8.3 Resources and waste

Construction and operation of the project would generate waste streams which would require management and disposal in accordance with relevant state policies and guidelines. This chapter provides a description of each waste stream, expected quantities of waste materials where known, and applicable waste management strategies. Estimated requirements and potential sources of construction resources are also provided.

Table 8-23 sets out the Director-General's Requirements as they relate to resource management and waste minimisation and, where in the environmental impact statement these have been addressed.

Table 8-23 Director-General's Requirements – resource and waste

Director-General's Requirements	Where addressed
A Spoil Management Strategy detailing how spoil will be managed during construction, including likely volumes, likely nature and classification of excavated material, opportunities for recycling, potential disposal sites, stockpile management, and method of transportation.	Detailed description of spoil management during construction including likely volumes, nature classification, handling, reuse and disposal is provided in **Section 8.3.1**. Spoil routes are described in detail in **Section 7.1** (Traffic and transport).

8.3.1 Assessment of potential impacts

Construction resource consumption

Construction materials

Large quantities of materials would be required for the construction of the project. Wherever possible, construction materials would be sourced from within the Sydney region. However, due to the project's location within a suburban area, construction materials are unlikely to be available within the immediate area. As such, extraction and procurement of select materials such as concrete, steel, asphalt, polypropylene and copper is likely to be required from quarries, manufacturers and suppliers outside the project area.

Approximate required quantities and potential sources for each material are detailed in **Table 8-24.**

Table 8-24 Resource requirements

Material	Estimated quantity required
Plain shotcrete	41,000 cubic metres
Steel fibre reinforced shotcrete – concrete	221,000 cubic metres
Steel fibre reinforced shotcrete – steel	8,200 tonne
Polypropylene reinforced shotcrete – polypropylene	136 tonne
No-Fines – concrete	64,000 cubic metres
Base paving – concrete	66,4000 cubic metres
New jersey kerbs – concrete	26,000 cubic metres
Piles – concrete	59,000 cubic metres
Retaining walls – concrete	54,000 cubic metres
Bridges – concrete	1,300 cubic metres
Noise walls	1,400 cubic metres
Rock bolts	5,000 tonne
Reinforcing steel	5,280 tonne
Asphalt	25,000 tonne
Crushed aggregate	21,500 tonne
Conduit – PVC	810,000 metres
Copper cables	1,880 tonne
Concrete drainage pipes	18,000 metres

Construction resource requirements for the project are typical for a tunnelling project of this scale. Resource requirements may have an impact on resource availability within the local area over the construction period. The impact would be minor and limited to the construction period.

Water resources

Water would be required during construction activities, including for:

- Tunnelling activities such as cooling water and dust suppression.
- Surface works such as compaction of pavement materials and dust suppression.
- Concrete batching.
- Site offices and ablutions.

Higher quality water for some construction activities may be sourced from local drinking water supplies. Water from groundwater sources may also be used. The total volume of water required for construction of the project would be around 3,055 mega litres. Estimated volumes and potential supplies of water for each site, based on the construction program and the anticipated demand and supply sources at varying time throughout construction, are provided in **Table 8-25.**

Table 8-25 Water requirements

Source		Southern interchange compound (C5)	Wilson Road compound (C6)	Trelawney Street compound (C7)	Northern interchange compound (C9)	Road works	Total
Total potable water supply (mega litres)	Sydney Water mains	635	485	450	600	80	2,250
Total non-potable water supply (mega litres)	Collected rainwater	35	10	10	15	-	70
	Treated groundwater	190	160	150	235	-	735
Total		860	655	610	850	80	3,055

The volume of water required would be typical for tunnelling projects of this scale. It is anticipated that the local water supply network would have sufficient capacity to accommodate project water requirements.

Power

Power supply would be required during construction works, supplied to the majority of construction ancillary facilities. In particular, high voltage power would be required at the tunnel support sites. The power supply for each site would be sourced from outside the project corridor. **Table 8-26** summarises the power supply for temporary construction ancillary facilities including supply source, likely supply route and power demand. The construction power supply routes shown below are for information purposes only and do not form part of this assessment. Further assessment would be required in consultation with the relevant power supply authority.

Ancillary facilities which are not supporting tunnelling works, such as for the Hills M2 Motorway integration works, would not require access to high voltage power. These sites would be powered via diesel powered generators or a local connection to the mains infrastructure.

The location of power supply infrastructure is shown in **Figure 8-8** to **Figure 8-11**.

Table 8-26 Construction power supply

Construction site	Supply source substation	Distance to worksite (kilometres)	Supply route	Connected load (mega volt ampere)
Southern interchange compound (C5)	Pennant Hills Zone Substation	5	Victoria Road into Loftus Road then Pennant Hills Road to the southern interchange site	7
Wilson Road compound (C6)	Pennant Hills Zone Substation	0.5	Victoria Road into Loftus Road then to Killaloe Avenue and along Wilson Road to the site	5
Trelawney Street compound (C7)	Pennant Hills Zone Substation	4	Victoria Road across Loftus Road to Boundary Road then into Belamy Street. Up Stevens Street to Yarrara Road which becomes the Esplanade to Duffy Road. Along Duffy Road to Pennant Hills Road then to Loch Maree Avenue and into the site.	5
Northern interchange compound (C9)	Hornsby Zone Substation	4.5	Bridge Road to Sherbrook Road, Edgeworth David Avenue to the M1 Pacific Motorway corridor. Along the motorway corridor to the construction site	5

Note: These routes are indicative only and subject to change during detailed design and consultation with relevant power authorities.

Initial discussions with power supply authorities have confirmed that these substations have the required capacity to supply the site without impacting on the local supply network.

Figure 8-8 Location of power supply infrastructure for the southern interchange

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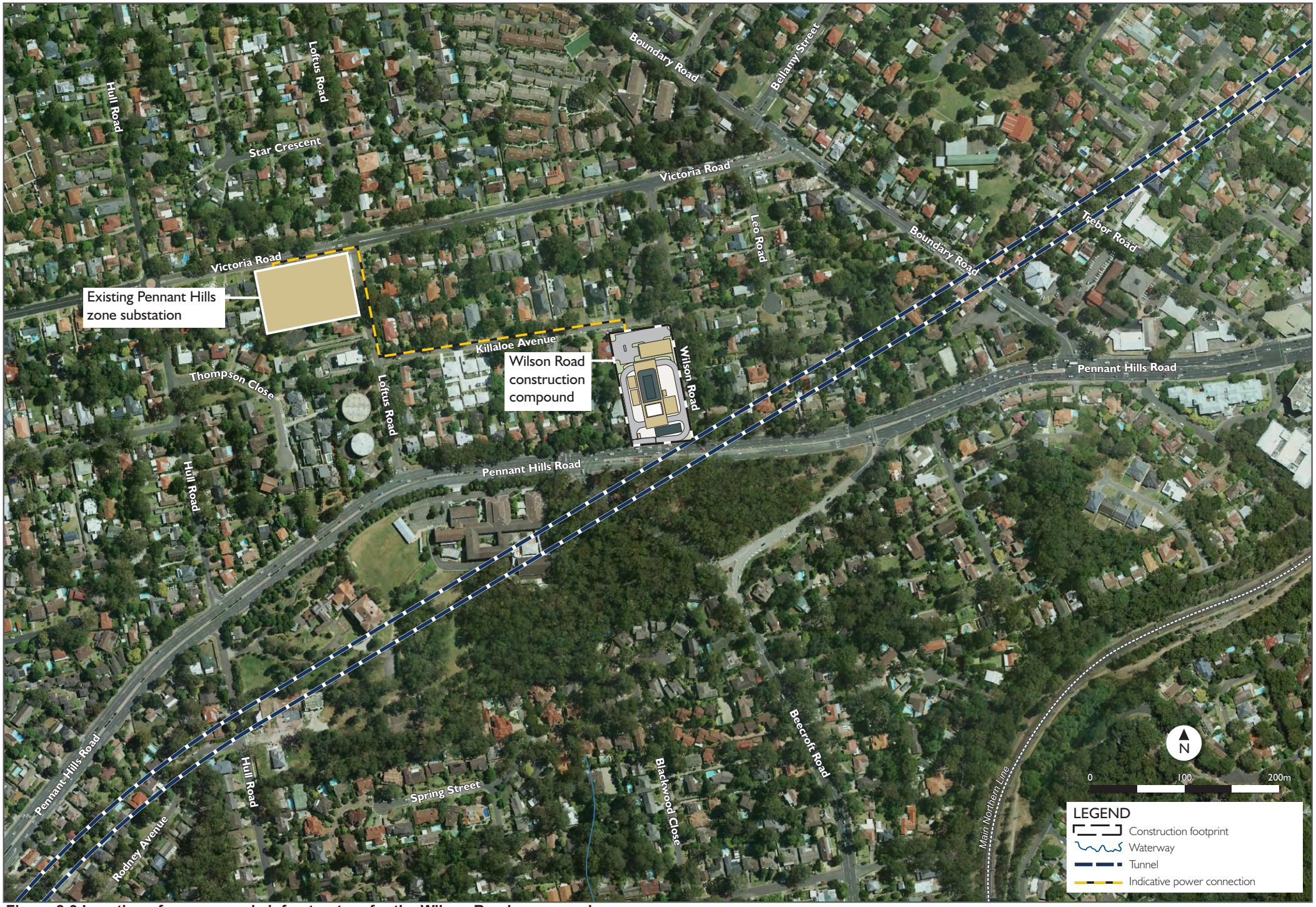

Figure 8-9 Location of power supply infrastructure for the Wilson Road compound

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Figure 8-10 Location of power supply infrastructure for the Trelawney Street compound

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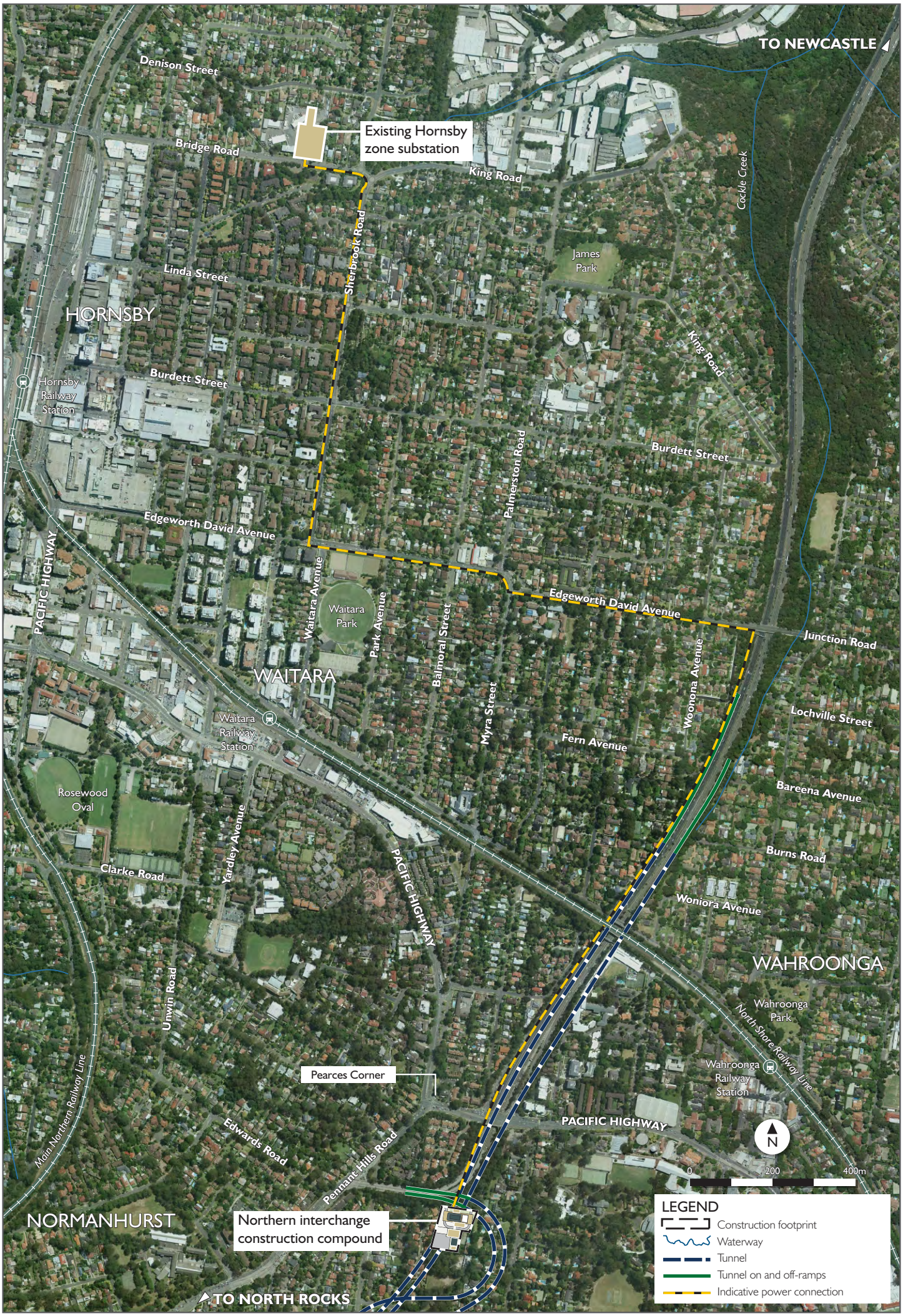

Figure 8-11 Location of power supply infrastructure for the northern interchange

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Construction waste management (non-spoil)

Solid wastes

Various waste streams would be generated during construction of the project, including construction and demolition waste, vegetation waste, packaging materials and liquid wastes. All wastes would be managed using the waste hierarchy approach of waste avoidance and waste re-use before consideration of waste disposal.

Should the generation of wastes be unavoidable or wastes unsuitable for re-use, disposal methods would be selected based on the classification of the waste material in accordance with the Waste Classification Guidelines (DECCW, 2009c). The Waste Classification Guidelines provide direction on the classification of waste, specifying requirements for management, transportation and disposal of each waste category. All wastes would be managed in accordance with the waste provisions contained within the *Protection of the Environment Operations Act 1997* and, where re-used off-site, would comply with relevant Environment Protection Authority resource recovery exemptions and requirements.

Wastes streams anticipated to be generated during construction of the project include:

- Excavated wastes, such as soil and rock, primarily from tunnelling and cutting including virgin excavated natural material.
- Wastewater from tunnel construction operations.
- Demolition wastes from existing structures that require removal (eg residential and commercial buildings):
  - Concrete, bricks, tiles, timber (untreated, treated), metals, plasterboard, carpets, electrical and plumbing fittings and furnishings (doors, windows).
- Hazardous waste (including asbestos).
- Vegetation waste from the removal of trees, shrubs and ground covers that are unable to be mulched and re-used within the project.
- General construction waste:
  - Timber formwork, scrap metal, steel, concrete, plasterboards and packaging material (crates, pallets, cartons, plastics and wrapping materials).
- Waste from operation and maintenance of construction vehicles and machinery (adhesives, lubricants, waste fuels and oils, engine coolant, batteries, hoses and tyres).
- General wastes from site offices (putrescibles, paper, cardboard, plastics, glass and printer cartridges).
- Wastewater from other sources including dust suppression and washdown and sewerage / greywater from construction compounds.

Potential adverse impacts arising from waste management associated with the project include:

- Excessive volumes of spoil directed to landfill due to inadequate recycling and re-use.
- Dust impacts due to incorrect storage, handling and disposal of spoil.

- Excessive volumes of waste directed to landfill due to excessive resource consumption and inadequate collection, classification and disposal of waste.
- Contamination of soil, surface and / or groundwater from the inappropriate storage, transport and disposal of liquid and solid waste.

Waste types and volumes generated during construction of the project would be typical of that produced on tunnel construction projects of this scale and would be appropriately managed through the implementation of standard management and mitigation measures (provided in **Table 8-31**). Existing metropolitan waste management facilities would have capacity to receive the waste streams generated by the project.

Demolition waste generated by the project has the potential to contain hazardous materials, in particular asbestos containing material. Management and disposal of asbestos containing material would be undertaken in accordance with:

- *Work Health and Safety Act 2011*.
- Code of Practice for the Safe Removal of Asbestos 2nd Edition (NOHSC, 2005a).
- Code of Practice for the Management and Control of Asbestos in Workplaces (NOHSC, 2005b).
- Protection of the Environment Operations (Waste) Regulation 2005 – clause 42 special requirements relating to asbestos waste.
- AS2601:2001 Demolition of Structures.

Removal of asbestos containing material would generally involve the following:

- Development of a site specific asbestos removal control plan.
- Establishing asbestos removal boundaries with appropriate security signage and barriers.
- Preparation of the work area.
- Use of the wet removal method where feasible and reasonable.
- Removal of asbestos containing material in sections and placement in suitably labelled and properly sealed asbestos waste containers.
- Decontamination of the workplace, tools and personal protective equipment.
- Disposal of asbestos waste at an appropriately licensed facility.

Waste management activities associated with the construction of the project are not considered to pose a significant risk to the environment with the implementation of standard measures (provided in **Table 8-31**) which would adequately address waste generation, storage, disposal and re-use.

Resource consumption and waste generated by the project would contribute to the emission of greenhouse gases during construction. The consideration of this impact and emission reduction opportunities are discussed further in **Section 8.4** (Greenhouse gas and climate change).

Wastewater

During construction, tunnelling works would result in significant volumes of wastewater requiring treatment and disposal. Water treatment methods and discharge water quality are described in **Section 7.9** (Surface water).

Water volumes generated during the construction phase of the project would vary based on construction activities that are taking place in the tunnel, the amount of groundwater infiltrating into the tunnel and the length of tunnel that has been excavated. The rate of groundwater infiltration is predicted to be around 1.7 litres per second per kilometre. Anticipated water discharge volumes at the relevant temporary construction ancillary facilities are summarised in **Table 8-27**. These volumes represent the total wastewater generation over the duration of the construction period (around four years).

Table 8-27 Indicative wastewater volume

Site	Wastewater volume (mega litres)
Southern interchange compound (C5)	575
Wilson Road compound (C6)	485
Trelawney Street compound (C7)	455
Northern interchange compound (C9)	705

Feasible and reasonable opportunities for wastewater re-use on-site or for construction purposes (such as dust suppression both in the tunnels and for surface works) or off-site (such as irrigation of Pennant Hills Golf Club or local parks) would be pursued. However, the generation of wastewater from tunnel construction would be significantly greater than the potential for re-use and, therefore, off-site discharge would be required.

Wastewater not used on-site would be discharged into the local stormwater system in accordance with the requirements of the local council and the Environment Protection Authority.

Construction waste management (spoil)

General spoil management

This section outlines the general approach to clean spoil management. The management of contaminated soil and details of a Spoil Management Strategy are provided in the following sections.

It is estimated that the project would generate about 2.6 million cubic metres of surplus spoil. The majority of spoil would be generated from excavation of the tunnels. As such, the primary facilities for receipt and dispatch of spoil would be the four tunnel support sites. Relatively smaller quantities of spoil would be generated by site preparation activities, excavation of dive structures, excavation of ventilation shafts, and cut and fill activities for the above ground components of the project. The indicative volume of spoil to be extracted and managed through each of the construction ancillary facilities is summarised in **Table 8-28.**

Table 8-28 Indicative spoil generation

Site	Spoil volume (cubic metres)
Hills M2 Motorway integration works	39,800
Southern interchange compound (C5)	613,900
Wilson Road compound (C6)	441,950
Trelawney Street compound (C7)	492,200
Northern interchange compound (C9)	743,150
Northern portals	281,200
TOTAL	2,612,200

Based on the depth of the tunnel and the local geology, the majority of excavated spoil material would be uncontaminated crushed sandstone and shale, classified as virgin excavated natural material. This would generally consist of mixed size crushed rock, ranging from shale and sand to lumps of rock.

The design of the project has taken into consideration the waste hierarchy by aiming to reduce the volume of excess spoil generated, as far as practical. Where possible and fit for purpose, spoil would be beneficially re-used as part of the project before alternative spoil disposal options such as other infrastructure projects or use as fill for disused quarries are pursued. These objectives would be further considered during the detailed design phase.

It is acknowledged, however, that the project has limited on-site requirements for fill and construction space for the long-term storage of spoil is constrained. As a result of the limited opportunities for on-site re-use of spoil, the majority of spoil generated would require disposal elsewhere. The following sites have been identified as having the capacity for spoil disposal:

- ADI site, St Marys – capacity of between two and 2.5 million cubic metres.
- Gosford Quarry – capacity of around 2.5 million cubic metres.
- Hornsby Quarry site – capacity of around 3.3 million cubic metres.
- CSR Quarry – capacity of around 1.16 million cubic metres.
- Defence precinct Schofields – capacity of around 500,000 cubic metres.
- Great Southern Rock (GSR) Quarry (Sandy Point Quarry) – currently an active quarry, the subject of a development application to extend and intensify quarrying activities. Anticipated capacity of around five million cubic metres.

These sites have a need for spoil or fill material and represent viable disposal / reuse locations. Other disposal/re-use sites may be used depending on need at the time spoil is generated.

Prior to leaving the construction site, excavated spoil would be classified in accordance with the Waste Classification Guidelines: Part 1 Classifying Waste (DECCW, 2009c) to ensure it is appropriately reused within an approved development or disposed of at an appropriately licensed facility. In the case of spoil generated from the excavation of tunnels, spoil testing would cease following initial testing to verify that the excavated material is VENM. Spoil generated during surface excavations would be subject to ongoing sampling and classification in accordance with the Waste Classification Guidelines: Part 1 Classifying Waste (DECCW, 2009c).

Spoil from tunnelling works would be transported from the tunnel face to the surface using dump trucks. At the surface, spoil would be stockpiled and handled within acoustic sheds with space for around one day's spoil production capacity. Spoil would then be loaded into haulage trucks within the acoustic shed and transported from the construction compounds by spoil trucks, along pre-determined haulage routes. The identification of these haulage routes, potential impacts arising from their use and appropriate management measures are described in **Section 7.1** (Traffic and transport).

Contaminated soil

A contamination due diligence assessment has been undertaken as part of this environmental impact statement (further details are provided in **Section 7.8** Hydrogeology and soils). This assessment identified the potential presence of contaminated material at the Pioneer Avenue compound (C8) associated with the former use of the site and the presence of fill of unknown origin.

There is also the potential to discover further contaminated soil during construction of the project either during surface works or from tunnelling activities.

In the event of discovery of previously unidentified area(s) of contaminated material, all relevant work would cease in the vicinity of the discovery. Relevant works would not recommence until the need for and scope of remedial action(s), if required, are identified in accordance with the requirements of the *Contaminated Land Management Act 1997*.

Spoil, including contaminated spoil, would be classified in accordance with the Waste Classification Guidelines: Part 1 Classifying Waste (DECCW, 2009c). Depending on the extent of contamination, spoil would be considered for reuse either on the project site or at other approved development in line with resource recovery exemptions. Where reuse is not possible, spoil would be disposed of at an appropriately licensed facility.

Spoil management strategy

A formal Spoil Management Strategy would be developed and documented for the project prior to the commencement of soil disturbing works. The Strategy would take into account the progression of the detailed design of the project and specific conditions of approval that may be applied to the project. The broad parameters within which the Strategy would be developed are summarised in **Table 8-29.**

Table 8-29 Spoil Management Strategy broad parameters

Parameter	Strategy response
Spoil generation	2.6 million cubic metres (surplus spoil)
Spoil generation locations	Spoil would be generated at the following temporary construction sites: • Hills M2 Motorway integration works (39,800 cubic metres). • Southern interchange compound (C5) (613,900 cubic metres). • Wilson Road compound (C6) (441,930 cubic metres). • Trelawney Street compound (C7) (492,200 cubic metres). • Northern interchange compound (C9) (743,170 cubic metres). • Northern portals (281,000 cubic metres).
Spoil management hierarchy	Where feasible and reasonable, spoil would be managed according to the following hierarchy: • Avoidance of spoil generation through design and management. • Reuse of spoil within the project. • Beneficial reuse of spoil outside the project for site levelling, development or rehabilitation. • Disposal of spoil outside the project for a non-beneficial uses (landfilling).
On-site management	Spoil would be transported from the tunnel face to the surface by truck, where it would be stored in an acoustic shed at each temporary construction site with capacity to store up to one day's spoil generation from the site. Spoil would be loaded onto trucks within the acoustic shed prior to transport off-site.
Spoil testing	Spoil would be sampled, analysed and characterised according to the Waste Classification Guidelines: Part 1 Classifying Waste (DECCW, 2009c). In the case of spoil generated from the excavation of tunnels, spoil testing would be limited to initial testing to confirm that the excavated material is virgin excavated natural material.
Spoil quality	The majority of spoil that would be generated by the project is expected to meet the classification of virgin extracted natural material. There is some potential, particularly for spoil generated at the surface around current and historical development, that spoil may be classified as solid waste. More heavily contaminated materials are not expected to be encountered.
Spoil disposal locations	Excess spoil would be disposed of at a location that has appropriate approval or licences to accept the material. Alternative sites from those listed in this chapter may also be considered for spoil reuse / disposal subject to necessary environmental planning approvals being in place for those sites and the specific needs of the project. Solid waste and more highly contaminated materials would only be reused on-sites permitted to accept the materials, or otherwise directed to an appropriately licensed waste management facility.
Spoil transport	Spoil would be transported by truck. Spoil transport to the disposal site would be via Pennant Hills Road, the Hills M2 Motorway and the M1 Pacific Motorway. Transport beyond the Hills M2 Motorway and the M1 Pacific Motorway would be subject to the assessment and approval of those other sites to receive spoil materials.

Operation resource consumption

Water resources

The deluge system, which would form part of the fire and life safety system, would require a supply of water. The primary source of water for the system would be two fire water tanks located at the northern end of the project. Each tank would have capacity of 1,220 cubic metres and would have an infill line from the Sydney Water town mains network. The tanks would be designed to act as a buffer to ensure peak flow demands do not adversely impact the town mains network.

During operation water would also be required for landscaping irrigation at the interchanges and tunnel support facilities.

Power

An operational electricity supply would be required to supply power to the main alignment tunnels and associated mechanical and electrical equipment. It is essential that electrical power to the tunnels be provided as an uninterrupted supply for ventilation and other safety reasons. As such, two sources of supply would be required; each rated to supply the full load of the tunnel electrical systems. The power supply would be provided through two 66 kilovolt feeders supplied via a new switching station that would be located on the south-west side of the Pennant Hills Road / Hills M2 Motorway interchange (the Coral Tree Drive switching station which is further discussed in **Chapter 5**). The feeders would connect to a project supply substation on the other side of the motorway where the power supply would be stepped down to 22 kilovolt. From the project supply substation, power would be reticulated to another six substations along the project. Of the total seven project substations, three would be located underground and four would be located aboveground (incorporated into other operational ancillary facilities).

Initial discussions with power supply authorities indicate that these substations have sufficient capacity to supply the project without negative impacts on the local power supply.

The project has been designed to minimise energy consumption and maximise energy efficiency. Measures to increase energy efficiency are detailed in **Section 8.4** (Greenhouse gas and climate change). The anticipated energy consumption per kilometre of tunnel per annum, compared to other tunnels in Sydney is provided in **Table 8-30**.

Table 8-30 Tunnel energy consumption

Tunnel	Megawatt hour per kilometre per annum
NorthConnex	1,167
Eastern Distributor	1,375
M5 East Tunnel	6,750
Lane Cove Tunnel	2,139

Note: Eastern Distributor operates with managed portal emissions

Peak oil

Roads and Maritime are taking the view that it is prudent to consider that oil production may peak and then decline. This could increase the cost and reduce the availability of transport fuels and construction materials derived from oil. For transport, the solutions to the problem of “peak oil” are similar to those for climate change. Alternatives to fossil fuels need to be found and transport must become more energy efficient. There are moves to establish alternatives to oil as a fuel for transport and to improve energy efficiency. This would enable the economic benefits provided by road transport to continue to be delivered with a reduced need for fossil fuels. Similar action is being taken, through recycling and investigation of alternative materials, to reduce the need for construction products derived from fossil fuels.

Roads and Maritime is also participating with Austroads and industry in research and trials with the goal of developing more sustainable road construction materials and practices and reducing reliance on products derived from oil. As road transport is a significant and necessary element of the NSW economy, that also provides many social benefits, Roads and Maritime will continue to ensure that all potential impacts on this system, such as peak oil, are identified and action is taken to manage these risks.

With reference to the project, traffic modelling across the Sydney network indicated that the proposed project would result in increased travel speeds and shorter distance of the tunnel compared to the surface roads. This would result in an overall reduction in the quantity of fuel consumed by private and freight vehicles and a subsequent reduction in the quantity of emissions produced. As noted in **Section 8.4** (Greenhouse gas and climate change), it is estimated that by 2027, savings in operational road use emissions would be greater than the estimated emissions generated during construction of the project. Furthermore, it is estimated that operational emission savings from road use of around 68,600 Mt CO_2-e would be achieved by 2029 when compared against the ‘do nothing’ scenario.

Operation waste management

Solid waste

Additional wastes would be generated during routine maintenance and repair activities required over time which may include mercury containing light globes used for the operation of the tunnel and ancillary facilities. Waste would also be generated from the operation of the motorway control centre. The type and volume of wastes generated would be dependent on the nature of the activity, but would predominantly consist of minor volumes of general office waste (paper, plastics, food waste), green waste, oil, road materials, as well as contaminated waste resulting from potential fuel spills and leaks. The volume and types of wastes would be typical of these types of facilities and could be accommodated by existing metropolitan waste management facilities.

With the implementation of standard work practices during routine maintenance and repair activities the overall impact of operational waste streams would be minimal.

Wastewater

As the main alignment tunnels would be drained, there would be an ongoing inflow of groundwater into the tunnels albeit relatively little. This would require the project to accommodate operational capture, removal, treatment and discharge of groundwater. The anticipated inflow of groundwater into the main alignment tunnels and on and off-ramp tunnels during the operational phase is anticipated to be around:

- 0.39 to 1.66 litres per second per kilometre for the first tunnel.
- 0.195 to 0.83 litres per second per kilometre for the second tunnel as the first tunnel would partially dewater the rock stratum.

This equates to a total of around 170 to 700 mega litres per year in total for two nine kilometres tunnels. However, there may be peak localised inflows in the order of three to five litres per second. The wastewater generation volumes are typical of existing tunnel projects of this scale within the Sydney region.

Captured groundwater would be treated at the water treatment plant located near the southern interchange. The operational water treatment plant would have a capacity to treat and dispose of up to 40 litres per second. Opportunities for reuse including irrigation of landscapes within the project, irrigation of Pennant Hills Golf Club and / or local parks would be considered in preference to discharge to the local stormwater system. The project has been designed to achieve a maximum water discharge quality equivalent to the 95 per cent protection level specified for freshwater eco-systems in accordance with ANZECC guidelines (ANZECC & ARMCANZ, 2000). The discharge water quality level would be determined in consultation with the NSW Environment Protection Authority during the detailed design phase.

Further information on groundwater inflow, drainage and treatment is provided in **Section 7.8** (Hydrogeology and soils) and **Section 7.9** (Surface water)**.**

8.3.2 Environmental management measures

Resource use and waste management impacts are commonly encountered on all road projects and can be managed and mitigated through the development of construction management plans and implementation of standard approaches.

The project would generate a significant volume of spoil from the tunnelling works. Various options are available with the capacity to receive this material. A Spoil Management Strategy would be developed to ensure this material is appropriately handled on the sites and disposed of including consideration of re-used and recycling options.

Measures to avoid, minimise or manage resource consumption and waste streams generated as a result of the project are detailed in **Table 8-31.**

Table 8-31 Environmental management measures – resources and waste

Impact	No.	Environmental management measure	Timing
Construction			
Resource consumption	RW1	Wherever feasible and reasonable, construction material would be sourced from within the Sydney region.	Pre-construction and construction

Impact	No.	Environmental management measure	Timing
	RW2	Unnecessary resource consumption would be avoided by making realistic predictions on the required quantities of resources, such as construction materials.	Construction
	RW3	Resource recovery, which includes re-use, recycling and reprocessing, would be applied to the management of construction waste and would include: • Recovery of resources for reuse. Waste materials generated by the project would be re-used either on-site or off-site where possible, including the re-use of top soil in landscape works, and the use of mulch for erosion and sediment controls. • Recovery of resources for recycling. Resources would be segregated for recycling such as paper, plastic, glass, aluminium cans and other recyclable materials generated during construction. These materials would then be sent to an appropriate recycling facility for processing. • Recovery of resources for reprocessing. Cleared vegetation would be mulched or chipped on-site and used for landscaping, in the absence of a higher beneficial use being identified.	Construction
Management of waste	RW4	Wastes would be managed and disposed of in accordance with relevant State legislation and government policies including the *Protection of the Environment Operations Act 1997, Waste Avoidance and Resource Recovery Act 2001,* Waste Avoidance and Resource Recovery Strategy 2007 (DECC, 2007c) and the Waste Reduction and Purchasing Policy (RTA, 2009).	Pre-construction and construction
	RW5	A Waste Management Plan would be prepared as part of the Construction Environmental Management Plan detailing appropriate procedures for waste management.	Pre-construction and construction
	RW6	Wastes would be managed using the waste hierarchy principles of: • Avoidance of unnecessary resource consumption to reduce the quantity of waste being generated • Recover of resources for re-use on-site or off-site for the same or similar use, without reprocessing. • Recover of resources through recycling and reprocessing so that waste can be processed into a similar non-waste product and re-used. • Disposal of residual waste.	Construction

Impact	No.	Environmental management measure	Timing
	RW7	• Residual waste would be disposed of to a suitably licensed landfill or waste management facility where there are no other feasible and reasonable options for waste avoidance, re-use or recycling. Waste materials requiring removal from the site would be classified, handled and stored on-site in accordance with the Waste Classification Guidelines: Part 1 Classifying Waste (DECCW, 2009c) until collection by a contractor for disposal.	Prior to / during construction
	RW8	Off-site re-use of waste would comply with relevant EPA resource recovery exemptions and requirements.	Construction
	RW9	An asbestos survey would be undertaken of buildings to be demolished as part of the project. The survey would be conducted by a suitably qualified person.	Construction
	RW10	Asbestos handling and management would be undertaken in accordance with: • Work Health and Safety Act 2011. • Code of Practice for the Safe Removal of Asbestos 2nd Edition (NOHSC, 2005a). • Code of Practice for the Management and Control of Asbestos in Workplaces (NOHSC, 2005b). • Protection of the Environment Operations (Waste) Regulation 2005 – section 42 special requirements relating to asbestos waste. • AS2601:1991 Demolition of Structures.	Construction
Excess spoil	RW11	A spoil management strategy would be developed prior to the commencement of construction and implemented during construction. The strategy would identify spoil disposal site and describe the management of spoil on -site and during off-site transport.	Pre-construction
	RW12	Where possible and fit for purpose, spoil would be beneficially re-used within the project before off-site re-use or disposal options are pursued.	Construction
	RW13	Before being transported from construction sites, excavated spoil would be classified in accordance with the Waste Classification Guidelines: Part 1 Classifying Waste (DECCW, 2009c) to ensure appropriate reuse or disposal.	Construction
Wastewater	RW14	Feasible and reasonable opportunities for wastewater re-use on-site or for construction purposes would be pursued (such as dust suppression both in the tunnels and for surface works).	Construction

Impact	No.	Environmental management measure	Timing
	RW15	Wastewater not used on-site would be discharged into the local stormwater system in accordance with the requirements of an environment protection licence issued for the project.	Construction
Contaminated soil	RW16	In the event of discovery of previously unidentified area(s) of potentially contaminated material, all relevant work would cease in the vicinity of the discovery. Relevant works would not recommence until the need for and scope of remedial action(s), if required, are identified in accordance with the requirements of the *Contaminated Land Management Act 1997*.	Construction
Operation			
Management of waste	OpRW1	Wastes would be managed and disposed of in accordance with relevant State legislation and government policies including the *Protection of the Environment Operations Act 1997, Waste Avoidance and Resource Recovery Act 2001,* Waste Avoidance and Resource Recovery Strategy 2007 (DECC, 2007c) and the Waste Reduction and Purchasing Policy (RTA, 2009).	Operation
	OpRW2	Any mercury containing light globes used for the operation of the tunnel and operational ancillary facilities would be recycled at an accredited recycling facility.	Operation
Operational water requirements	OpRW3	Opportunities for re-use of wastewater would be considered including irrigation of landscapes within the project, irrigation of Pennant Hills Golf Club and / or local parks in preference to discharge to the local stormwater system.	Operation
	OpRW4	In order to reduce demand on local water supplies, investigate options for providing water required for operation of the deluge system from wastewater produced through the tunnel drainage system where it meets appropriate quality parameters.	Operation