NSW GOVERNMENT

Transport for NSW

Beaches Link and Gore Hill Freeway Connection

Appendix D

Utilities management strategy

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Technical working paper: Utilities management strategy

December 2020

Prepared for

Transport for NSW

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Table of Contents

List of tables

List of figures

Abbreviations and glossary

Abbreviation / Glossary Term	Definition
AC	Asbestos Cement
CICL	Cast Iron Cement Lined
DBYD	Dial Before You Dig
DN	Diameter
EW	Earthenware
m	Meter
mm	Millimetre
PVC	Polyvinylchloride
RC	Reinforced Concrete
RCP	Reinforced Concrete Pipe
Reference Design	Design sufficient to support the environmental impact statement
Risk	The potential effect of uncertainty on objectives
SCL	Steel Cement (mortar) Lined
SGW	Salt Glazed Ware
STS	Sub-Transmission Substation
VC	Vetrified Clay

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1 Introduction

This section provides an overview of the Beaches Link and Gore Hill Freeway Connection (the project), including its key features and location. It also outlines the Secretary's environmental assessment requirements addressed in this technical working paper.

1.1 Overview

The Greater Sydney Commission's Greater Sydney Region Plan – A Metropolis of Three Cities (Greater Sydney Commission, 2018) proposes a vision of three cities where most residents have convenient and easy access to jobs, education and health facilities and services. In addition to this plan, and to accommodate for Sydney's future growth the NSW Government is implementing the Future Transport Strategy 2056 (Transport for NSW, 2018), that sets the 40 year vision, directions and outcomes framework for customer mobility in NSW. The Western Harbour Tunnel and Beaches Link program of works is proposed to provide additional road network capacity across Sydney Harbour and Middle Harbour and to improve transport connectivity with Sydney's Northern Beaches. The Western Harbour Tunnel and Beaches Link program of works include:

- The Western Harbour Tunnel and Warringah Freeway Upgrade project which comprises a new tolled motorway tunnel connection across Sydney Harbour, and an upgrade of the Warringah Freeway to integrate the new motorway infrastructure with the existing road network and to connect to the Beaches Link and Gore Hill Freeway Connection project
- The Beaches Link and Gore Hill Freeway Connection project which comprises a new tolled motorway tunnel connection across Middle Harbour from the Warringah Freeway and the Gore Hill Freeway to Balgowlah and Killarney Heights and including the surface upgrade of the Wakehurst Parkway from Seaforth to Frenchs Forest and upgrade and integration works to connect to the Gore Hill Freeway at Artarmon.

A combined delivery of the Western Harbour Tunnel and Beaches Link program of works would unlock a range of benefits for freight, public transport and private vehicle users. It would support faster travel times for journeys between the Northern Beaches and areas south, west and north-west of Sydney Harbour. Delivering the program of works would also improve the resilience of the motorway network, given that each project provides an alternative to heavily congested existing harbour crossings.

1.2 The project

Transport for NSW is seeking approval under Part 5, Division 5.2 of the Environmental Planning and Assessment Act 1979 to construct and operate the Beaches Link and Gore Hill Freeway Connection project, which would comprise two components:

- Twin tolled motorway tunnels connecting the Warringah Freeway at Cammeray and the Gore Hill Freeway at Artarmon to the Burnt Bridge Creek Deviation at Balgowlah and the Wakehurst Parkway at Killarney Heights, and an upgrade of the Wakehurst Parkway (the Beaches Link)
- Connection and integration works along the existing Gore Hill Freeway and surrounding roads at Artarmon (the Gore Hill Freeway Connection).

A detailed description of these two components is provided in Section 1.4.

1.3 Project location

The project would be located within the North Sydney, Willoughby, Mosman and Northern Beaches local government areas, connecting Cammeray in the south with Killarney Heights, Frenchs Forest and Balgowlah in the north. The project would also connect to both the Gore Hill Freeway and Reserve Road in Artarmon in the west.

Commencing at the Warringah Freeway at Cammeray, the mainline tunnels would pass under Naremburn and Northbridge, then cross Middle Harbour between Northbridge and Seaforth. The mainline tunnels would then split under Seaforth into two ramp tunnels and continue north to the Wakehurst Parkway at Killarney Heights and north-east to Balgowlah, linking directly to the Burnt Bridge Creek Deviation to the south of the existing Kitchener Street bridge.

The mainline tunnels would also have on and off ramps from under Northbridge connecting to the Gore Hill Freeway and Reserve Road east of the existing Lane Cove Tunnel. Surface works would also be carried out at the Gore Hill Freeway in Artarmon, Burnt Bridge Creek Deviation at Balgowlah and along the Wakehurst Parkway between Seaforth and Frenchs Forest to connect the project to the existing arterial and local road networks.

1.4 Key features of the project

Key features of the Beaches Link component of the project are shown in Figure 1-1 and would include:

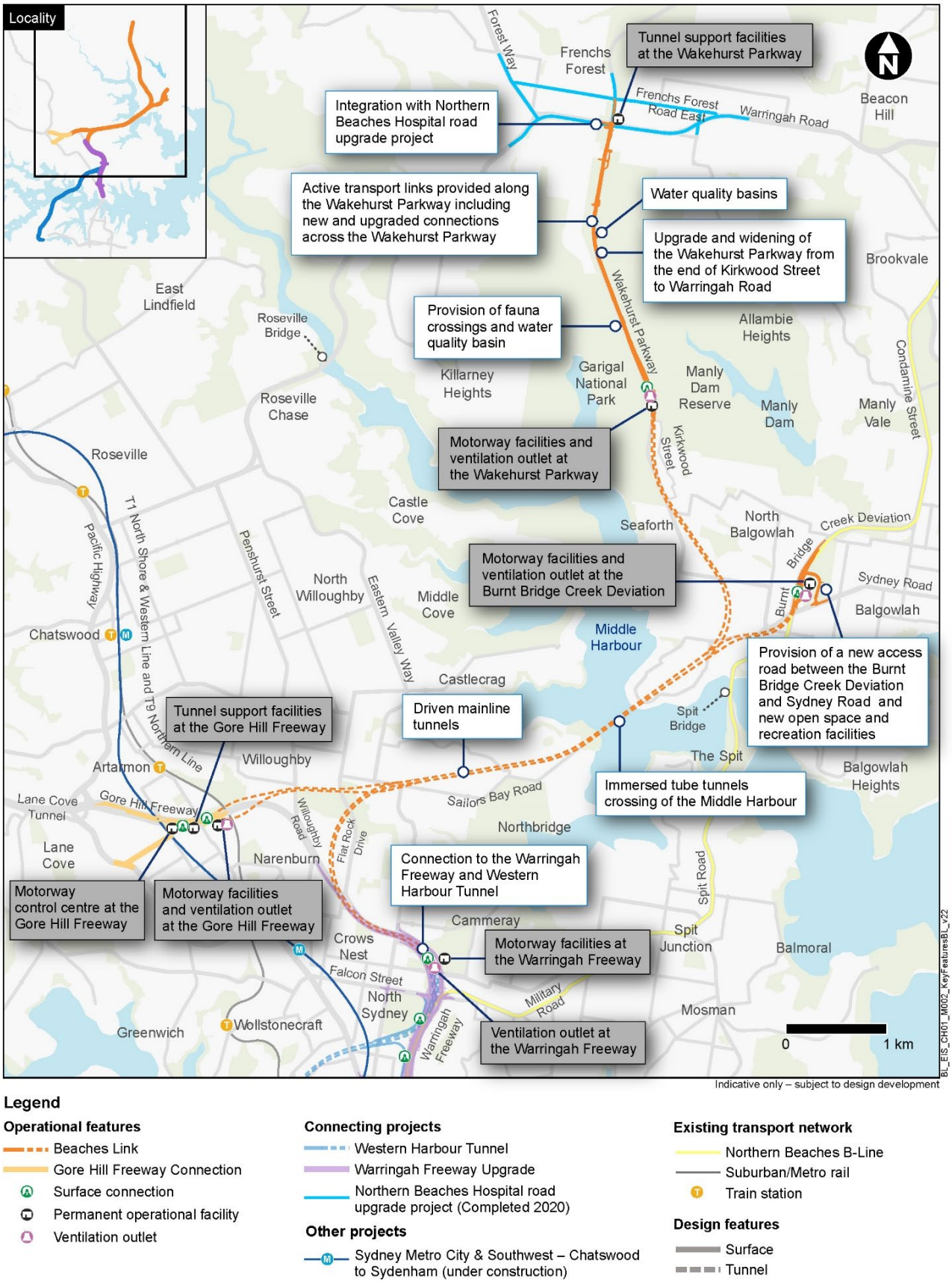
- Twin mainline tunnels about 5.6 kilometres long and each accommodating three lanes of traffic in each direction, together with entry and exit ramp tunnels to connections at the surface. The crossing of Middle Harbour between Northbridge and Seaforth would involve three lane, twin immersed tube tunnels
- Connection to the stub tunnels constructed at Cammeray as part of the Western Harbour Tunnel and Warringah Freeway Upgrade project
- Twin two lane ramp tunnels:
  - Eastbound and westbound connections between the mainline tunnel under Seaforth and the surface at the Burnt Bridge Creek Deviation, Balgowlah (about 1.2 kilometres in length)
  - Northbound and southbound connections between the mainline tunnel under Seaforth and the surface at the Wakehurst Parkway, Killarney Heights (about 2.8 kilometres in length)
  - Eastbound and westbound connections between the mainline tunnel under Northbridge and the surface at the Gore Hill Freeway and Reserve Road, Artarmon (about 2.1 kilometres in length).
- An access road connection at Balgowlah between the Burnt Bridge Creek Deviation and Sydney Road including the modification of the intersection at Maretimo Street and Sydney Road, Balgowlah
- Upgrade and integration works along the Wakehurst Parkway, at Seaforth, Killarney Heights and Frenchs Forest, through to Frenchs Forest Road East
- New open space and recreation facilities at Balgowlah
- New and upgraded pedestrian and cyclist infrastructure
- Ventilation outlets and motorway facilities at the Warringah Freeway in Cammeray, the Gore Hill Freeway in Artarmon, the Burnt Bridge Creek Deviation in Balgowlah and the Wakehurst Parkway in Killarney Heights
- Operational facilities, including a motorway control centre at the Gore Hill Freeway in Artarmon, and tunnel support facilities at the Gore Hill Freeway in Artarmon and the Wakehurst Parkway in Frenchs Forest
- Other operational infrastructure including groundwater and tunnel drainage management and treatment systems, surface drainage, signage, tolling infrastructure, fire and life safety systems, roadside furniture, lighting, emergency evacuation and emergency smoke extraction infrastructure, Closed Circuit Television (CCTV) and other traffic management systems.

Key features of the Gore Hill Freeway Connection component of the project are shown in Figure 1-2 and would include:

- Upgrade and reconfiguration of the Gore Hill Freeway between the T1 North Shore & Western Line and T9 Northern Line and the Pacific Highway
- Modifications to the Reserve Road and Hampden Road bridges
- Widening of Reserve Road between the Gore Hill Freeway and Dickson Avenue
- Modification of the Dickson Avenue and Reserve Road intersection to allow for the Beaches Link off ramp
- Upgrades to existing roads around the Gore Hill Freeway to integrate the project with the surrounding road network
- Upgrade of the Dickson Avenue and Pacific Highway intersection
- New and upgraded pedestrian and cyclist infrastructure
- Other operational infrastructure, including surface drainage and utility infrastructure, signage and lighting, CCTV and other traffic management systems.

A detailed description of the project is provided in Chapter 5 (Project description) of the environmental impact statement.

Subject to obtaining planning approval, construction of the project is anticipated to commence in 2023 and is expected to take around five to six years to complete.



Legend

Operational features
- Beaches Link
- Gore Hill Freeway Connection
- Surface connection
- Permanent operational facility
- Ventilation outlet

Connecting projects
- Western Harbour Tunnel
- Warringah Freeway Upgrade
- Northern Beaches Hospital road upgrade project (Completed 2020)

Other projects
- Sydney Metro City & Southwest – Chatswood to Sydenham (under construction)

Existing transport network
- Northern Beaches B-Line
- Suburban/Metro rail
- Train station

Design features
- Surface
- Tunnel

Figure 1-1 Key features of the Beaches Link component of the project

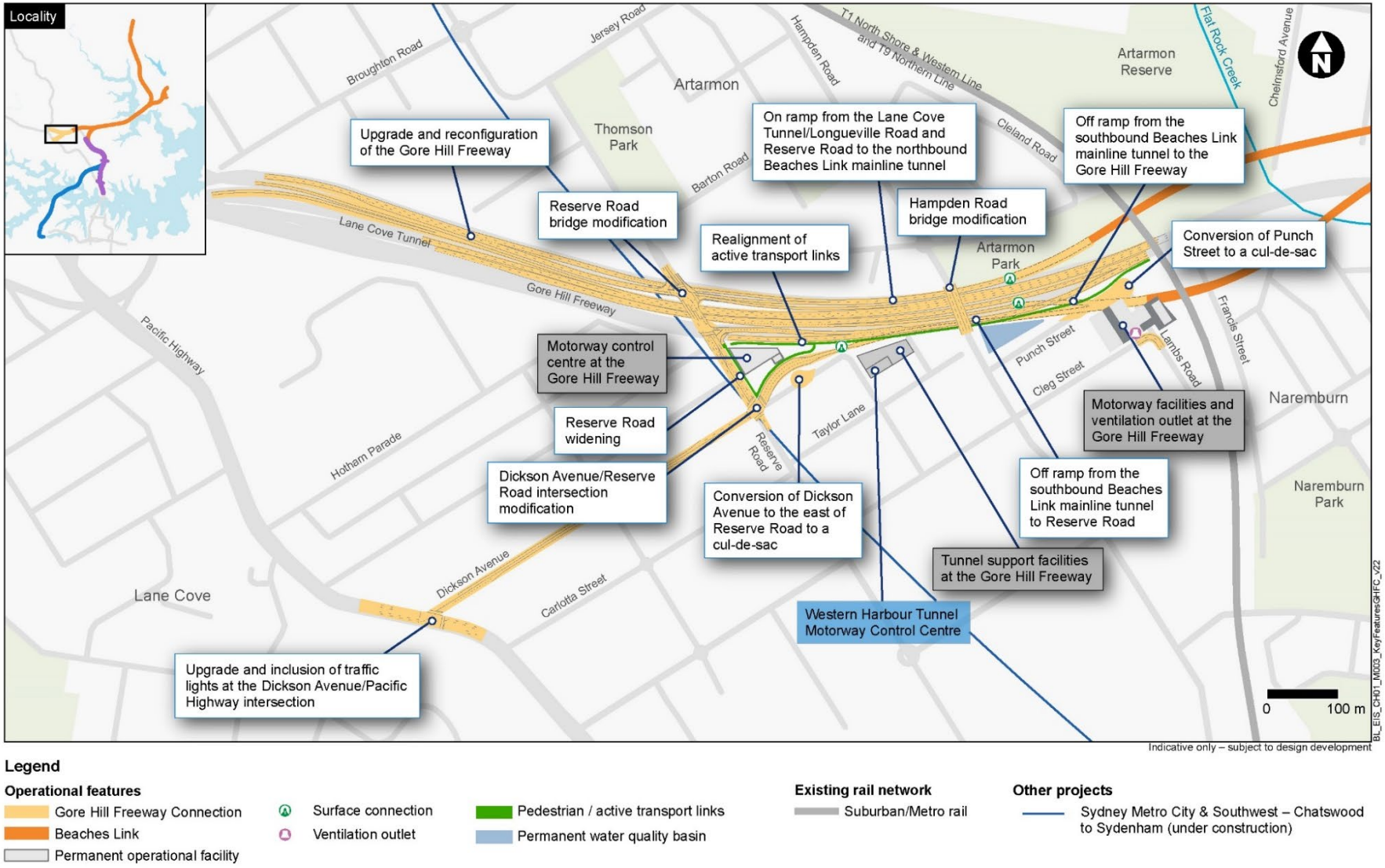


Figure 1-2 Key features of the Gore Hill Freeway component of the project

1.5 Key construction activities

The area required to construct the project is referred to as the construction footprint. The majority of the construction footprint would be located underground within the mainline and ramp tunnels. However, surface areas would also be required to support tunnelling activities and to construct the tunnel connections, tunnel portals, surface road upgrades and operational facilities.

Key construction activities would include:

- Early works and site establishment, with typical activities being property acquisition and condition surveys, utilities installation, protection, adjustments and relocations, installation of site fencing, environmental controls (including noise attenuation and erosion and sediment control), traffic management controls, vegetation clearing, earthworks, demolition of structures, building construction support sites including acoustic sheds and associated access decline acoustic enclosures (where required), construction of minor access roads and the provision of property access, temporary relocation of pedestrian and cycle paths and bus stops, temporary relocation of swing moorings and/or provision of alternative facilities (mooring or marina berth) within Middle Harbour
- Construction of the Beaches Link, with typical activities being excavation of tunnel construction access declines, construction of driven tunnels, cut and cover and trough structures, construction of surface upgrade works, construction of cofferdams, dredging and immersed tube tunnel piled support activities in preparation for the installation of immersed tube tunnels, casting and installation of immersed tube tunnels and civil finishing and tunnel fitout
- Construction of operational facilities comprising:
  - A motorway control centre at the Gore Hill Freeway in Artarmon
  - Tunnel support facilities at the Gore Hill Freeway in Artarmon and at the Wakehurst Parkway in Frenchs Forest
  - Motorway facilities and ventilation outlets at the Warringah Freeway in Cammeray (fitout only of the Beaches Link ventilation outlet at the Warringah Freeway (being constructed by the Western Harbour Tunnel and Warringah Freeway Upgrade project), the Gore Hill Freeway in Artarmon, the Burnt Bridge Creek Deviation in Balgowlah and the Wakehurst Parkway in Killarney Heights
  - A wastewater treatment plant at the Gore Hill Freeway in Artarmon
  - Installation of motorway tolling infrastructure
- Staged construction of the Gore Hill Freeway Connection at Artarmon and upgrade and integration works at Balgowlah and along the Wakehurst Parkway with typical activities being earthworks, bridgeworks, construction of retaining walls, stormwater drainage, pavement works and linemarking and the installation of roadside furniture, lighting, signage and noise barriers
- Testing of plant and equipment and commissioning of the project, backfill of access declines, removal of construction support sites, landscaping and rehabilitation of disturbed areas and removal of environmental and traffic controls.

Temporary construction support sites would be required as part of the project (refer to Figure 1-3), and would include tunnelling and tunnel support sites, civil surface sites, cofferdams, mooring sites, wharf and berthing facilities, laydown areas, parking and workforce amenities. Construction support sites would include:

- Cammeray Golf Course (BL1)
- Flat Rock Drive (BL2)
- Punch Street (BL3)
- Dickson Avenue (BL4)
- Barton Road (BL5)
- Gore Hill Freeway median (BL6)

- Middle Harbour south cofferdam (BL7)
- Middle Harbour north cofferdam (BL8)
- Spit West Reserve (BL9)
- Balgowlah Golf Course (BL10)
- Kitchener Street (BL11)
- Wakehurst Parkway south (BL12)
- Wakehurst Parkway east (BL13)
- Wakehurst Parkway north (BL14).

A detailed description of construction works for the project is provided in Chapter 6 (Construction work) of the environmental impact statement.

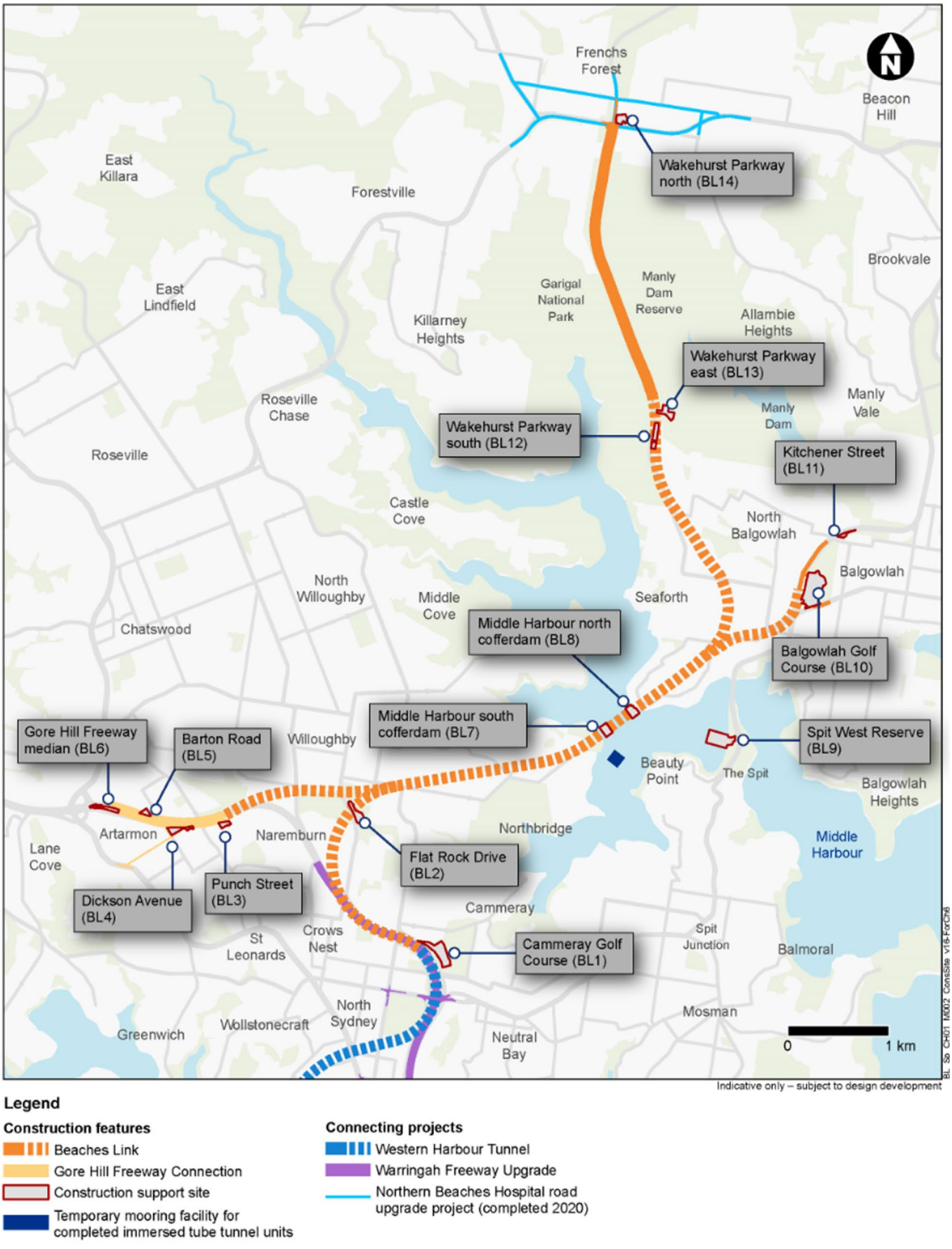


Figure 1-3 Overview of the construction support sites

1.6 Purpose of this report

This report has been prepared to support the environmental impact statement for the project and to address the environmental assessment requirements of the Secretary of the NSW Department of Planning, Industry and Environment.

This report provides an overview of the principles and practices that would apply to the management of utilities during the construction of the project. It includes a list of major utilities located within or adjacent to the construction footprint that have the potential to be affected by construction of the project and outlines the approach to management of mitigation measures and adjustments to utilities.

It also outlines the options currently being considered for provision of construction power supply and the permanent operational power supply for the project. These would be subject to separate approvals where appropriate in consultation with utility providers.

1.7 Secretary's environmental assessment requirements

The Secretary's environmental assessment requirements relating to the Utilities management strategy, and where these requirements are addressed in this report are outlined in Table 1-1.

Table 1-1 Secretary's environmental assessment requirements - Utilities management strategy

Secretary's environmental assessment requirements	Where addressed
Utilities	
The Proponent must assess potential impacts on utilities (including communications, electricity, gas, fuel and water and sewerage) and the relocation of these utilities. There are no fuel pipelines affected by the proposed project works.	This document
Where the project is predicted to impact on utilities, the Proponent must undertake a utilities management strategy, identifying management options, including relocation or adjustment of the utilities.	This document

2 Approach to proposed works on existing utilities

All public utility assets that are understood to be impacted and may require relocation or protection measures have been identified along the project reference design alignment for the Beaches Link and Gore Hill Freeway Connection. Most sections of the tunnels have sufficient depth of cover not to directly impact existing utilities. However, potential settlement and vibration impacts during construction of the project have also been be considered near “High Risk” major (trunk) utilities. Areas outside of the construction footprint may be impacted by utility works, such as the route selected for the installation of construction power or permanent operational power which are required to support the project.

Utilities investigations and consultations with utility providers have been carried out and would continue during the ongoing project development, further design development and construction phases of the project.

The utilities which have been considered in this Utilities management strategy include communications, gas, electricity, water and sewerage. The Utilities management strategy only considers major utilities as defined in Section2.2. Minor utility works which do not meet that definition are not considered in this strategy. Impacts to minor utilities would be addressed through standard management measures.

The information contained in this Utilities management strategy regarding existing utilities and proposed utility works is based on:

- Utility investigations conducted to date
- Preliminary discussions with utility providers
- The reference design for the project as set out in the environmental impact statement.

The information contained in this report is likely to change over time as further investigations are carried out, discussions with utility providers progress, and as the design of the project and the construction methodology are refined once a construction contractor has been appointed. New or revised management options may also be identified in the future during the detailed design phase of the project.

This Utilities management strategy should be read in conjunction with the Beaches Link and Gore Hill Freeway Connection environmental impact statement.

2.1 Utility investigations to date

Utilities investigations and consultation with utility providers commenced in 2017 and is ongoing.

Utilities information base data has been obtained by carrying out Dial-Before-You-Dig (DBYD) enquiries, a combination of survey models and Work As Executed drawings provided by Transport for NSW, and from information provided through consultation with utility asset owners in a CAD/GIS format and PDF.

The process for gaining an understanding of the existing utilities has included:

- Discussion with utilities authorities
- Review Work As Executed and survey models
- Potholing investigations where required
- DBYD enquiry to confirm the information presented in the models
- Identification of conflicts, surveying locations, and checking levels
- Tracing of utilities within the construction footprint that could be accessed, and able to be picked up
- Development of a three-dimensional (3D) utilities model for selected areas.

Where utilities have been identified to be at risk or impacted, these have been defined by where surface and excavation works are proposed in their vicinity.

Additional information is still being received in the form of detailed ground and utility survey investigations commissioned by Transport for NSW. As such, details included in this report would continue to evolve and be refined as the design progresses.

As utility relocation designs are carried out, additional utility tracing and/or potholing may be required to inform those designs.

2.2 Existing utilities

This Utilities management strategy details the utility works proposed as part of the project. Existing utilities within the areas of interest include (but are not limited to):

- Ausgrid (electricity) – power cables above and below ground, pits, tunnels, substations, poles, lights
- Telecommunications (optic fibre and copper communications) – Telstra and other communications providers – cables above and below ground, tunnels, buildings, towers, pits
- Sydney Trains (electricity)
- Sydney Water (sewerage and water supply) – tunnels, buildings, pipes/culverts, pits, structures
- Jemena (gas) – conduits, pipes, pit, structures
- Lane Cove Tunnel - utilities servicing the existing tunnel

There are no fuel pipelines affected by the proposed project works.

Existing utilities have been classified as a major or minor asset based on the definitions as detailed in Table 2-1.

Table 2-1 Utility asset classification

Public Utility	Minor	Major
Ausgrid (electricity)	Low Voltage, High Voltage (up to and including 11 kV), and Street Lighting	Transmission network (33 kV and above)
Telstra, Optus, NBN (communications) and other communication providers	Local area network	Major international cables Major optic fibre
Sydney Water (sewerage)	N/A	All sewerage assets classified as major
Sydney Water (water supply)	< DN375	≥ DN375 Heritage items
Jemena (gas)	Low Pressure	High Pressure ≥ 1050 kPa

Additional major utility services impacted by the project may be identified during future design stages in consultation with utility service providers. These utilities would also be subject to this Utilities management strategy.

2.3 Treatment approach to utilities

To resolve utility clashes along the proposed alignment, any or all of the following would be required:

- Where possible, redesign the works to allow retention of the utility in its current position
- Utility adjustment or relocation

- Utility protection
- Removal of abandoned utilities and infrastructure, if required
- The possibility to accommodate the utility within the proposed design.

The approach does not allow for the upgrading of utilities apart from any upgrades required to manage potential impacts arising from the project such as upgrades of infrastructure or power supply connections. All utility works would be carried out in consultation with the relevant utility provider.

Utilities comprising asbestos materials have been identified as potentially impacted by the proposed works. All work related to these utilities would be carried out by a licenced asbestos removal company with an appropriate asbestos management plan in place, in accordance with the specific laws about working with asbestos as per Chapter 8 of the Work Health and Safety Regulation 2017, and in accordance with SafeWork NSW practices and guidelines.

2.4 Typical construction methodology for utility works

The construction methodology would vary according to the type of utility, the scale of the work and the location. However, typically the methodology for constructing an underground utility may include:

- Investigations to confirm location of existing utilities such as potholing and works to allow decision to protect or relocate utilities as required
- Establishing temporary construction facilities including storage, laydown and stockpile areas, site offices and amenities
- Securing work areas such as with fencing and hoarding
- Installing pre-construction environmental management controls
- Removing and managing/protecting vegetation as required
- Saw cutting to remove asphalt or concrete pavement
- Carrying out initial trench excavations and shoring. Note that in some circumstances tunnelling or boring techniques can be used. Launching and receiving sites are required for these techniques
- Stockpiling excavated materials for reuse or removal for off-site disposal
- Preparing sub-grade surface (e.g. crushed rock) to accommodate utilities
- Laying utilities either as pipes or conduits
- Constructing joint bays and pits
- Pulling cables through conduits
- Connecting utilities to existing systems
- Testing and commissioning of utilities
- Backfilling trenches and re-instating surface to an appropriate condition
- Removing excess stockpiles, materials and equipment
- Removing or suitably isolating redundant utilities where practical
- Rehabilitating areas disturbed by works, such as with new topsoil and vegetation
- Site clean-up and decommissioning temporary construction facilities, work areas and environmental management controls.

The work would be carried out in stages and would proceed in a manner as directed by the program along the route. The depth and width of excavation would depend on several factors such as the type of utility, local topography, the location of existing utilities and sub-surface conditions.

3 Proposed works on existing utilities

3.1 Area of interest

The areas of interest within the construction footprint include:

- Gore Hill Freeway Connection
- Balgowlah surface road works
- Wakehurst Parkway realignment and upgrade.

The assessment of existing utilities and proposed utility works in each area of interest within the construction footprint are discussed in Sections 3.2 to 3.4.

Future design phases may identify relocations that extend outside the construction footprint. The impact on any existing utilities outside the construction footprint would be assessed during further design development of the project.

Further development of the project design, ongoing investigations, technical requirements and outcomes of consultation with utility providers are continuing. New or revised management options may also be identified in the future during further design development of the project.

3.2 Gore Hill Freeway Connection

The Gore Hill Freeway Connection component of the project would include surface road works to connect to the Beaches Link tunnels. Adjustment and reconfiguration of the Gore Hill Freeway would be required to accommodate three Beaches Link tunnel portals that would surface at Artarmon. Two tunnel portals surface between Hampden Road and the T1 North Shore and Western Line, and one tunnel portal surfaces at Reserve Road. The configuration of Gore Hill Freeway Connection between Lane Cove Tunnel and T1 North Shore and Western Line would be modified to provide connectivity between the Beaches Link tunnels and the Gore Hill Freeway. Works would be required to protect or relocate utilities that are impacted by the Gore Hill Freeway Connection component of the project. Some of the major utilities impacted by the surface works associated with the Gore Hill Freeway Connection include:

- High pressure secondary gas main regulator valve at the north-eastern corner of Reserve Road and Dickson Avenue intersection at Artarmon
- Optic fibre telecommunications pit and pipe network from multiple communications providers (NBN, Optus, TPG, UeComm, Vocus, Telstra) at the south-eastern corner of Reserve Road and Dickson Avenue intersection at Artarmon.
- 132 kV underground electrical cables in Lambs Road and Punch Street at Artarmon
- Two DN600 water mains and a high pressure secondary gas main crossing Gore Hill Freeway Connection to the east of Reserve Road Bridge
- Sewer and water supply mains at Hampden Road and Reserve Road region and within Gore Hill Freeway Connection itself
- Adjustment of a mobile phone tower and building at Punch Street at Artarmon

The existing utilities running through the Reserve Road and Hampden Road Bridges would not be impacted by the project.

The Ausgrid tunnel and 132 kV transmission cables within, running north-south under T1 North Shore and Western Line are not planned to be relocated. During the construction of the tunnel portals, it is proposed for the transmission cables in Punch Street and Lambs Road, which come from Ausgrid's tunnel under the T1 North Shore and Western Line and then split at the corner of Punch Street and Lambs Road, to be protected and supported. The area affected by the project is near a 132 kV cable jointing pit including auxiliary cables and a pilot cable termination access point.

Discussions with Ausgrid indicate a preference for a mechanical protection solution rather than a complete relocation of assets. It should be noted that these assets are critical infrastructure for Ausgrid's network. Before Ausgrid would approve any protection works it would need to approve a comprehensive Work Method Statement and staged methodology of the cable and pit support works. The Work Method Statement and methodology would consider the possible vibration and mechanical loads and their effects on the cables and provide solutions and show how this will be managed. An initial draft methodology has been assessed as adequate by Ausgrid. Final details would need to be agreed between the construction contractor and Ausgrid.

All utilities crossing Gore Hill Freeway east of Reserve Road would be impacted by the project due to the cut and cover tunnel structures and trough works for the Beaches Link tunnels.

The existing sewer main at the Gore Hill Freeway between Reserve Road and the T1 North Shore and Western Line corridor would be impacted and would need to be relocated.

Identified major public utilities at the proposed Gore Hill Freeway Connection, their impact assessment and proposed treatments are discussed in Table 3-1.

Table 3-1 Utilities at Gore Hill Freeway Connection and proposed treatments

Utility service provider	Utility description	Existing location	Proposed treatments
Telstra	Communications	Various optic fibre - up to 120F; copper - up to 1500-pair along northern side of Dickson Avenue and eastern side of Reserve Road. Other carriers (Vocus and NBN) present through the Telstra ducts.	**Relocate.** Surface works would impact pits on Dickson Avenue. Extra lane widening of Reserve Road would impact the conduits run and would need to be relocated.
Telstra	Communications	Telstra owned major and local area network crossing east under Reserve Road from the south-western corner to the south-eastern corner of the Reserve Road and Dickson Avenue intersection, then along the southern side of Dickson Avenue east of Reserve Road. Combination of direct buried and through conduits network comprising of various fibre - up to 120F; copper - up to 1500-pair.	**Relocate.** Affected. Telstra's six-pit at the south-eastern corner of Dickson Avenue and Reserve Road is impacted by the proposed intersection reconfiguration works and would need to be relocated. The cables and conduits that would run under the new cul-de-sac on Dickson Avenue would be protected. It is assumed that the proposed road works would tie into existing levels on southern side of Dickson Avenue. However, the communications pits at each corner of the Dickson Avenue and Hesky Lane intersection would be impacted and would have to relocate to outside the extent of proposed kerb works.
Telstra	Communications	Runs along southern side of Punch Street. Cables run to the Telstra communication mast in Punch Street. Communications network includes TPG assets through the Telstra owned conduits.	**Relocate.** Affected in part by the cut and cover works and site clearing works. Communications run to the communications mast in Punch Street to be relocated/protected to suit the proposed works for Punch Street and cut and cover works.
Telstra	Communications	Three P100 PVC through underground Telstra conduits under eastern verge of Chelmsford Avenue and cross Gore Hill Freeway north-south from Chelmsford Avenue to Station Street.	**Protect.** Affected by the proposed DN2250 RCP stormwater pipe parallel to Gore Hill Freeway between Francis Street and Station Street. The communications conduit would pass over the proposed stormwater pipe and would need to be protected during construction of stormwater pipe, subject to confirmation of alignment of the conduits.

Utility service provider	Utility description	Existing location	Proposed treatments
Optus	Communications	Optus owned underground fibre cable under western verge of Chelmsford Avenue and crosses Gore Hill Freeway north-south from Chelmsford Avenue to Station Street.	**Protect.** Affected by the proposed DN2250 RCP stormwater pipe parallel to Gore Hill Freeway between Francis Street and Station Street. The communications conduit would pass over the proposed stormwater pipe and would need to be protected during construction of stormwater pipe, subject to confirmation of alignment of the conduits.
Optus	Communications	Optus fibre optic cables through Telstra duct crosses Gore Hill Freeway north-south from Chelmsford Avenue to Station Street.	**Protect.** Affected by the proposed DN2250 RCP stormwater pipe parallel to Gore Hill Freeway between Francis Street and Station Street. The communications conduit would pass over the proposed stormwater pipe and would need to be protected during construction of stormwater pipe, subject to confirmation of alignment of the conduits.
Optus	Communications	Optus owned underground Intercity Optic Fibre (IOF) cable through Optus owned duct crosses Gore Hill Freeway north-south from Chelmsford Avenue to Station Street. Appears to follow Telstra's alignment in Chelmsford Avenue and under Gore Hill Freeway and then branching off at Station Street.	**Protect.** Affected by the proposed DN2250 RCP stormwater pipe parallel to Gore Hill Freeway between Francis Street and Station Street. The communications conduit would pass over the proposed stormwater pipe and would need to be protected during construction of stormwater pipe, subject to confirmation of alignment of the conduits.
AAPT	Communications	AAPT fibre through AAPT duct crosses Gore Hill Freeway north-south from Chelmsford Avenue to Station Street. Appears to follow Optus's alignment in Chelmsford Avenue and under Gore Hill Freeway.	**Protect.** Affected by the proposed DN2250 RCP stormwater pipe parallel to Gore Hill Freeway between Francis Street and Station Street. The communications conduit would pass over the proposed stormwater pipe and would need to be protected during construction of stormwater pipe, subject to confirmation of alignment of the conduits.
Telstra	Communications	Telstra owned existing communication tower and building at Punch Street. DBYD information shows Optus and Telstra owned assets accessing this tower, and Vocus owned equipment at mast only.	**Protect.** Affected by cut and cover work and supporting infrastructure for the Beaches Link tunnel connection to Gore Hill Freeway and would need to be adjusted. Optus and Vocus also use the tower. Alignment designed to avoid tower compound.
UeComm	Communications	Under eastern footpath of Reserve Road south of intersection with Dickson Avenue, then north-east corner of Dickson Avenue and Reserve Road intersection, and under Dickson Avenue northern footpath towards Waltham Street, and under Waltham Street eastern footpath.	**Relocate.** Section of conduits/cables in Dickson Avenue between Waltham Street and Reserve Road to be relocated. Section of asset at south-eastern corner of Dickson Avenue and Reserve Road intersection, including pits, affected by proposed extent of kerb realignment for the new Gore Hill Freeway off ramp onto Reserve Road, and asset under Dickson Avenue southern footway affected by proposed road upgrade and site clearing works for Dickson Avenue east of the intersection with Reserve Road. Concept relocation design received from UeComm.

Utility service provider	Utility description	Existing location	Proposed treatments
Vodafone	Communications	Vodafone owned equipment at Telstra's communication tower and building at Punch Street, Artarmon. TPG have confirmed they are providing the communications feed to this equipment. TPG cables through Telstra owned conduit network.	**Adjust.** Vodafone assets may be limited to inside the compound, and if so, impact to Vodafone assets would be limited. Adjustment works to be confirmed in consultation with asset owner and Telstra.
TPG	Communications	TPG communications cables through Telstra owned conduits network along southern side of Punch Street. Cables run to the communication mast in Punch Street.	**Relocate.** Affected in part by the cut and cover works and site clearing works. To be dealt with the relocation of the Telstra assets in Punch Street to the communications mast in Punch Street.
NBN	Communications	NBN fibre optic cables through Telstra ducts along northern side of Dickson Avenue and eastern side of Reserve Road.	**Relocate.** Surface works would impact pits on Dickson Avenue. Widening of Reserve Road would impact the conduits run and would need to be relocated. To be dealt with the relocation of the Telstra assets in Reserve Road and Dickson Avenue.
Vocus	Communications	Vocus fibre optic cables through Telstra ducts along northern side of Dickson Avenue and eastern side of Reserve Road.	**Relocate.** Surface works would impact pits on Dickson Avenue. Widening of Reserve Road would impact the conduits run and pits so would need to be relocated. To be dealt with the relocation of the Telstra assets in Reserve Road and Dickson Avenue.
Pipe Networks (TPG)	Communications	TPG owned pit and pipe fibre optic network at south-eastern corner of Reserve Road and Dickson Avenue intersection. eastern footpath starting at the south-eastern corner of the intersection with Dickson Avenue and heading south towards Taylor Lane.	**Relocate.** Pit affected by proposed extent of kerb realignment for the re-configured Reserve Road and Dickson Avenue intersection for the new Reserve Road on-ramp alignment. Pit and pipe network to be adjusted at south-east corner of Dickson Avenue and Reserve Road intersection.
Ausgrid	Electricity - transmission	Existing 33 kV transmission cables including pilot cables under Reserve Road southbound carriageway between Barton Road, north of Gore Hill Freeway, through Reserve Road Bridge, and heading south towards Gleg Street. Combination of direct buried and through conduits. Once south of bridge, joined by 11 kV. All in existing eastern footpath from bridge to south of Dickson Street intersection. Running parallel to the western side of the underground and overhead distribution network along the eastern side of Reserve Road. Conduits strapped under Reserve Road Bridge.	**Relocate.** Not affected by proposed Reserve Road Bridge widening works however affected by widening of Reserve Road from bridge to south of Dickson Avenue intersection, as cables now in roadway with reduced cover.

Utility service provider	Utility description	Existing location	Proposed treatments
Ausgrid	Electricity - transmission	132 kV transmission cables. Start at Chelmsford Avenue then through a pipe jacked tunnel underneath Gore Hill Freeway at the T1 North Shore and Western Line, and runs along northern side of Punch Street, and it appears to follow the shared cycleway/pathway under Hampden Road underpass, and then along the northern side of Taylor Lane towards the intersection with Waltham Street. Important cable route feeding Crows Nest, including jointing bays. Feeders 9E3, 9E4/2, 925/2, 9E5 (Lindfield to Willoughby).	**Protect.** Affected by Beaches Link exit ramp cut and cover and trough structure for Punch Street and Lambs Road. 132 kV transmission lines would require protection and temporary support during construction. Constructed at minimal cover. Likely to require vibration/settlement monitoring to the east of the proposed cut and cover if works through the Hampden Road/Taylor Lane park area.
Ausgrid	Electricity - transmission	132 kV transmission cables. Starts at Chelmsford Avenue then runs through pipe jacked tunnel underneath Gore Hill Freeway at the T1 North Shore and Western Line, and along eastern side of Lambs Road then Cleg Street. Important cable route feeding Crows Nest. Feeders 9E3, 9E4/2, 925/2, 9E5 (Lindfield to Willoughby).	**Protect.** Possibly affected by Beaches Link exit ramp cut and cover and trough structure. 132 kV transmission lines would require protection and temporary support during construction. Minimal cover. The existing 132 kV cables under Lambs Road between Punch Street and Cleg Street would be affected by the new proposed 22 kV Substation footprint. The alignment of the cable needs to be confirmed to check whether these cables may be affected by the fire water storage and pump station building footprint. The existing 132 kV cables and joint bay to be protected and retained while the construction of the substation and water tank above ground affected by tunnel adit. To be monitored during tunnelling and analysed during design.
Ausgrid	Electricity - transmission	132 kV transmission cables, presuming oil filled cables. Runs along southern side of Punch Street, passes under the T1 North Shore and Western Line south of Gore Hill Freeway, then heads north and crosses Gore Hill Freeway at Chelmsford Avenue. Investigations show only OOS and AUX cables. Ausgrid confirmed 132 kV cables are out of service. As out of service and redundant, Ausgrid to prepare a design to disconnect, drain, and remove.	**Remove.** Affected by Beaches Link exit ramp cut and cover and trough structure. Also impacted by proposed box culvert between Francis Street and Station Street. To be confirmed if still live. Cables can be removed prior to the cut and cover works and a contract is prepared for Ausgrid to perform the Non-Contestable draining and cable removal portion of the required removal.
Ausgrid	Electricity - transmission	132 kV transmission cables, presuming oil filled cables. Pass under the T1 North Shore and Western Line south of Gore Hill Freeway at the substation location, then heads north and crosses Gore Hill Freeway at Chelmsford Avenue. Investigations show only OOS and AUX cables. Ausgrid confirmed 132 kV cables are redundant. Joins the transmission assets in Cleg Street. As out of service and redundant, Ausgrid to prepare a design to disconnect, drain, and remove.	**Protect.** Affected by the proposed DN2250 RCP stormwater pipe parallel to Gore Hill Freeway between Francis Street and Station Street. Cables can be removed prior to the drainage construction works and a contract is prepared for Ausgrid to perform the Non-Contestable draining and cable removal portion of the required removal.

Utility service provider	Utility description	Existing location	Proposed treatments
Sydney Metro	Electricity	Sydney Metro trains owned 33 kV power supply from under Dickson Avenue road carriageway east of Reserve Road, then turns north onto Reserve Road northbound traffic lanes, and across Gore Hill Freeway through Reserve Road Bridge.	**Protect.** Assumed no direct impact as no surface works proposed for Dickson Avenue (East) and Reserve Road northbound carriageway. It may require temporary construction protection when working near/over/under this asset due to the need for relocation of gas or other services. The construction contractor to confirm location of this asset in both plan and depth.
Sydney Water	Sewer	DN225 PVC concrete encased along northern side of Gore Hill Freeway between Simpson Street east of Hampden Road to junction with another sewer main to a maintenance hole on north-eastern side of Hampden Road.	**Relocate.** Sewer main to be relocated. Affected by trough structure, cut and cover, and pavement works.
Sydney Water	Sewer	DN450 VC sewer main under existing Gore Hill Freeway shared path on southern side of Gore Hill Freeway starting from the west of Reserve Road Bridge where it joins another sewer main at a maintenance hole at the south-western corner of Gore Hill Freeway and Hampden Road Bridge. It then crosses under Gore Hill Freeway to northern side of freeway heading east. Depths to invert: 5.1m (south-west maintenance hole), 7.43m (north-east maintenance hole) crossing Gore Hill Freeway. Sewer main is not concrete encased where incoming to a maintenance hole junction.	**Relocate.** Affected by trough and cut and cover works and therefore requires relocation. To be relocated clear of cut and cover and trough structure.
Sydney Water	Sewer	DN150 and DN225 EW sewer main along southern side of Punch Street to a maintenance hole to the west of Lambs Road.	**Relocate.** Impacted by cut and cover works. Sewer to be relocated as part of the relocation works for the DN450 VC sewer main.
Sydney Water	Sewer	DN150 SGW sewer main runs along the back of properties in Waltham Street and connects to the DN450 VC sewer main along southern side of Gore Hill Freeway.	**Relocate.** Impacted by cut and cover works. Sewer to be relocated as part of the relocation works for the DN450 VC sewer main.
Sydney Water	Sewer	DN225 SGW sewer main runs across Taylor Lane and under adjoining open space where it connects to the DN450 VC sewer main along southern side of Gore Hill Freeway.	**Relocate.** Impacted by cut and cover works. Sewer to be relocated as part of the relocation works for the DN450 VC sewer main.
Sydney Water	Sewer	DN225 EW sewer main runs from properties and verge in Punch Street, and then crosses Gore Hill Freeway west of the North Shore Rail Line. Sewer main not concrete encased under Gore Hill Freeway.	**Relocate.** Impacted by cut and cover works. Sewer to be relocated as part of the relocation works for the DN450 VC sewer main.
Sydney Water	Sewer	DN225 VC sewer main runs south from Parkes Road and connects to the DN450 VC sewer main north of Gore Hill Freeway.	**Relocate.** Impacted by cut and cover works. Sewer to be relocated as part of the relocation works for the DN450 VC sewer main.

Utility service provider	Utility description	Existing location	Proposed treatments
Sydney Water	Sewer	DN150 SGW sewer main under Dickson Avenue between Hesky Lane and Waltham Street.	**Protect.** Sewer maintenance hole cover may need to be adjusted to suit new road levels and pipe protected, subject to confirmation of depth of pipe.
Sydney Water	Sewer	DN150 PVC sewer main under properties south of Gore Hill Freeway between Reserve Road and Hesky Lane and under Gore Hill Freeway shared path.	**Remove.** Properties serviced by this sewer would be demolished to facilitate the new westbound exit ramp onto Reserve Road. Existing sewer to be disused and removed. Connection point to the DN450 VC sewer main may need to be retained in that relocation design to service the proposed Beaches Link motorway control centre.
Sydney Water	Sewer	DN150 VC sewer main along eastern side of Hesky Lane south of Gore Hill Freeway.	**Remove.** Properties serviced by this sewer would be demolished to facilitate the new westbound exit ramp onto Reserve Road. Existing sewer to be disused and removed.
Sydney Water	Sewer	Under Gore Hill Freeway shared path between Hesky Lane and Waltham Street.	**Remove.** Properties serviced by this sewer would be demolished to facilitate the new westbound exit ramp onto Reserve Road. Existing sewer to be disused and removed.
Sydney Water	Sewer	DN150 and DN225 part SGW and part PVC sewer main under the intersection of Dickson Avenue and Waltham Street then heading north to under the shared path along the southern side of Gore Hill Freeway where it joins the DV450 VC sewer main.	**Adjust.** Section of existing sewer to be adjusted due to the DN450 VC sewer main relocation, and reconnected into the replacement sewer, as it serves retained properties in Waltham Street.
Sydney Water	Sewer	Sewer main collecting flows from retained properties in Cleg Street under properties between Cleg Street and Punch Street and connecting to sewer along southern side of Punch Street. Runs under building to be demolished.	**Relocate.** Impacted by proposed building demolition and site clearing works, would need to be relocated.
Sydney Water	Water	DN600 CICL water main on northern side of Gore Hill Freeway between Hampden Road and North Shore Railway Line. Crossing Gore Hill Freeway near the T1 North Shore and Western Line/along Gore Hill Freeway between Cleland Road and Francis Street.	**Relocate.** Passing over initial portion of driven tunnel in poor ground conditions. Sydney Water have undertaken a settlement analysis of their assets crossing the tunnel alignment and for this main (Item 13 - Phase 2 Report) and apply Risk Rating 3 - Replace. This asset could require replacement and would be confirmed by the construction contractor in consultation with Sydney Water. Contestable works and to be carried out by the construction contractor.
Transport for NSW	Unknown	Existing building/structure within park in Taylors Lane just to the west of Hampden Road underpass. Ownership and purpose unknown, possible ITS note for Lane Cove Tunnel? Could be a private asset as not shown on DBYD plans. Transport for NSW to confirm ownership and purpose of the building.	**Remove.** Existing structure/building near proposed cut and cover works adjacent to this site. Site visit in September 2020 by Transport for NSW has confirmed the structure/building has been removed. It appears the building has been replaced with newer ITS cabinets on SUP, rather than on original site. This would need to be confirmed with Transport for NSW. Any residual services through the site are to be removed.

3.3 Surface connections at Balgowlah

Some major utilities impacted by the surface connections at Balgowlah include:

- The existing sewer main at the back of properties in Hope Street and backing onto Burnt Bridge Creek Deviation. This sewer has been identified by Sydney Water as impacted and would need to be re-lined.
- The existing sewer main at the back of properties in Dudley Street draining to the sewer main carrier along Burnt Bridge Creek would need to be relocated due to the new cul-de-sac on Dudley Street and property acquisitions. This sewer has been identified by Sydney Water as impacted and would need to be re-lined.

Identified major utilities at the location of the surface works at Balgowlah, North Balgowlah and Seaforth, their impact assessment and proposed treatments are discussed in Table 3-2 below.

Table 3-2 Utilities at Balgowlah Connection and proposed treatments

Utility service provider	Utility description	Existing location	Proposed treatments
Telstra	Communications	Bank of four to five DN100 AC (asbestos conduits) comprising of large copper (1800, 1200, 800 pair) and small fibre optic (12 to 36F) cables along northern side of Sydney Road. Includes existing road crossing under the intersection of Sydney Road and Maretimo Street, and a short underground run under Sydney Road southern footpath to the east of the intersection with Maretimo Street.	**Relocate.** Affected by the proposed widening of Sydney Road for new access road intersection. Communications conduits/cables to be relocated in new footpath and at suitable depth to pass under the new access road intersection. Note, minimum 1200mm cover is required for relays under Transport for NSW roads, so relocation likely if the existing cover is insufficient. The existing road crossing would also need to be relocated to suit the new communication run alignment.
Sydney Water	Sewer	DN375 RC sewer main crossing Burnt Bridge Creek Deviation along southern side of the existing Burnt Bridge Creek to a junction with multiple sewer lines. This is SM601 on Sydney Water Corporation Phase 1 Report.	**Adjust.** Affected by proposed stormwater culvert structure. Passes above driven tunnels. The existing maintenance hole to be lowered/adjusted to suit the culverts. The sewer under the proposed culverts to be concrete encased. Subject to tunnel depth and clearance at crossing, the sewer may require protection, and likely to require Building Over Asset application for works under the existing sewer. Sydney Water has carried out a settlement analysis of their assets crossing the tunnel alignment and have predicted settlement causes exceedance of all limits for this asset (SM601 in Phase 1 Report) and recommend relay and upsize from DN375 to DN450. However, this was based on earlier tunnel alignment. This asset could require replacement and upsizing and would be confirmed by the construction contractor in consultation with Sydney Water at the time of the relocation design based on the final alignment design. Contestable works and to be carried out by the construction contractor.

Utility service provider	Utility description	Existing location	Proposed treatments
Sydney Water	Sewer	DN375 RC sewer main running along eastern side of existing Burnt Bridge Creek. Connects to multiple sewer mains crossing the alignment.	**Protect.** Assumed not affected as no works proposed for Burnt Bridge Creek and outside the extent of any proposed earthworks for Burnt Bridge Creek Deviation widening and Balgowlah Golf Course. Likely to require Building Over Asset application and protection where in close proximity to proposed works or building over. Connect to existing sewer maintenance hole north of Kitchener Street. Sydney Water has carried out a settlement analysis of their assets crossing the tunnel alignment and have predicted settlement causes exceedance of all limits for this asset and recommend relay and upsize from DN375 to DN450. This asset could require replacement and upsizing and would be confirmed by the construction contractor in consultation with Sydney Water at the time of the relocation design based on the final alignment design. Contestable works and to be carried out by the construction contractor.
Sydney Water	Sewer	DN150 SGW sewer main crossing Burnt Bridge Creek Deviation north of Boronia Street. Connects to the DN375 RC sewer main.	**Protect.** Crossing under proposed road widening. Possible Building Over Asset application and/or protection depending on impact.
Sydney Water	Sewer	DN225 EW sewer main crossing Burnt Bridge Creek Deviation between Serpentine Crescent and Boronia Street. Connects to the DN375 RC sewer main	**Adjust.** Crossing under proposed road widening. Likely to require Building Over Asset application and protection for building over. The sewer maintenance hole at the northern limit of the southbound widening would require adjustment to suit new path/verge levels.
Sydney Water	Sewer	DN300 VC sewer main crossing Burnt Bridge Creek Deviation from northern end of Serpentine Crescent. Connects to the DN375 RC sewer main	**Adjust.** Crossing under proposed road widening. Likely to require Building Over Asset application and protection for building over. The sewer maintenance hole to the eastern side of the widening within Balgowlah Golf Course is at the bottom of a proposed batter and may require adjustment to suit the new earthworks levels.
Sydney Water	Sewer	DN225 SGW sewer main under road pavement along northern side of Sydney Road, then crossing Sydney Road to Maretimo Street to a sewer junction.	**Adjust.** The existing sewer currently runs under the road and not affected. Possible small change to sewer maintenance hole cover level. maintenance hole cover to be adjusted, or new maintenance hole cover to be constructed to match new road levels.
Sydney Water	Sewer	DN225 VC sewer main in verge along southern side of Sydney Road.	**Adjust.** Assumed sewer main not impacted by minor works for the intersection of Maretimo Street and Sydney Road. The existing maintenance hole at the intersection may require maintenance hole cover adjustment to suit proposed intersection levels.

Utility service provider	Utility description	Existing location	Proposed treatments
Sydney Water	Sewer	DN225 VC sewer main runs underneath properties along Dudley Street. This sewer connects to the sewer carrier main along Burnt Bridge Creek. Connects to the DN375 RC sewer main.	**Relocate.** Affected due to the impact to the existing sewer by the shortening of Dudley Street and houses demolition to facilitate the widening of Burnt Bridge Creek Deviation between Sydney Road and to the north of Burnt Bridge Creek stormwater culvert crossing. The existing sewer may need be relocated if the proposed sports fields are not avoided. Sewer connection is maintained to the remaining properties in Dudley Street.
Sydney Water	Sewer	DN225 VC sewer main at the back of properties in Hope Street and backing onto Burnt Bridge Creek Deviation. Connects to the DN375 RC sewer main at the northern end. DBYD shows this sewer as being 0.9m to 2.5m deep.	No direct impact to the sewer main. However, Sydney Water has carried out a settlement analysis of their assets crossing the tunnel alignment and have predicted settlement causes exceedance of all limits for this asset (SM602 in Phase 1 Report) and recommend relining of the sewer main. However, this was based on earlier tunnel alignment. This asset could require relining and would be confirmed by the construction contractor in consultation with Sydney Water at the time of the relocation design based on the final alignment design as final alignment may reduce settlement impact. Contestable works and to be carried out by the construction contractor.

3.4 Wakehurst Parkway surface road works

The realignment and upgrade of Wakehurst Parkway includes construction of on and off ramps to connect the mainline tunnels with the Wakehurst Parkway at Killarney Heights, and works would be required along the proposed upgrade works to protect or relocate utilities that are impacted by the proposed design. Major utilities impacted by the Wakehurst Parkway works include:

- An existing Sydney Water DN450 water main crossing the proposed alignment north of the Bantry Bay Reservoir site is assumed to require relocation due to the trough structure of the tunnel
- An existing Sydney Water DN1200 water main crosses the alignment south of Aquatic Drive. Based on assessment of the Work As Executed drawings, detailed site survey and visual site inspections, it is assumed that the water main is sufficiently deep under the existing Wakehurst Parkway. There are no proposed works for this existing water main east of Wakehurst Parkway. However, the current proposed design widens Wakehurst Parkway to the west and cutting into the existing batter. The proposed road alignment has been raised to provide for sufficient cover over the water main and develop a protection measure to retain the water main in-situ
- Utilities crossing Wakehurst Parkway from Fitzpatrick Avenue East to Aquatic Drive:
  - Telstra communication cables, multiple fibres up to 144F, multiple large copper cables up to 3000-pair. Northern Beaches Hospital supplied tracing has been used in the design model to assess impacts
  - Jemena secondary (1050 kPa) gas main. This gas main has been re-laid as part of the Northern Beaches Hospital works. Northern Beaches Hospital Work As Executed information model as supplied has been used to assess impacts.

- Existing water supply trunk mains, communications services and gas services adjacent to the entry into Sydney Water's Bantry Bay Reservoir site off Kirkwood Street, as well as communications, power (including 33 kV overhead powerlines and poles), and water supply mains within the Bantry Bay Reservoir site may be affected and may require protection and adjustment works due to the proposed Wakehurst Parkway east construction support site (BL13) (car parks, site sheds, tunnel access decline, etc) within the Bantry Bay Reservoir site. These include:
  - Relocation of a DN375 scour line
  - Protection of a DN375 water main along the western boundary of the Bantry Bay Reservoir site
  - Protection of a DN500 water main under the existing Bantry Bay Reservoir access road between the communications tower and the entry into the reservoir from Kirkwood Street
  - Protection of a DN300 water main under existing the Bantry Bay Reservoir access road between the communications tower and the entry into the reservoir site from Kirkwood Street.

Identified major utilities along the reference design Wakehurst Parkway alignment, their impact assessment and proposed treatments are discussed in Table 3-3.

Table 3-3 Utilities at Wakehurst Parkway and proposed treatments

Utility service provider	Utility description	Existing location	Proposed treatments
Telstra	Communications	Combination of Telstra local and major area network under Wakehurst Parkway eastern footway in front of the five properties at the intersection with Judith Street, then under southern footpath of Judith Street heading east to the intersection with Kirkwood Street. Includes service connections to properties fronting Wakehurst Parkway (three to the south and two to the north of the Judith Street/Wakehurst Parkway intersection). Includes 12F optic fibre cable.	**Protect.** Likely to require protection where it passes under the Wakehurst Parkway south construction support site (BL12) entry/exit driveway. Not likely to be affected under Wakehurst Parkway eastern footway as no works proposed for this area.
Telstra	Communications	Existing communications conduits crossing under Wakehurst Parkway at Fitzpatrick Avenue East / Aquatic Drive comprising of major copper (3000, two 2700, 1200 pair), multiple fibres (144F, three 120F, 80-F, 60F and smaller), plus other communications carriers including Vocus.	**Relocate.** The existing conduits through the existing embankment affected by the cut and retaining wall works for Wakehurst Parkway widening. Up to 3m of additional cut in western verge, though road pavement levels are similar to existing. Assume the conduits under Wakehurst Parkway not to be affected however the extension of the communications run due to the widening to be installed with minimum 1200mm cover. Treatment length would be manhole to manhole, and optic fibre cables would be node to node. Assessment based on 12d utilities model for Northern Beaches Hospital project as supplied by Transport for NSW.

Utility service provider	Utility description	Existing location	Proposed treatments
Telstra	Communications	Existing communications conduits crossing under Wakehurst Parkway at Fitzpatrick Avenue East / Aquatic Drive comprising of major copper (2400 and 1400 pair).	**Relocate.** The existing conduits through the existing embankment affected by the cut and retaining wall works for Wakehurst Parkway widening. Up to 3m of additional cut in western verge, though road pavement levels are similar to existing. Assume the conduits under Wakehurst Parkway not to be affected however the extension of the communications run due to the widening to be installed with minimum 1200mm cover. Treatment length would be manhole to manhole, and optic fibre cables would be node to node. Assessment based on 12d utilities model for Northern Beaches Hospital project as supplied by Transport for NSW. This would get re-laid in the same duct run as the other adjoining communications run.
Ausgrid	Electricity – overhead transmission	33 kV overhead transmission power lines crossing Wakehurst Parkway in a north-west to south-east direction near Manly Dam Reserve. Connects to electrical assets to the south-east and to the north-west.	**Protect.** No impact to existing poles by proposed road widening works. The section of road is shown as being in cut therefore less risk relating to clearance. The pole to the east and the overhead wires would likely need to be protected during the works.
Ausgrid	Electricity – underground transmission	132 kV transmission pilot cable crossing Wakehurst Parkway at Fitzpatrick Avenue East / Aquatic Drive. Direct buried and part concrete encased where crossing under Wakehurst Parkway.	**Remove.** Out of service asset and planned to be redundant. Transport for NSW have confirmed that Ausgrid removed the section of pilot cable at the location of the detention tank and fauna underpass in Aquatic Drive. The pilot cable remains in place where it crosses Wakehurst Parkway. Section of impacted cables and conduits run by the proposed Wakehurst Parkway road works to be removed by Beaches Link project construction contractor.
Ausgrid	Electricity – overhead transmission	33 kV overhead transmission power lines along the western side of Wakehurst Parkway near Manly Dam Reserve. Connect to another overhead run to the south and up to the existing power pole just to the north of the proposed water quality basin adjacent to Wakehurst Parkway.	**Protect.** Passing over the proposed water quality basin and the overhead lines are to be maintained and protected.
Ausgrid	Electricity – overhead transmission	33 kV overhead transmission power lines passing over the north-eastern corner of the Bantry Bay Reservoir site. Connects to another overhead run near Manly Dam Reserve to the north-west.	**Protect.** The clearance below the power lines to be confirmed. Would need protection as proposed works under the power lines. Site sheds, water treatment plant, sedimentation basin, and new access road decline at Wakehurst Parkway east construction support site (BL13) would consider the position of existing poles to avoid the need to relocate the overhead power lines.

Utility service provider	Utility description	Existing location	Proposed treatments
Jemena	Gas	Newly constructed underbore of a secondary 1050kPa gas main crossing Wakehurst Parkway at Fitzpatrick Avenue East / Aquatic Drive alignment. The Northern Beaches Hospital survey file also shows another section of an underbore under Fitzpatrick Avenue / Aquatic Drive northern verge however this is not shown on the current DBYD plans by Jemena and needs to be confirmed with Jemena and Northern Beaches Hospital construction contractor. Although outside the current scope of works, the alignment of the gas main or gas mains in Fitzpatrick Avenue / Aquatic Drive needs to be confirmed.	**Protect.** Based on the as constructed alignment for the underbore as provided by the Northern Beaches Hospital construction contractor via Transport for NSW the new underbore appears to be clear of the proposed widening and cut batter in the western verge however may need some protection during the new cut batter construction. Levels at road are similar to existing, hence no impact to the gas main where it passes under Wakehurst Parkway existing carriageway. Note: It is understood the existing 1050kPa secondary main crossing has been disused when this underbore was constructed as part of the Northern Beaches Hospital project.
Jemena	Gas	Decommissioned secondary 1050kPa gas main crossing Wakehurst Parkway at Fitzpatrick Avenue East / Aquatic Drive alignment to the south of the newly constructed underbore.	**Remove.** If the existing gas main has not been removed when disused following the construction of the underbore to the north, the disused pipe would need to be removed as impacted by the additional cut for the widening of the western verge.
Sydney Water	Sewer	Existing sewer along the back of properties along Kirkwood Street and the properties near Judith Street with access to Wakehurst Parkway. Sewer through open space between the properties and Wakehurst Parkway. Also crosses under Judith Street.	**Protect.** The existing sewer adjacent to Wakehurst Parkway south construction support site (BL12). This sewer drains retained properties along Kirkwood Street so the sewer line must remain in service.
Sydney Water	Water	DN375 water main crossing under Wakehurst Parkway at Kirkwood Street from Bantry Bay Reservoir, then along western side of Wakehurst Parkway heading north.	**Relocate.** Affected by proposed Wakehurst Parkway road widening works and possibly by the construction of the water quality basin. Road design is about 2.2 to 2.5m below existing (Beaches Link southbound and Wakehurst Parkway exit). Even if southbound exit was to be brought up to Kirkwood Street level, mainline would be too low. The water main including scour valve to be relocated clear of new road alignment. Until traced and exact impact assessed, allow full relocation. Relocation at end may possibly be avoided.
Sydney Water	Water	DN450 water main from Bantry Bay Reservoir crosses under Wakehurst Parkway and passes under a DN375 water main along the western side of Wakehurst Parkway, then continues on west side of Wakehurst Parkway.	**Relocate.** Affected by proposed cut (design about 0.5m below existing) and trough structure. The water main would need to be relocated.

Utility service provider	Utility description	Existing location	Proposed treatments
Sydney Water	Water	DN1200 trunk water main crossing under Wakehurst Parkway south of Warringah Aquatic Centre. In easement, sections of water main above ground to the east and west of Wakehurst Parkway. As built drawings available (date unknown, in feet and inches). Water main modelled using the as built levels and Level B survey to assess impact and identify suitable mitigation measure.	**Protect.** Road widening cuts into western batter over pipe. Road alignment raised to reduce impact. It is currently proposed to protect and bridge over the water main where it is rising under widened road. This is subject to discussion and review of the proposed mitigation by Sydney Water. Work As Executed drawings indicate current crossing not welded or concrete encased. High risk infrastructure asset and Sydney Water may require special protection treatment on this water main under new retaining wall and road widening work.
Sydney Water	Water	Unknown size water main crossing under Wakehurst Parkway south of intersection with Warringah Road. Alignment obtained from Northern Beaches Hospital 12d utilities model. Water main not shown on DBYD plans. Water main size to be confirmed.	**Protect.** Subject to confirmation of depth of the water main, it may need to be protected during road construction works over.
Sydney Water	Water	DN450 water main along the western side of Wakehurst Parkway near Manly Dam Reserve.	**Protect.** Water main passes east side adjacent to proposed water quality basin. The water quality basin would be designed to any avoid impact on existing water main. Temporary construction protection may be required.
Sydney Water	Water	DN375 water main under the eastern footway closest to the boundary along Kirkwood Street towards the entry into Bantry Bay Reservoir WS0008WP0122. Continues as DN375 SCL IBL inside Bantry Bar reservoir site under the existing access road.	**Protect.** Possibly affected by the road and pavement modification work (no new kerb and gutter on east side) in Kirkwood Street and would need temporary construction protection.
Sydney Water	Water	DN375 water main under Kirkwood Street northern footway/verge west of the entry gates to Bantry Bay Reservoir to a tee with asset ID W7004 east of Wakehurst Parkway. Also connects to a DN375 SCL IBL near the entry into Bantry Bay Reservoir Site WS0008WP0122.	**Adjust.** Likely to be affected by the road and pavement modification work in Kirkwood Street and would need adjustment or protection. As trunk main, Sydney Water would be conservative. Allow for adjustment.
Sydney Water	Water	Water supply feed line and valves set on the northern side of the reservoir to the DN450 CICL running north-south along the western boundary of the Bantry Bay Reservoir site east of Wakehurst Parkway.	**Relocate.** Water main passing under proposed noise wall and construction access road. Noise wall would be designed to avoid impact on the existing water main. Likely to require protection where passing under the proposed noise wall and construction access road, subject to Building Over Asset application to Sydney Water. The valves set would not be impacted. Also runs under south-east corner of proposed acoustic shed. Allow for relocation.

Utility service provider	Utility description	Existing location	Proposed treatments
Sydney Water	Water	Part DN375 and part DN450 water main along the western boundary of Bantry Bay Reservoir site from Kirkwood Street to a tee with the scour line.	**Relocate.** Affected by proposed new noise wall, access road works, and proposed concrete slab for a construction facility shed for the Wakehurst Parkway east construction support site (BL13). It also passes over proposed driven tunnel. The noise wall would be designed to avoid impact on the existing water main. The section of water main under the new road and the concrete slab for the shed would require protection. The section of the water main passing over the mined tunnel would need to be replaced with a SCL concrete encased pipe to withstand settlement.
Sydney Water	Water	DN500 water main under the existing Bantry Bay Reservoir access road between the communications tower and the entry into the Bantry Bar Reservoir site from Kirkwood Street.	**Avoid.** No work inside the site in this area except new fence. Temporary construction protection if required.
Sydney Water	Water	DN300 water main under existing the Bantry Bay Reservoir access road between the communications tower and the entry into the reservoir site from Kirkwood Street.	**Avoid.** No work inside the site in this area except new fence. Temporary construction protection if required.
Sydney Water	Water	Reservoir scour line in the north-eastern side of the Bantry Bay Reservoir Tank.	**Relocate.** Scour line passing under proposed noise wall and proposed acoustic site building within the Wakehurst Parkway east construction support site (BL13). Subject to confirmation of the Wakehurst Parkway east construction support site (BL13) layout, the scour line would be relocated to avoid the construction buildings. Noise wall would be designed to avoid impact on the existing scour main. Works to consider impact assessment to the existing reservoir.

4 Utility connections

4.1 Construction and operational power supply overview

The Ausgrid System Planning group has completed a planning study to investigate the proposed connection of construction power supplies for the Beaches Link and Gore Hill Freeway Connection project. Ausgrid has also completed a planning study detailing possible routes for the tunnel operational power supply.

Construction power supply would be via a temporary 11 kV connection to enable tunnel construction whereas the operational power supply demands are dependent on the power demand during the tunnel operation.

Estimates of the power demands are discussed in the sections below, however, the actual power demands are subject to final construction methodologies and requirements would be confirmed during future design phases of the project.

Based on the supply capacities of their sub-transmission substations and the portal locations Ausgrid allocate the appropriate high voltage power supply connection points. The locations for Beaches Link and Gore Hill Freeway Connection substations are determined. Ausgrid may need to conduct enabling works at their sub-transmission substations to allow for the additional capacity required for the tunnel maximum demand.

4.1.1 Construction power supply

Several construction support sites are proposed along the project as detailed in Section 1 of this report. Major construction power would be required at sites where tunnelling is to be carried out by roadheaders. Construction power supply to other construction support sites would be arranged by the construction contractor and is likely to be provided either from local supplies or by generators.

Ausgrid System Planning group has completed a planning study to investigate the proposed connection of four (4) construction supplies for the Beaches Link and Gore Hill Freeway Connection project. The construction power supplies are regarded as temporary 11kV connection points.

The projected estimate of maximum power demands is shown in Table 4-1. The maximum power demand has been conservatively calculated to allow for larger or additional roadheaders. Target power connection dates are indicative only and would be reviewed during further design development in consultation with Ausgrid. The actual requirements would be confirmed in future design phases.

Transport for NSW has appointed a Level 3 Accredited Service Provider (ASP3) to carry out the detailed designs for the construction power supply for the five construction support sites where tunnelling is proposed and high voltage electricity supply would be required as noted in Table 4-1. It is proposed for the construction power supplies to be installed along existing road and pathways corridors where feasible to minimise environmental impacts and the visual impact of utility works to the surrounding community. An existing services search was carried out to determine if there is potential to impact on existing utilities. The design for all five construction power supply routes are complete and are being reviewed and considered by Ausgrid. It should be noted that the construction power supply routes have been reviewed and dictated by Ausgrid nominated supply points, necessitating construction runs outside the construction footprint.

Table 4-1 Estimate of construction power supply demand

Construction Support Site Location	Indicative Temporary Power Requirement (MVA)	Timing
Corner of Cleg Street and Lambs Road, Artarmon – Punch Street (BL3) Construction Support Site	3	Q3 2022 – Q1 2026
Flat Rock Baseball Diamond, Willoughby – Flat Rock Drive (BL2) Construction Support Site	7	
Wakehurst Parkway, Seaforth – Wakehurst Parkway east (BL13) Construction Support Site	3	
Sydney Road near Balgowlah Golf Course, Balgowlah – Balgowlah Golf Course (BL10) Construction Support Site	3	
Cammeray Golf Course (BL1) Construction Support Site – north-west portion of the Cammeray Golf Course	3	

4.1.2 Operational power supply

The permanent loads for the Beaches Link and Gore Hill Freeway Connection are designed to allow for single outage supply contingency. This means that the complete tunnel can either be supplied directly from one end by a sub transmission substation using separate bus-bars, or both ends of the tunnel from different supply yards. The estimated power required for the Beaches Link tunnels is based on inputs from ventilation, power, drainage, and auxiliary design loads based on previous tunnel projects.

4.1.2.1 Beaches Link tunnels

Aboveground substations would be co-located with motorway facilities at the Warringah Freeway, the Gore Hill Freeway, the Burnt Bridge Creek Deviation and the Wakehurst Parkway.

The aboveground substation at the Wakehurst Parkway at Killarney Heights would be connected to the existing electricity supply network via new conduits installed along the Wakehurst Parkway upgrade works. Subject to further consultation with Ausgrid, it is expected that electricity supply connections would be made with the Warringah sub-transmission substation.

Power during operation of the tunnel is required for exhaust fans, air supply fans, fire hydrant pumps, fire sprinkler pumps, CCTV monitoring and other operational requirements. Preliminary findings show that the power required for the Beaches Link tunnels is about 30 MVA. The maximum demand is based on the worst case operating scenario defined by the tunnel ventilation system.

It is proposed for the permanent power supply for the Beaches Link Tunnel to connect to the Wakehurst Parkway portal via two new 33 kV feeders from the Ausgrid owned Warringah Sub-Transmission Substation (STS).

The proposed Ausgrid supply substation for the Beaches Link tunnel has been selected based upon its proximity to the proposed portal supply substation. Subject to further design development of the tunnel, Ausgrid may need to conduct enabling works at their sub-transmission substation to allow for the additional capacity required for the tunnel maximum demand.

High level investigation has been carried out to develop a possible cable route for the permanent power supply from the Warringah STS to the Wakehurst Parkway tunnel portal at Seaforth. The proposed cable route comprises of two 33 kV cables from the Warringah STS site heading west along Aquatic Drive to Wakehurst Parkway, and then heading south along Wakehurst Parkway to the Wakehurst Parkway tunnel portal. This route is the shortest path to the proposed supply points and may vary from routes taken by Ausgrid's existing assets in the vicinity. The bulk of the route would be incorporated within the new Wakehurst Parkway upgrade alignment. When not within the construction footprint, the route only passes through industrial areas, not residential.

An existing utilities search has not been carried out along the proposed routes nor has an easement assessment been done. The intent of this preliminary route selection is to provide a high-level assessment to indicate the practicality of the proposed power supply feeder route.

Upon the selection of a preferred operational power supply route by the construction contractor, an existing services search would be carried out to assess impact on existing utilities. Subject to the utilities impact assessment, alternative routes may need to be considered.

4.2 Utilities route options considerations

For some of the proposed utility works there may be several potential route options which are available. In determining a preferred route option, the following would be considered as relevant:

- The requirements of the relevant utility provider
- Minimising commercial and schedule risk
- The location of existing utilities in relation to the project infrastructure and surrounding existing utilities
- Allowing ease of access for both construction and maintenance
- Locating infrastructure in areas of previous disturbance such as road reserves or infrastructure corridors
- Adopting the shortest feasible route (all other considerations allowing)
- Where possible, avoiding or minimising impacts on:
  - Sensitive environmental areas (e.g. watercourse crossings)
  - Known areas of contamination or acid sulfate soils
  - Heritage Conservation Areas and listed heritage items
  - Areas of public open space
  - Visibility of, and access to, commercial businesses
  - Residential and other sensitive receivers
  - Major roads which are heavily trafficked
- Cumulative impacts with other concurrent or overlapping projects.

5 Stakeholder and community coordination

5.1 Community consultation and notification

Any notification of proposed utility works would be as per the requirements of the asset owners, community consultation, and notification periods in accordance with the construction contractors' construction environmental management plan as appropriate.

Where there are no alternative feasible route options for the utility adjustment, then the local community who may be affected would be given prior notification of the works, at least five days prior to the works commencing.

5.2 Co-ordination of utility works

To ensure that the potential cumulative environmental impacts associated with proposed utility works are effectively managed it is essential that various individual utility works are co-ordinated.

The project interfaces with other major infrastructure projects, Western Harbour Tunnel and Warringah Freeway Upgrade and Sydney Metro City & Southwest (Chatswood to Sydenham). It is proposed that a quarterly Utility Co-ordination Committee be established by the construction contractor. Utility Authorities would be invited to attend and provide updates on any upcoming utility upgrade or new utility works that may interface with the project to facilitate better planning for, and co-ordination of, utility works.

It is proposed that the Utility Co-ordination Committee comprise of representatives from the following organisations:

- Transport for NSW
- Sydney Metro
- Ausgrid
- Jemena
- Sydney Water
- Telstra and other telecommunications providers
- Local government authorities
- The contractors for other interfacing projects such as Western Harbour Tunnel and Warringah Freeway Upgrade and Sydney Metro City & Southwest (Chatswood to Sydenham) as appropriate.

6 Environmental management

6.1 Environmental management process

Utility works would be carried out to meet a series of environmental objectives. These objectives have been identified to be consistent with environmental performance measures in the environmental impact statement but provide more specific content relevant to utility works where appropriate.

Under the planning approval for the project utility works may or may not fit within the definition of construction. If works fall within the definition of construction, a range of additional approvals are required before the works can commence, including approval of the construction environmental management plan by the Secretary of the Department of Planning, Industry and Environment. In many cases it is envisaged that utility works (because they are relatively small scale) would not fall within the definition of construction and would generally require internal Transport for NSW approval and/or the approval of the project Environmental Representative. These two different pathways are summarised in Figure 6-1.

Irrespective of the pathway required to enable commencement, environmental management measures would be identified to meet the environmental objectives and in response to an environmental risk assessment.

In some cases (for example major utility connections) additional planning approval may be required. In those situations, the works would be subject to requirements specific to those approvals. Transport for NSW would however work with relevant utility providers to ensure consistency with the environmental management outcomes identified in this strategy.

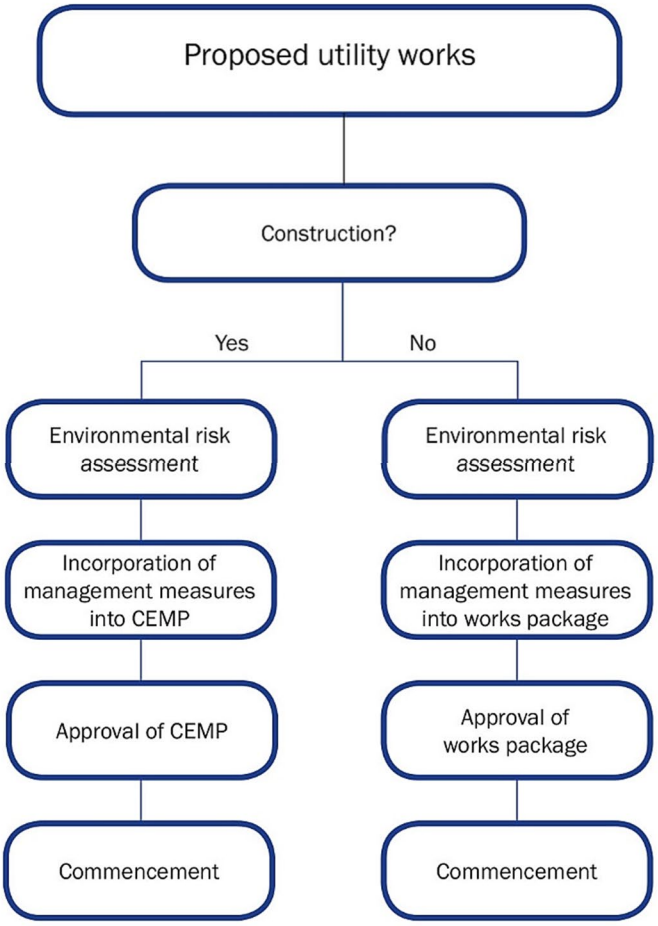


Figure 6-1 Utilities works – environmental management process

6.2 Potential impacts to be managed

Typical environmental impacts associated with anticipated utilities works during the construction phase of the project are identified in Table 6-1 This list is not intended to limit the range of environmental aspects to be considered, but rather provides a guide for likely matters to consider.

Table 6-1 Potential impacts to be managed during utilities works

Environmental aspect	Typical impacts to be managed
Traffic and access	• Additional construction related traffic resulting in changes/disruptions to traffic movements • Traffic-related safety incidents during construction (workers and road users) • Changes/disruption to property access • Changes/disruption to bus services/routes • Changes/disruption to pedestrian and cyclist movements • Temporary reduction in available car parking.
Noise and vibration	• Vibration depending on utility removal/installation technique (e.g. horizontal directional drilling or trenching) • Road traffic noise due to construction vehicle movements/haulage routes and changes in traffic movements associated with detours • Construction noise associated with physical works and type of plant and equipment proposed • Construction vibration on retained and re-laid utilities.
Air quality	• Dust from construction works (e.g. from exposed surfaces, spoil stockpiles or spoil haulage) • Exhaust emissions from equipment, machinery and construction vehicles.
Non-Aboriginal heritage	• Direct impacts from works within heritage curtilage or heritage conservation area • Potential indirect impacts to views and vistas associated with heritage items/conservation areas • Potential impacts to heritage buildings/fabric from vibration • Unexpected impacts on unknown heritage items (e.g. archaeological items) during utility relocation/adjustment works.
Aboriginal heritage	• Potential disturbance to registered sites or areas of potential archaeological deposits • Unexpected finds during utility relocation/adjustment works.
Soils and water	• Erosion of soils resulting in offsite sedimentation • Potential disturbance, handling and disposal of contaminated material including acid sulfate soils.
Flooding	• Potential impacts on construction activities due to flooding.
Biodiversity	• Removal of vegetation and/or trees • Impact to tree protection zones • Loss of habitat such as trees and other vegetation types causing habitat fragmentation • Noise and vibration impacts to fauna.
Land use and property	• Potential leasing of property for construction works • Potential changes to, or requirements for, easement arrangements for utility.
Social and economics	• Loss of community facilities/open space • Changes to access during construction • Potential impacts to businesses as a result of changes in traffic, access, parking and amenity.

Environmental aspect	Typical impacts to be managed
Landscape character and visual amenity	• Adverse visual and landscape character impacts due to construction related activities (e.g. trenching, stockpiling of materials, parking/use of construction plant and vehicles, fencing, etc.) • Light spill from out-of-hours works during construction • Rehabilitation of land (potential replanting etc.) following relocation/adjustment works.
Hazard and risk	• Transport and storage of hazardous substances and dangerous goods • Potential rupture of, or interference with, underground utilities • Risk of bushfires • Utilities comprising of asbestos materials have been identified as potentially impacted by the proposed works.
Resource use and waste management	• Increased demand on electricity and water supply • Increased demand on local and regional resources • Increased diesel use • Impacts associated with poor waste management • Impacts associated with unexpected waste volume or types.
Sustainability	• Emissions of greenhouse gases as a result of construction activities.
Cumulative impacts	• Construction noise and traffic associated with other construction support sites in proximity to the works.

6.3 Environmental objectives for utility works

Environmental objectives for utility works are listed below. These objectives would be required to be met and would be an important input in the further design development of utility works and in the development of specific management measures. This list is subject to ongoing review to remain aligned to environmental performance measures and mitigation measures in the environmental impact statement.

Table 6-2 Environmental objectives for utility works

Environmental aspect	Management objectives for utility works
Traffic and transport	• Minimise disruption to traffic operation, road users, pedestrians, cyclists and access to adjoining properties (private and public) • Maximise the safety for workers by isolating work areas from traffic flows, applying low exposure work methods, education and the installation of appropriate traffic control • Minimise use of on-street parking by site workers • Minimise disruption to traffic operation, road users, pedestrians, cyclists and access to adjoining properties (private and public) • Limit obstructions and restrictions, and when required, provide alternatives to maintain access for local community, transport operators (buses) including over- dimension load movements and commercial developments • Encourage sustainable transport options by site workers.
Noise and vibration	• Minimise noise and vibration impacts on residents and businesses • Develop construction methodologies to avoid structural damage to any existing buildings, infrastructure or heritage items as a result of construction vibration • Keep the community notified of works.
Air quality	• Minimise dust and vehicle emissions from construction activities as far as practicable.
Non-Aboriginal and Aboriginal heritage	• Avoid impacts on items or places of heritage value • Avoid accidental impact on heritage items • Maximise worker awareness of Aboriginal and Non- Aboriginal heritage.
Soils and water quality	• Prevent pollution of surface water through appropriate erosion and sediment control • Maintain existing water quality of surrounding watercourses • Prevent the pollution of groundwater through appropriate controls • Minimise the potential for impact on groundwater dependent ecosystems.
Flooding	• Minimise the potential for permanent utility infrastructure to impact flood behaviours • Minimise the potential for flooding to impact utility infrastructure.
Biodiversity	• Minimise impacts on flora and fauna • Retain existing flora and fauna habitat wherever possible • Appropriately manage the spread of weeds and plant pathogens.
Land use and property	• Minimise impacts to private property during utility works.
Social and economics	• Maintain access to residences and businesses during utility works • Plan utility works to be carried out at the same time as other project construction works to minimise disturbance more than necessary in one location.
Landscape character and visual amenity	• Minimise the visual impact of utility works to the surrounding community.
Hazard and risk	• Continue investigations and consultation with utility providers to avoid potential risks to existing utilities and services during construction of the project.

Environmental aspect	Management objectives for utility works
Resource use and waste management	• Use recycled materials • Avoid unnecessary resource consumption • Recycle and reuse materials onsite • Use water efficient construction methods and equipment.
Sustainability	• Minimise energy use and carbon emissions during construction • Encourage subcontractors and materials suppliers to adopt sustainability objectives in their works and procurement.
Cumulative impacts	• Coordinate utility works and other project construction works to minimise cumulative impacts such as traffic, parking, noise and vibration, land use, air quality and visual.

6.4 Risk based environmental assessment process

A risk based environmental assessment process would be carried out prior to the development of environmental management measures (refer to Figure 6-2). The environmental risk assessment would be consistent with relevant Australian and international standards.

It is also intended that the environmental risk assessment would be carried out in an iterative manner with the detailed design of utility works to maximise the opportunity for environmental objectives to be met. The risk based environmental assessment would be carried out whether or not a particular utility relocation package is deemed to fall within the definition of construction.

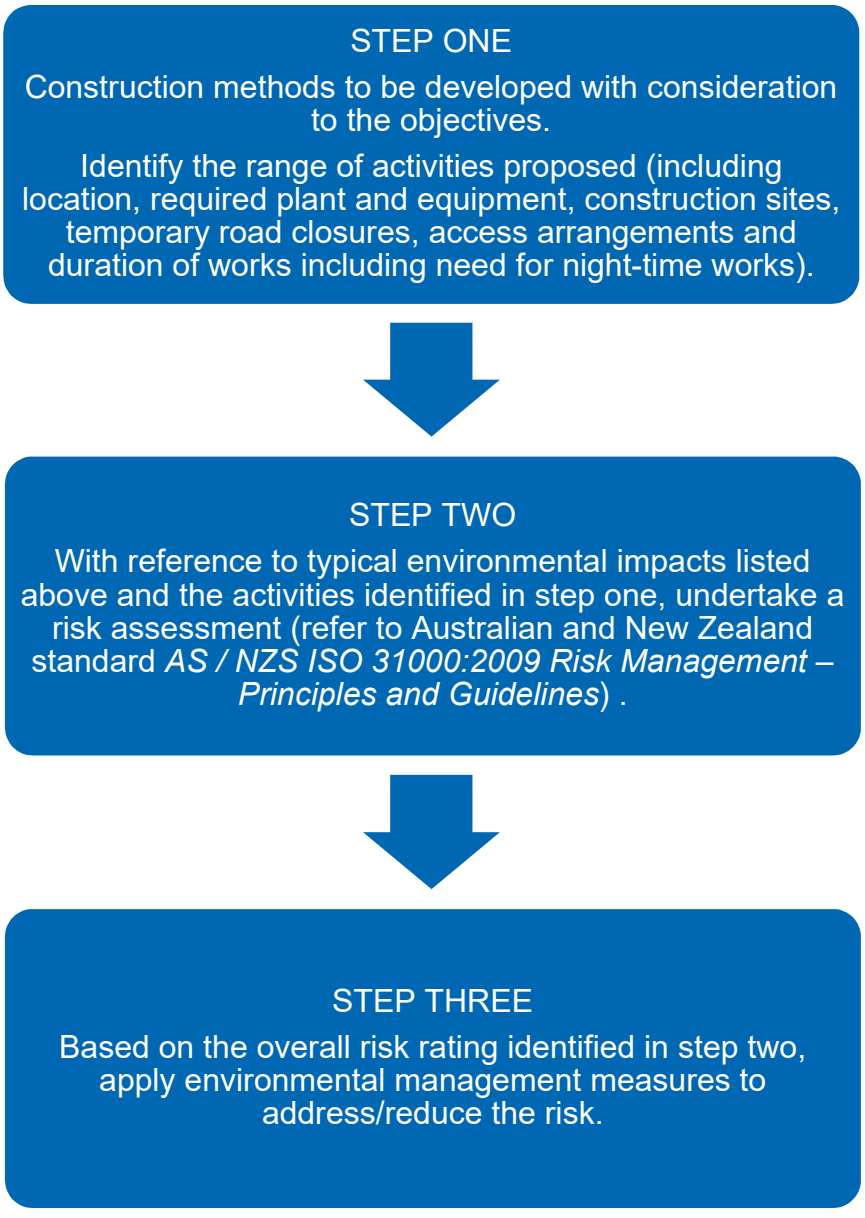


Figure 6-2 Risk based environmental assessment process