where required (refer to Chapter 16 (Soils and contamination) and Chapter 17 (Groundwater and geology))
- Installation of drainage infrastructure
- Excavation for road widening along President Avenue and Princes Highway
- Road embankment works
- Utility works including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities.

Other earthworks would be required for:

- Tunnel dive and cut-and-cover structures at the President Avenue intersection and construction access tunnels
- Installation of stabilisation and excavation support (retention systems) such as sheet pile walls (where required) and diaphragm walls
- Construction of retaining structures
- Construction of the shared cycle and pedestrian pathways
- Piling excavation for President Avenue shared cycle and pedestrian bridge
- Drainage structures including the operational water treatment basin
- Excavation for temporary diversion of the waterbody within Rockdale Bicentennial Park
- Temporary diversion of West Botany Street to allow construction of cut and cover tunnel section.

Princes Highway/President Avenue intersection upgrade

The Princes Highway/ President Avenue intersection upgrade works would consist of:

- Protection and relocation of utilities
- Demolition and clearing of structures
- Excavation of the road to sub-grade level, and the installation of the new road pavement and stormwater infrastructure
- Footpath pavement work, final asphalt and line marking and traffic signal, street lighting and signage installation.

The traffic management for the construction of this intersection is detailed in section 7.6.
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Cut-and-cover structures
A cut-and-cover structure would be required at the following locations:

- **C2** - within the existing Roads and Maritime depot for the construction decline, providing construction access to the mainline tunnels
- **C3** - north of President Avenue intersection through Rockdale Bicentennial Park, Rockdale Wetlands and West Botany Street for the tunnel dive structure.

Cut-and-cover is a tunnel excavation method that generally involves excavating downwards from the surface of the ground, with installation of a tunnel structure including a base, walls and a roof (refer to Figure 7-10). The excavation area would be waterproofed to prevent groundwater infiltration. Once the roof is in place, surface activity can generally resume as construction works continue below. Construction activities associated with cut-and-cover structures would include:

- Excavation, together with the temporary diversion of the waterbody within Rockdale Bicentennial Park and West Botany Street
- Stabilisation and excavation support (retention systems) such as sheet pile walls and diaphragm walls (where required)
- Piling works
- Construction of pile capping beams
- Installation of roof slabs
- Installation of permanent struts and form, reinforcement and pouring of horizontal beams used for bracing and support
- Waterproofing and dewatering
- Finishing works.

Shared cycle and pedestrian pathways
Construction of the shared cycle and pedestrian pathways north of Rockdale Bicentennial Park would involve site establishment, excavation of the path to subgrade level, pavement works, followed by rehabilitation and landscaping.

Construction of the President Avenue shared cycle and pedestrian bridge would involve:

- Site establishment
- Piling excavation and construction of abutments and piers
- Construction of spans, headstocks and girders
- Construction of the southern and northern approach pathways
- Erection of the final girder and span onto the bridge
- Installation of the hand rails, anti-throw screens
- Final fit-out, landscaping and rehabilitation of site.
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Cut and cover through dry land

Stage 1: Site preparation

Stage 2: Excavation and diaphragm wall installation

Stage 3: Diaphragm wall installation

Stage 4: Cover structure installed and landscaping

Bedrock

Existing ground water flow

Stockpiling

Diaphragm wall

Road surface

Cover structure

Excavator

Water body

Temporary diversion of water body

Diverted water body

Reinstated water body

Figure 7-10 Indicative cut-and-cover excavation method
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7.4.5 Construction of permanent operational infrastructure

Operation of the project requires permanent infrastructure. The majority would be constructed within C2 and C3. Construction of a substation and water treatment facility would occur within C1. Refer to section 6.9.1 for further details on the permanent operational infrastructure.

Mechanical and electrical fitout of the Arncliffe ventilation facility would need to occur within C1. These structures are currently being constructed as part of the New M5 Motorway project.

Construction of permanent infrastructure within C2 would include pavement works for the construction of the motorway carpark and the motorway yard, as well as the construction of the Motorway Control Centre building, maintenance facility, pump room and deluge tanks and bulky equipment store. These buildings would be constructed using conventional steel frame or reinforced concrete methods, followed by internal fitout and reconfiguration of the site to enable ongoing/future use for maintenance activities, including rehabilitation and landscaping.

Ventilation facilities

The Rockdale ventilation facility would be constructed on the west side of West Botany Street and would involve:

- Footing and base slab installation
- Erection of precast or in situ poured concrete wall panels for shaft structure stability
- Installation of precast floor or in situ poured elements at the fan room and damper levels
- Installation of roof panels and stair structures for maintenance, access and monitoring of the facilities
- Fixing of façade support structures to ventilation shaft walls as per architectural requirements
- Internal fitout of plant areas, equipment installation and commissioning.

Fitout and installation works would also occur at the Arncliffe ventilation facility being built as part of the New M5 Motorway project. It is envisioned that a significant portion of the ventilation facility would be constructed within the cut and cover structure for the southbound tunnel.

Fire pumps and tanks

The project would require water storage in the form of tanks and a pump station to supply the deluge fire suppression system that would service the tunnels. The tanks and pump station would be located within MOC2, and constructed within C2. The construction would involve:

- Footing and base slab installation
- Construction of fire deluge tanks
- Construction of concrete blockwork walls and precast walls for tank enclosure
- Installation of roofing
- Installation of architectural treatments and façade systems
- Installation of in-ground services
- Internal fitout and commissioning of fire pump infrastructure.

Electrical substations

One intake substation would be constructed above ground within MOC3. This intake electrical substation would manage the intake and distribution of the project’s power needs.

The substation would be constructed by installing the concrete blockwork, in-ground services, architectural treatments and façade systems, followed by internal fitout and commissioning of electrical infrastructure.
Permanent power supply connection

A permanent power supply connection would be constructed within and outside the project footprint to service the construction and operation of the project (refer to Figure 7-11).

The power line would be constructed underground either by trenching or, where required, under-boring. Where the power line crosses waterways or railways, it would be installed in a conduit attached to an existing bridge. The power line would be located within the existing road reserve or underbored, where allowed by the relevant authority, with the exception of where it would cross Bardwell Valley Golf Club and run along the edge of Silver Jubilee Park.

Prior to work commencing the following planning measures will be carried out by each site specific work crew:

- Obtain current Dial Before You Dig (DBYD) drawings for the work area
- Locate existing services
- Undertake dilapidation survey
- Obtain a current Excavation/Penetration Permit for excavation work
- Notify residents and businesses of any out-of-hours works or impacts on access
- Assess the area for potential contamination
- Submit Traffic Control Plan (TCP) and Road Occupancy Licence (ROL) for approval where required
- Subcontractor’s crew to conduct/attend prestart induction prior to any work commencing
- TCP to be implemented on site for work in close proximity to live traffic.

Site-specific environmental controls would be implemented within each construction area along the route of the power line.

The works would generally involve the following:

- Trenching (or under-boring) and excavation of the road reserve, park area or railway corridor
- Relocation or protection of existing services
- Placement of power cables
- Horizontal Directional Drilling (HDD) or under-boring
- Backfilling trenches and reinstatement of pavement.

The works would require small amounts of localised excavation for trenching and under-boring. Where possible, excavated material would be backfilled and the pavement reinstated or re-moved from site. There would be limited surface disturbance beyond the limits of the utility trenches.

No ancillary facilities are proposed in conjunction with the proposed works. Temporary fencing would be erected around the work site during works and would be removed once works in the area were completed. For the duration of the work program, plant and equipment would be left in-situ within the road reserve each night until works are completed.

Construction of the power line would generally be carried out during standard daytime construction hours. Certain activities would need to occur out of hours, as directed by the relevant road authorities to minimise traffic impacts, or by the utilities providers to minimise disruption to services. The affected community would receive appropriate notification of the works.

The land required for the proposal is owned by Roads and Maritime or the relevant Council.
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C.: Construction boundary
- Permanent power supply line
- Permanent power supply construction route

Figure 7.11 Permanent power supply line and construction route
7.4.6 Drainage and water management infrastructure

The project would require construction of new drainage infrastructure and alterations to existing drainage infrastructure (refer to Chapter 6 (Project description) and Chapter 18 (Surface water and flooding)). It would also require the construction of water management infrastructure, including water treatment plants for the construction and operational phases of the project (see section 7.4.5 for a description of the construction methodology for water treatment plants).

Drainage and water management infrastructure works would include construction of the following:

- A tunnel drainage system
- Operational water treatment facility at Arncliffe (MOC1)
- Temporary water treatment plants (at most construction ancillary facilities)
- Temporary flood detention basin at C3
- A new pavement drainage system at the President Avenue tunnel portals
- New surface water drains, drainage pits and pipes at the President Avenue intersection
- An operational water treatment basin adjacent to the President Avenue intersection
- New and upgraded culverts at President Avenue intersection
- Adjustment to Princes Highway stormwater infrastructure.

The operational water treatment facility at Arncliffe (MOC1) would be constructed using prefabricated components which would be assembled on site. The water treatment facility would then be connected to the incoming power supply, followed by testing and commissioning.

There would also be demolition and removal of redundant drainage infrastructure where required.

7.4.7 Road pavement works

These works would be carried out along the tunnels and surface roads following construction of the main structures. Existing road pavements would be modified to integrate with the project where required.

Where the project ties into existing roads (i.e. at the President Avenue intersection and the connection with the New M5 Motorway), pavements would be widened, reconfigured, milled and resurfaced.

7.4.8 Finishing works

These works would be undertaken towards the completion of construction and would include:

- Line marking of new road surfaces and some existing roads
- Erection of directional and other signage and other roadside furniture such as street lighting
- Erection of toll gantries and other control systems
- Traffic signal installation and modification
- Earthworks including cutting, filling and grading to shape the finished surface level
- Landscaping and revegetation works
- Construction of pedestrian and cycle paths
- Closure and backfill of temporary access tunnels
- Site demobilisation and removal of construction ancillary facilities, and preparation of the sites for future use
- Rehabilitation of land where not required for operational use
- Reinstatement of Bicentennial Park waterway.
7.4.9 Concurrent activities
Concurrent project construction activities are likely to take place in the vicinity of President Avenue, Princes Highway and West Botany Street for a period of up to three years. These activities would include:

- Tunnelling works and spoil handling at C2
- Excavation and construction of cut-and-cover structure at C3
- President Avenue widening works at C3
- Property demolition, rehabilitation and adjustment at C6
- Relocation of utilities, stormwater infrastructure and substation at C6
- Pavement works along Princes Highway and President Avenue at C6

Concurrent construction activities are likely to result in greater noise, air quality and traffic impacts, which would be considered during the development of the detailed construction program. Such activities would be staged where possible to minimise cumulative impacts.

7.5 Utility works
Assessment of impacts to utilities identified key areas of interest within the project (see Figure 7-12). Existing major utilities within the areas of interest include:

- Power (Ausgrid) – high voltage transmission (33kV or greater) and substations
- Gas (Jemena) – secondary gas mains
- Potable water (Sydney Water) – mains of 300 millimetre diameter or greater
- Sewer (Sydney Water) – gravity mains of 300 millimetre or greater
- Telecommunications – multiple fibre optic cables

It is likely that utilities affected by the project would need to be protected, relocated or realigned as part of construction of the project. This is particularly the case around areas of surface or shallow soil disturbance. The nature and extent of utility changes has been proposed, however would be confirmed during the design development of the project following consultation with the utility providers. Table 7-4 provides an overview of the proposed treatments for major services.

Table 7-4 Indicative utility management during construction

<table>
<thead>
<tr>
<th>Utility</th>
<th>Location</th>
<th>Proposed treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ausgrid 132kV Feeder – Feeder 9RT and 91 ExL</td>
<td>President Avenue, under the current trafficable pavement.</td>
<td>Maintained and protected during construction.</td>
</tr>
<tr>
<td>Ausgrid 132kV Feeder – Feeder 91H/2 and 907</td>
<td>Intersection of President Avenue and O’Neill Street</td>
<td>Maintained and protected during construction.</td>
</tr>
<tr>
<td>Secondary Gas Main</td>
<td>President Avenue and West Botany Street intersection</td>
<td>Maintained and protected during construction. To be determined following consultation with Jemena.</td>
</tr>
<tr>
<td>Water Main</td>
<td>President Avenue</td>
<td>Permanent relocation to the project’s services corridor.</td>
</tr>
<tr>
<td>Ausgrid 33kV Feeder</td>
<td>West Botany Street</td>
<td>The existing cables would be replaced by a standard six-way duct line after construction.</td>
</tr>
<tr>
<td>Secondary gas main</td>
<td>West Botany Street</td>
<td>Temporary relocation during construction and reinstatement during final stages of construction</td>
</tr>
<tr>
<td>Sewer Main</td>
<td>West Botany Street</td>
<td>Temporary relocation during construction and reinstatement during final stages of construction</td>
</tr>
</tbody>
</table>
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Area of interest
Utilities corridor
Construction boundary
Construction ancillary facility
Permanent power supply line
Permanent power supply construction boundary

Figure 7-12 Utility area of interest
7.6 Traffic management and access

Construction of the project would be subject to careful traffic management to maintain the functionality of surrounding roads as well as the safety of members of the public, motorists and construction personnel. Generally, temporary road pavements would be constructed as early as possible within the program to separate motorists from work zones. However, phases of traffic management and traffic switches may be required at some locations to facilitate construction.

The detailed design process will determine traffic management measures to be implemented during construction. These will be documented in a Construction Traffic and Access Management Plan (CTAMP) as part of the Construction Environmental Management Plan.

7.6.1 Changes to the road network

Detailed traffic staging and the use of temporary retaining structures would allow the maintenance of existing through lanes (two eastbound and two westbound) and turn movements along President Avenue during construction. President Avenue would need to be closed to traffic for a number of nights during the erection of the President Avenue shared cycle and pedestrian bridge, to ensure safe construction.

In addition, the outer lanes of West Botany Street will need to be closed outside of peak hours during site establishment at C3, prior to construction of the cut-and-cover structures.

Other changes to the road network around President Avenue, shown on Figure 7-13 and Figure 7-14, are anticipated to include:

- Temporary diversion of West Botany Street traffic lanes for the cut-and-cover structures across West Botany Street and utility relocations
- Reinstatement of original alignment of West Botany Street following construction of the cut and cover structures
- Temporary traffic signals on West Botany Street at C2 to allow safe movements of construction traffic into and out of C2
- Temporary traffic signals on West Botany Street at C3 in order to allow construction traffic to pass from the construction area for MOC3 on the eastern side to the western side of West Botany Street
- Temporary closure of access to and from President Avenue at Civic Avenue to ensure the safety of construction workers and road users during the President Avenue intersection upgrade
- Reopening of Civic Avenue to ‘left in’ and ‘left out’ turns only following the President Avenue intersection upgrade
- Permanent closure of access to and from President Avenue at Moorefield Avenue and O’Neill Street during the President Avenue intersection upgrade
- Temporary closure of the outer southbound lane of Princes Highway and outer eastbound lane of President Avenue during the Princes Highway / President Avenue intersection upgrade works. Vehicular access will be blocked during utilities relocation and pavement widening works
- Reopening of lanes at the Princes Highway / President Avenue intersection following the upgrade works
- Provision of a right turn bay and refuge bay to formalise a right turn into Lachal Avenue from President Avenue.

Parking along President Avenue would be made progressively unavailable during construction. The sign-posted speed along West Botany Street and President Avenue may be reduced for safety reasons and to facilitate traffic management during some parts of construction.

In addition, parking along West Botany Street adjacent to construction works would be unavailable during construction of the cut-and-cover structures.
Temporary traffic signals to allow construction traffic to pass between east and west sides of West Botany Street.

Closure of outer southbound lane of Princes Highway and outer eastbound lane of President Avenue during intersection upgrade.

Temporary closure of access to and from Civic Avenue at President Avenue during intersection upgrade.

Closure of outer lanes of West Botany Street outside of peak hours during site establishment.

Temporary diversions of West Botany Street during construction of the cut-and-cover structures.

Traffic staging would allow the maintenance of existing through lanes (two eastbound and two westbound) along President Avenue during the intersection upgrade.
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- Surface works
  - Embankment
  - Permanent power supply line
  - Permanent power supply construction boundary
- Underground construction
  - Construction ancillary facility
- Permanent road closure
- Road reopening

**Figure 7-14** Permanent changes to the road network
7.6.2 Temporary changes to the active transport network

The CTAMP would also include a strategy for managing temporary changes to pedestrian and cyclist facilities including:

- Closing or detouring the pedestrian pathways along either side of President Avenue during works along President Avenue. This would occur one side at a time and diversions would be put in place.

- Temporary blocking of the walking path that circumnavigates Rockdale Bicentennial Park during construction of the cut-and-cover structure. Pedestrian movements would be diverted along the northern boundary of C3 or along West Botany Street and President Avenue to the south of C3.

- Retention of the pedestrian access between West Botany Street and Kings Road with potential relocation to the northern extent of the park area.

- Closure of the pedestrian bridge over Rockdale Wetlands for the duration of the construction works in the area. Pedestrians would be diverted along President Avenue.

Temporary closure (one side at a time) of pedestrian pathways along either side of Princes Highway during the intersection upgrade works. Pedestrians would be diverted to the opposite side during closure of one side.

7.6.3 Temporary changes to the public transport network

Bus stops are located at the following locations within the construction boundary:

- President Avenue at O’Neill Street, Brighton-Le-Sands
- President Avenue at West Botany Street, Kogarah
- President Avenue at Traynor Avenue, Kogarah
- President Avenue at Cross Street, Kogarah
- President Avenue opposite TAFE Sydney, Kogarah
- Two stops at James Cook Boys Technology High School, Kogarah – located along the southbound side of Princes Highway.

Some lane closures would be required along President Avenue and West Botany Street outside of peak hours, and along Princes Highway for a number of weeks. These works may require the temporary relocation of some bus stops along President Avenue and Princes Highway. This would be undertaken in consultation with Transport for NSW and the bus operators and Bayside Council.

The relocation of bus stops would not impact on the operation of bus services, however it may result in some passengers having to walk a short distance further to access a temporary bus stop. For the bus stops which are required to be relocated, the distance from existing bus stops would be minimised. The same access provisions as those currently provided at these bus stops would be retained.
7.6.4 **Access routes and vehicles numbers**

Construction vehicles expected to access the works include:

- Light trucks and commercial vehicles (e.g. delivery vans)
- Heavy vehicles (e.g. semi-trailers, spoil trucks, concrete trucks and cranes)
- Oversize and over mass vehicles and special purpose vehicles (e.g. precast concrete beam delivery, plant on low loaders or large mobile cranes).

Oversize and over mass vehicles would predominantly access the works at night given the restrictions on movement of these vehicles during the day, and to minimise impacts on the surface road network during peak periods.

**Table 7-5** summarises proposed access to the construction sites. Wherever possible, it is proposed that access be gained directly from arterial roads. The delivery of materials and/or equipment by heavy vehicles to C5 would be via local streets. **Table 7-6** sets out estimated daily construction vehicle numbers during construction. **Section 7.7.2** provides details about construction hours, including when spoil haulage would occur.

During detailed design, confirmation of access routes between construction sites would be confirmed and documented in the CTAMP.

The confirmation of access routes would also consider the use of a marshalling area(s) for spoil trucks to further assist in managing the arrival of vehicles to site. A marshalling area would be provided within the boundaries of C1. Additional marshalling areas may be located in a non-residential area and in close proximity to both the arterial road network and construction ancillary facilities.

The use of dedicated marshalling areas would avoid queuing and parking of heavy vehicles on local roads in the vicinity of the project. The CTAMP will confirm marshalling area(s) and provisions for their use.

**Table 7-5 Indicative access routes between construction ancillary facilities**

<table>
<thead>
<tr>
<th>Site</th>
<th>Access and egress points (light and heavy vehicles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Marsh Street (existing signalised intersection)</td>
</tr>
<tr>
<td></td>
<td>– left-in and right-in, left-out</td>
</tr>
<tr>
<td>C2</td>
<td>West Botany Street (temporary traffic signals)</td>
</tr>
<tr>
<td></td>
<td>– left-in and right-in, left-out and right-out</td>
</tr>
<tr>
<td>C3</td>
<td>President Avenue</td>
</tr>
<tr>
<td></td>
<td>– left-in, left-out</td>
</tr>
<tr>
<td></td>
<td>West Botany Street (temporary traffic signals)</td>
</tr>
<tr>
<td></td>
<td>– left-in and right-in, left-out and right-out from east and west of West Botany Street</td>
</tr>
<tr>
<td>C4</td>
<td>West Botany Street</td>
</tr>
<tr>
<td></td>
<td>– left-in, left-out and right in, right out</td>
</tr>
<tr>
<td>C5</td>
<td>Bruce Street (temporary traffic controls)</td>
</tr>
<tr>
<td></td>
<td>– right-in, left-out</td>
</tr>
<tr>
<td>C6</td>
<td>President Avenue</td>
</tr>
<tr>
<td></td>
<td>– left-in, left-out</td>
</tr>
<tr>
<td></td>
<td>Bestic Street (temporary traffic controls)</td>
</tr>
<tr>
<td></td>
<td>– left-in and right-in, left-out and right-out</td>
</tr>
</tbody>
</table>
### Table 7-6 Indicative construction vehicle numbers

<table>
<thead>
<tr>
<th>Location</th>
<th>Daily vehicles</th>
<th>AM peak hour</th>
<th>PM peak hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(two-way)</td>
<td>(7.00–8.00 am)</td>
<td>(5.00–6.00 pm)</td>
</tr>
<tr>
<td></td>
<td>Heavy vehicles</td>
<td>Light vehicles</td>
<td>Heavy vehicles</td>
</tr>
<tr>
<td></td>
<td>Arrive</td>
<td>Depart</td>
<td>Arrive</td>
</tr>
<tr>
<td>C1 Arncliffe construction ancillary facility</td>
<td>276</td>
<td>336</td>
<td>13</td>
</tr>
<tr>
<td>C2 Rockdale construction ancillary facility</td>
<td>274</td>
<td>352</td>
<td>12</td>
</tr>
<tr>
<td>C3 President Avenue construction ancillary facility</td>
<td>178</td>
<td>642</td>
<td>6</td>
</tr>
<tr>
<td>C4 Shared cycle and pedestrian pathways construction ancillary facility</td>
<td>16</td>
<td>64</td>
<td>1</td>
</tr>
<tr>
<td>C5 Shared cycle and pedestrian pathways construction ancillary facility</td>
<td>26</td>
<td>88</td>
<td>1</td>
</tr>
<tr>
<td>C6 Princes Highway construction ancillary facility</td>
<td>20</td>
<td>176</td>
<td>1</td>
</tr>
<tr>
<td>- Bestic Street</td>
<td>16</td>
<td>22</td>
<td>1</td>
</tr>
</tbody>
</table>

**Notes:**
Vehicle numbers include the total movements to and from the site (i.e. two way) in the time period specified. Indicative construction vehicle numbers (daily and for the AM and PM peak hour) would vary based on the final construction methodology and program.
7.6.5 Spoil haulage routes
Excess spoil that cannot be reused within the project would require off-site reuse or disposal. The project would target 95 per cent beneficial re-use of the usable portion of the spoil, in accordance with the project spoil management hierarchy.

It is anticipated that spoil would be hauled to spoil reuse and disposal sites using heavy vehicles. Spoil haulage routes to and from construction ancillary facilities have been developed (and would be confirmed during detailed design) with the following aims:

- Minimise the use of local or residential streets and maximise the use of arterial roads
- Minimise any safety implications for pedestrians, cyclists and other road users
- Avoid the need to pass through or under the Sydney CBD
- Minimise the cumulative use of roads accessing different construction sites.

It is assumed spoil haulage routes would be the same as heavy haulage routes. The majority of spoil haulage would occur during 7am – 6pm on weekdays and between 8am – 1pm on Saturday. Spoil removal would occur outside of peak periods where feasible. Some night time spoil haulage would be required.

Several potential spoil management sites have been identified which could receive spoil generated by the project. They are all located within 40 to 70 kilometres from the construction boundary. The selected sites would be determined during detailed design. Alternative haulage routes would be available for spoil trucks under ‘exceptional circumstances’. These would be outlined in the CTAMP and may include:

- Queuing of heavy vehicles onsite, requiring other heavy vehicles to temporarily bypass construction ancillary facility sites to prevent queuing on public roads
- Road works or an accident/incident that prevents heavy vehicles from accessing or travelling on the designated haulage route
- A temporary hazard (e.g. an illegally parked vehicle, a lost vehicle load or floodwater) requires a heavy vehicle(s) to bypass an access gate or designated route to avoid causing damage to public and/or private property
- During temporary road closures.

Chapter 21 (Waste management) outlines the spoil strategy for the project and identifies potential spoil disposal sites.

7.6.6 Workforce parking
It is anticipated that construction workforce parking would be provided at the following sites:

- Arncliffe construction ancillary facility (C1) – around 140 car parking spaces
- Rockdale construction ancillary facility (C2) – around 50 car parking spaces
- President Avenue construction ancillary facility (C3) – around 150 car parking spaces
- Shared cycle and pedestrian pathways construction ancillary facilities (C4/C5) – around 10 parking spaces at each
- Princes Highway construction ancillary facility (C6) – around 25 car parking spaces.

These facilities would be used to provide worker parking and shuttle bus transfers to other nearby construction sites. The numbers of construction personnel requiring parking would vary over the duration of the construction program.

The CTAMP will include a car parking strategy which will detail measures to manage parking impacts in adjacent streets. It would also identify areas where there are high levels of existing parking demand around the construction ancillary facilities and works sites as well as alternative car parking sites for use by the construction workforce.
7.7 Construction workforce numbers and work hours

7.7.1 Construction workforce
The indicative peak construction workforce at each site is detailed in Table 7-7. The construction workforce would comprise trades and construction personnel, subcontractor construction personnel and engineering, functional and administrative staff. The size of the workforce would vary across the working day with a reduction in personnel for night shifts. The total daily peak workforce is around 270 personnel.

Table 7-7 Peak construction workforce estimates

<table>
<thead>
<tr>
<th>Site</th>
<th>Approximate day shift peak construction workforce</th>
<th>Approximate night shift peak construction workforce</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>65</td>
<td>35</td>
</tr>
<tr>
<td>C2</td>
<td>94</td>
<td>55</td>
</tr>
<tr>
<td>C3</td>
<td>114</td>
<td>11</td>
</tr>
<tr>
<td>C4</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>C5</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>C6</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>273</td>
<td>101</td>
</tr>
</tbody>
</table>

1 Assuming a typical day / night approximately 6 – 12 months into construction
2 The workforce comprises construction management personnel, supervision staff, plant operators, inspection personnel (Contractors/Roads and Maritime) and support (e.g. cleaners, security).

7.7.2 Construction hours
Identification of construction hours has taken into account the key objectives of reducing the length of construction and minimising all noise- and traffic-related impacts.

Table 7-8 provides a summary of the proposed construction work hours at each construction ancillary facility and at others areas within the construction boundary.

Works outside of standard construction hours
Other activities that would be carried out outside of standard daytime construction hours include:

- Work determined to comply with the relevant noise management level at the nearest sensitive receptor
- The occasional delivery of materials on oversized vehicles outside approved hours as required by the NSW Police or other authorities (including Roads and Maritime) for safety reasons
- Construction activities that cannot be interrupted and also cannot be completed within daytime hours, including:
  - Completion of diaphragm walls or concrete pouring
  - Some utilities relocation or protection works
- Emergency responses to avoid injury, the loss of life, damage to property and/or to prevent environmental harm
- Activities requiring the temporary possession of roads or to complete traffic switches may need to be carried out outside the standard daytime construction hours during periods of low traffic volumes, to minimise safety impacts and inconvenience to road users, including work along President Avenue and Princes Highway
- Activities agreed with potentially affected receptors.

With the exception of emergencies, activities would not take place outside standard daytime construction hours without prior notification to potentially affected receptors.
Table 7-8 Typical construction work hours

<table>
<thead>
<tr>
<th>Work hours</th>
<th>Activity</th>
<th>Site or construction area</th>
</tr>
</thead>
</table>
| 24 hours a day, up to seven days a week | • Tunnelling and spoil handling within construction sites  
• Underground construction and tunnel mechanical and electrical fitout  
• Occasional delivery of oversize plant  
• Spoil removal and haulage | C1, C2 and C3 Underground, in-tunnel |
| 7.00 am to 6.00 pm on weekdays, 8.00 am to 1.00 pm on Saturdays  
No works on Sundays or public holidays (Standard construction working hours) | • Demolition and surface works and structures  
• Construction of permanent operational infrastructure  
• Cut-and-cover construction  
• Mechanical and electrical fitout of operational buildings. | C1, C2, C3, C4, C5 and C6 |
| Any time | Minor activities or non-disruptive preparatory work, repairs or maintenance may be carried out outside standard daytime construction hours, where the activities do not lead to an exceedance of the applicable noise management level at an affected receptor. | Within the construction boundary |
| Between 9.00 am and 5.00 pm, Mondays to Fridays and 9.00 am to 1.00 pm on Saturdays. | Controlled blasting underground and rock breaking.  
Blasts would be limited to one single detonation in any one day per receptor group, unless otherwise agreed by the Secretary or the NSW Environment Protection Authority (EPA).  
Respite periods would be scheduled to minimise the frequency and duration of extended rock breaking activities with potential for impulsive or tonal noise emissions. | Underground construction of the mainline tunnels |
| As specified in an Environmental Protection Licence (e.g. out of hours) | Activities authorised by an Environment Protection Licence.  
For example, blasting and rock breaking and other high impact noise activities could also occur outside of standard day time construction hours, if authorised by an Environmental Protection Licence. | Within the construction boundary |
| At any time | Emergency or directed activities, such as:  
• Activities as directed by a relevant authority  
• Activities if required to prevent an imminent loss of life or environmental damage. | Within the construction boundary |
7.7.3   Construction noise attenuation

Temporary noise attenuation at construction ancillary facilities may include:

- Temporary acoustic barriers along the boundaries of construction ancillary facilities at locations that face sensitive receptors

- Acoustic sheds around temporary access tunnels and associated above ground spoil handling areas where out-of-hours works would be undertaken near sensitive receptors, including:
  - Arncliffe construction ancillary facility (C1)
  - Rockdale construction ancillary facility (C2).

In addition, spoil stockpiling and management would occur within the President Avenue construction ancillary facility (C3).