



Figure 5-27 Project construction footprint - Map 3



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Figure 5-28 Project construction footprint - Map 4



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Figure 5-29 Project construction footprint - Map 5



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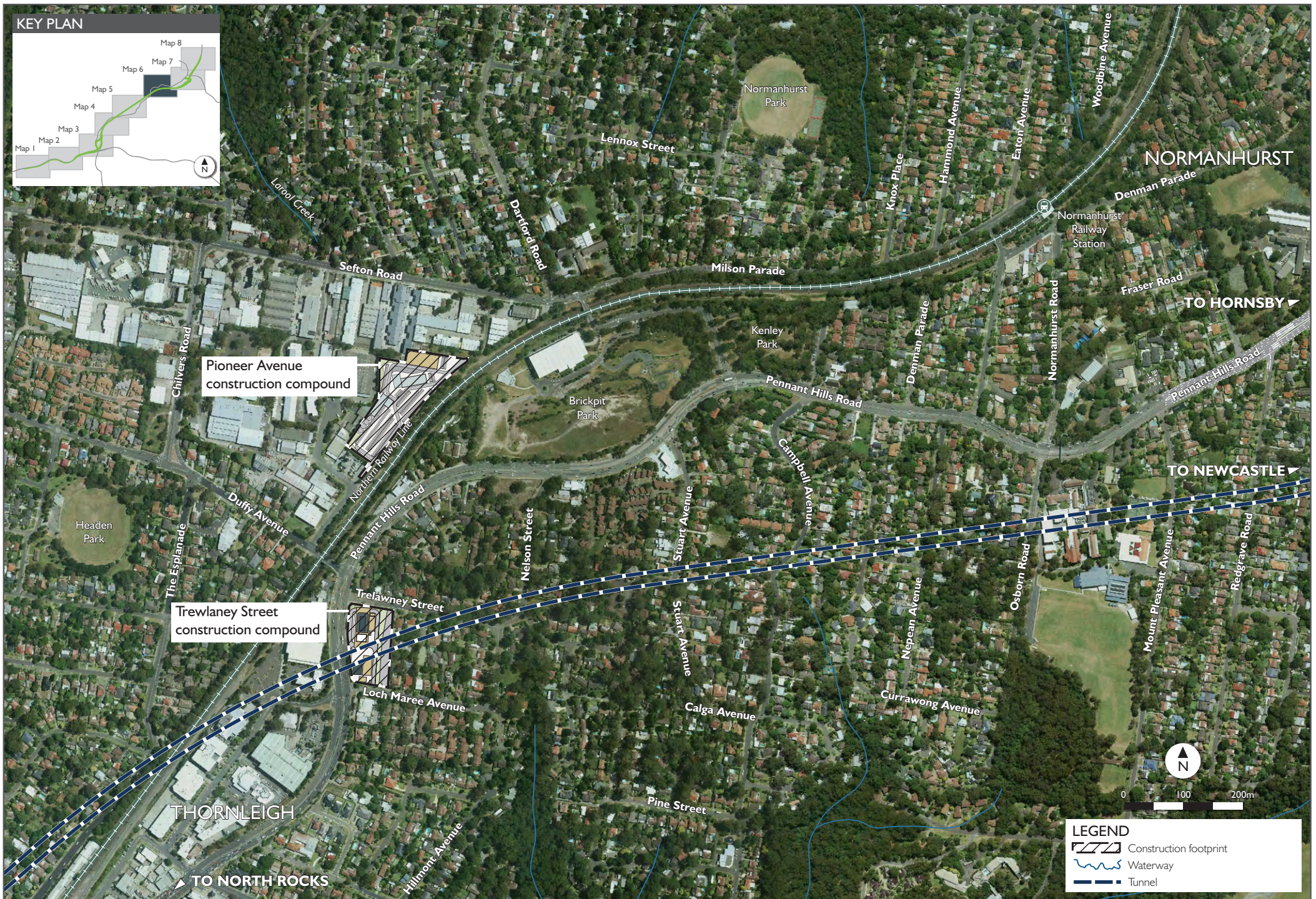


Figure 5-30 Project construction footprint - Map 6



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Figure 5-31 Project construction footprint - Map 7



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**Figure 5-32 Project construction footprint - Map 8**



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### 5.3.2 Overview of construction works

Details of the proposed early works and construction activities are provided in **Table 5-4**. Detailed descriptions of each construction activity are provided in sections which follow.

**Table 5-4 Overview of construction works**

Component	Typical activities
Early works	<ul style="list-style-type: none"> <li>• Additional surveys and investigative works, including existing condition surveys of buildings and infrastructure, and geotechnical investigations.</li> <li>• Land acquisition.</li> <li>• Road and intersection modifications and installation of traffic controls.</li> <li>• Enabling works including public utility adjustments.</li> <li>• Supply of utilities to construction facilities.</li> <li>• Minor clearing works.</li> </ul>
Site establishment works	<ul style="list-style-type: none"> <li>• Installation of environmental controls.</li> <li>• Demolition of existing structures.</li> <li>• Vegetation clearing.</li> <li>• Establishment of construction facilities.</li> <li>• Traffic management measures.</li> </ul>
Tunnelling works	<ul style="list-style-type: none"> <li>• Excavation and temporary ground support.</li> <li>• Construction of declines and shafts.</li> <li>• Construction of cut and cover tunnel structures.</li> <li>• Construction of retaining walls.</li> <li>• Tunnelling for roads (including ramps).</li> <li>• Spoil management.</li> <li>• Finishing works in tunnel and provision of permanent tunnel services.</li> <li>• Concrete paving for road surface.</li> <li>• Installation of road furniture.</li> <li>• Architectural finishing.</li> <li>• Surface site rehabilitation and restoration.</li> </ul>
Buildings and tolling gantries	<ul style="list-style-type: none"> <li>• Tunnel support facilities and substations.</li> <li>• Motorway control centre.</li> <li>• Ventilation facilities and substations at the southern and northern interchanges.</li> <li>• Water treatment plants.</li> <li>• Motorway tolling infrastructure.</li> <li>• Gantries on Pennant Hills Road for truck regulation.</li> <li>• Landscaping.</li> </ul>



Component	Typical activities
Southern interchange	<ul style="list-style-type: none"> <li>• Earthworks.</li> <li>• Drainage structures.</li> <li>• Spoil management.</li> <li>• Paving.</li> <li>• Construction of integration roadwork.</li> <li>• Construction of Pennant Hills Road roadwork.</li> <li>• Installation of road furniture.</li> <li>• Installation of lighting and traffic lights.</li> <li>• Architectural finishes and landscaping.</li> <li>• Provision of temporary detour route for cyclists.</li> <li>• Installation of noise walls.</li> <li>• Construction of the switching station at Coral Tree Drive.</li> <li>• Traffic management to facilitate the works listed above including installation of temporary barriers.</li> </ul>
Northern interchange	<ul style="list-style-type: none"> <li>• Earthworks.</li> <li>• Drainage structures.</li> <li>• Spoil management.</li> <li>• Paving.</li> <li>• Construction of tie-in roadwork.</li> <li>• Construction of surface roadwork.</li> <li>• Installation of road furniture.</li> <li>• Installation of lighting and traffic lights.</li> <li>• Architectural design and landscaping.</li> <li>• Provision of temporary detour route for cyclists and associated signage.</li> <li>• Installation of noise walls.</li> <li>• Traffic management to facilitate the works listed above including installation of temporary barriers.</li> </ul>
Testing and commissioning	<ul style="list-style-type: none"> <li>• Testing of plant and equipment.</li> <li>• Commissioning of the project.</li> </ul>
Site clean-up and demobilisation	<ul style="list-style-type: none"> <li>• Removal of construction facilities.</li> <li>• Landscaping and rehabilitation of affected areas.</li> <li>• Post construction condition surveys.</li> <li>• Removal of construction environmental controls.</li> <li>• Removal of construction site related traffic signage.</li> </ul>

### 5.3.3 Construction program

Subject to planning approval construction of the project is planned to commence in the first quarter of 2015, with completion of construction in the third quarter of 2019. The total period of construction works is expected to be around four years and around nine months of commissioning. The construction program is shown in **Table 5-5**.



**Table 5-5 Indicative construction program**

Construction activity	Indicative construction timeframe											
	2014	2015	2016	2017	2018	2019						
Site establishment												
Shaft excavations												
Tunnelling												
Tunnel lining												
Concrete pavement												
Tunnel mechanical and electrical fit-out												
Southern portal												
Hills M2 Motorway integration works												
Northern portal												
M1 Pacific Motorway tie-in works												
Wilson Road tunnel support facility												
Trelawney Street tunnel support facility												
Southern ventilation facility												
Northern ventilation facility												
Motorway control centre												
Commissioning												

#### 5.3.4 Early works

Early works are works that would generally take place early in the construction program in order to facilitate main construction activities. Early works would include:

- Property acquisitions.
- Demolition of properties.
- Adjustment, relocation and / or protection of utilities.
- Surveys and existing condition surveys of buildings and infrastructure.
- Investigative drilling.
- Traffic management changes to allow access to and egress from the construction sites.
- Installation of environmental control measures.
- Establishment of construction site fencing.
- Construction site establishment.
- Provision of power and other services to the construction sites.
- Heritage salvage or conservation works.
- Establishment of ancillary facility sites.
- Minor clearing works to facilitate other early works.



### 5.3.5 Tunnelling

#### **Tunnel excavation**

The project would involve the excavation of two tunnels around nine kilometres in length for the main alignment as well as additional tunnels for on and off-ramps at both the northern and southern interchanges. Tunnel depth would vary depending on geological constraints, however the tunnel crown (top of the tunnel) would vary up to a maximum depth of around 90 metres below ground level with shallower sections approaching the northern and southern portals.

Two standard cross sections for excavation would be used to accommodate the varying geology along the length of the project area. A fully arched profile would be used for excavations in Ashfield Shale and an arched roof profile with straight walls would be used for excavations in Hawkesbury Sandstone. Prior to tunnel fit-out, the main alignment tunnels would generally have an excavated width of around 14 metres, an excavated height of around eight metres and an excavated cross-sectional area of around 110 square metres. To accommodate 'line of sight' requirements and enlargements of egress tunnels and emergency bays, a number of sections would be widened beyond these standard widths.

The tunnels would not only provide space required for the traffic envelope, but would also provide space for required tunnel services including deluge systems, drainage infrastructure, communications cables, mechanical and electrical equipment, incident response infrastructure and ventilation infrastructure.

It is anticipated that tunnel excavation would be undertaken using a number of road headers and surface miners, supported from multiple sites. A road header is an excavation machine consisting of a boom-mounted rotating cutter head mounted on bulldozer-style tracks, a loader device usually on a conveyor, and a crawler travelling track to move the machine forward into the rock face. A surface miner is a mechanically driven excavation machine capable of cutting, crushing and loading in one continuous process. Localised blasting works may be carried out underground depending on the geological conditions encountered.

Ground support, involving tunnel lining, would be installed progressively following tunnel excavation. Two types of lining would be used for the project depending on the local geology. For the tunnels in Ashfield Shale or Class VI Hawkesbury Sandstone this would involve a full cast in-situ concrete lining, with a sprayed shotcrete lining used for the sections of tunnel in Class I to V Hawkesbury Sandstone.

The following have been identified as tunnelling launch and support sites (refer to **Section 5.3.12** for further details of these sites):

- The southern interchange compound (C5).
- Wilson Road compound (C6).
- Trelawney Street compound (C7).
- The northern interchange compound (C9).

Each of these sites would require support services for the tunnelling activity including power supply, ventilation, water supply, construction water treatment plants, workforce facilities and spoil handling and removal.

In addition to the main alignment tunnels and on and off-ramp tunnels, pedestrian cross passages would be excavated between the main alignment tunnels at 120 metre intervals and vehicle cross passages would be excavated around the Wilson Road and Trelawney Street tunnel support facilities. These cross passages would be excavated using small road headers, excavators with rock hammer, drilling and blasting

### **Tunnel civil finishing works**

On completion of the tunnelling works, a variety of civil finishing works would occur including:

- Roadway drainage.
- Road pavement.
- Installation of road furniture.
- Electrical substations.
- Low point sumps.
- Cross passages including electrical rooms.
- Emergency smoke extraction outlets.

### **Tunnel fit-out**

Following tunnel excavation and civil finishing works, the tunnels would be fitted out with required operational infrastructure. This would include power, ventilation, fire safety systems, communications, traffic control, tunnel lighting and the operations management and control systems.

This would be followed by a comprehensive commissioning process undertaken to validate the correct operation and integration of tunnel systems prior to road opening.

### **5.3.6 Earthworks**

Earthworks would be required for the following above ground sections:

- The tunnel portals at the two interchanges.
- The Hills M2 Motorway integration works.
- The M1 Pacific Motorway tie-in works.

Earthworks would be completed using conventional methods of road construction. The general earthworks construction method would include:

- Vegetation clearance and topsoil stripping. Mulched vegetation and topsoil would be stockpiled for later re-use in site rehabilitation and landscaping works.
- Areas of new cut and fill to design levels, and widening of existing cuts and embankments. This may include the construction of retaining walls and reinforced soil walls.
- Installation of road drainage infrastructure.



### 5.3.7 Bridge works

The project would involve the construction of three new cycleway bridges and alteration of three existing road bridges along the Hills M2 Motorway. Alterations to existing bridge structures are summarised in **Table 5-6**.

Bridge works would generally include:

- Construction of the substructure, likely to be from cast in-situ concrete in the following sequence:
  - Piling works, such as bored piles.
  - Pile cap construction including localised excavation around the piles.
  - Pier or column construction.
- Headstock construction.
- Construction of the superstructure, likely to be through the placement of pre-cast concrete segments.

**Table 5-6 Alterations to existing bridge structures**

Location	Crossing type	Details
Yale Close	Hills M2 Motorway bridge over waterway	Widening of the overbridge by one additional lane (3.5 metres) to the south.
Barclay Road	Barclay Road bridge over Hills M2 Motorway	Extension of the overbridge by one additional lane (4 metres) to the south.
Darling Mills Creek	Hills M2 Motorway viaduct over Darling Mills Creek	Widening of the viaduct by one additional lane (3.5 metres) to the south.

### 5.3.8 Drainage

The project would require construction of new drainage infrastructure and alterations to existing drainage infrastructure. This would include:

- Construction of new pits and pipes for both surface and tunnel sections of the road.
- Construction of a sump near the southern interchange.
- Construction of an operational water treatment plant near the southern interchange.
- Adjustment of existing pits to suit new road alignments.
- Modification to four existing detention basins along the Hills M2 Motorway.
- Extension of five transverse drainage culverts under the Hills M2 Motorway by retrofitting of pre-cast concrete pipes or box segments.
- Alterations to the existing Pennant Hills Road drainage infrastructure.
- Construction of a new transverse drainage structure under the M1 Pacific Motorway / Pennant Hills Road connector.
- Construction of two spillage containment tanks around the northern interchange.

### 5.3.9 Pavement

Following tunnelling works, earthworks and bridge works, pavement works would be required. This would involve the construction of:

- Base and select layers of materials (in areas of earthworks only).
- Pavement layers.
- Pavement drainage, including kerb and gutter (where required).
- Concrete barriers, wire rope fencing and guardrails (where required).

### 5.3.10 Finishing works

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

- Line marking of new road pavement.
- Erection of directional signage and other roadside furniture such as street lighting.
- Erection of toll gantries at the southern interchange, including four new toll gantries for the project and the relocation of two existing Hills M2 Motorway toll gantries.
- Erection of truck regulatory gantries at the northern and southern ends of Pennant Hills Road.
- Landscaping works.
- Site demobilisation and rehabilitation of temporary ancillary facilities.

### 5.3.11 Construction of operational ancillary facilities

The project would involve the construction of a number of operational facilities including:

- The motorway control centre.
- Tunnel support facilities.
- Ventilation buildings and facilities near the southern and northern interchanges.
- Switching station located on Coral Tree Drive.



### **Motorway control centre**

The motorway control centre (refer to **Figure 5-17**) would be fitted out with communications, security and electrical equipment to monitor and control all aspects of the tunnel, along with office space and worker amenities. Construction works would include:

- Excavation, footing and base slab installation.
- Erection of in-situ concrete columns and deck to the first floor.
- Erection of a precast concrete column to support the roof.
- Enclosure of the building with precast panels and curtain walls.
- Internal fit out of control rooms, computer rooms, offices and workshop and associated staff amenities.
- On-site maintenance and special vehicle sheds would be mainly constructed of light steel framing and roofs.
- Security fencing.
- Construction of an open storage and hardstand area for miscellaneous items.

### **Tunnel support facilities**

Two tunnel support facilities would be constructed as part of the project, each comprising an emergency smoke extraction outlet and a substation.

The locations are shown in **Figure 5-13**.

The emergency smoke extraction outlet would be operated in the unlikely event of an emergency within the tunnels.

The construction methodology for the tunnel support facilities would involve:

- Bulk excavation and installation of retention piles to form a space for the fan chamber, intake and discharge plenum.
- Construction of footings and base slab for the structures.
- Installation of precast concrete panels and steel roof to expedite enclosure of the building (water tight).
- Internal fit out of plant areas, equipment installation and commissioning of the smoke plant rooms.
- Excavation of shafts to the main alignment tunnels.
- Construction of substations.