Transport for NSW/Sydney Airport Corporation Limited

Sydney Gateway Road Project

Environmental Impact Statement/ Major Development Plan

Chapter 6 Project alternatives and options

2020

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Project alternatives and options

This chapter describes the strategic alternatives, options and design refinements that were considered during project development. It provides a summary of how the project has developed to date, describes alternatives to the project as a whole, and the options and design refinements considered as part of the design and construction planning process.

The SEARs addressed in this chapter are listed below. Full copies of the SEARs, and where they are addressed in this document, are provided in Appendix A. There are no MDP requirements relevant to project alternatives and options.

Reference	Requirement	Where addressed
General standard SEARs		
2.1	The EIS must include, but not necessarily be limited to, the following:	
	(e) an analysis of any feasible alternatives to the proposal	Section 6.3
	(f) a description of feasible options within the proposal, including the placement of any bridge piers within or in close proximity to Alexandra Canal	Section 6.5
	(g) a description of how alternatives to and options within the proposal were analysed to inform the selection of the preferred alternative / option. The description must contain sufficient detail to enable an understanding of why the preferred alternative to and options(s) within the proposal were selected	This chapter
	(h) a concise description of alternative construction methods that were analysed and preferred methods	Section 6.4.3

6. Project alternatives and options

6.1 Methodology

Design development and environmental assessment was undertaken in an integrated manner to ensure that the concept design and construction planning has been informed by consideration of potential environmental and social impacts. This approach facilitates ongoing improvements to the design throughout project development to avoid or minimise adverse impacts.

Project development included the following steps:

- Identify overarching project need/s
- Develop project objectives that meet those need/s
- Identify and consider a broad range of potential options to meet the need/s and satisfy project objectives
- Identify a preferred mode or method
- Consider route options, construction options and design options
- Identify and consider environmental and social constraints and potential impacts
- Undertake an iterative process of options consideration and review to identify optimal project solutions.

Multi-criteria analysis was used to compare options and support decision making. Multi-criteria analysis involves specialists from different technical and project development disciplines working together to consider and compare benefits and disadvantages of different options. This generates a balanced assessment of how well each option satisfies project objectives and/or various site specific design, environmental, social and constructability constraints.

The project development process is shown on Figure 6.1.

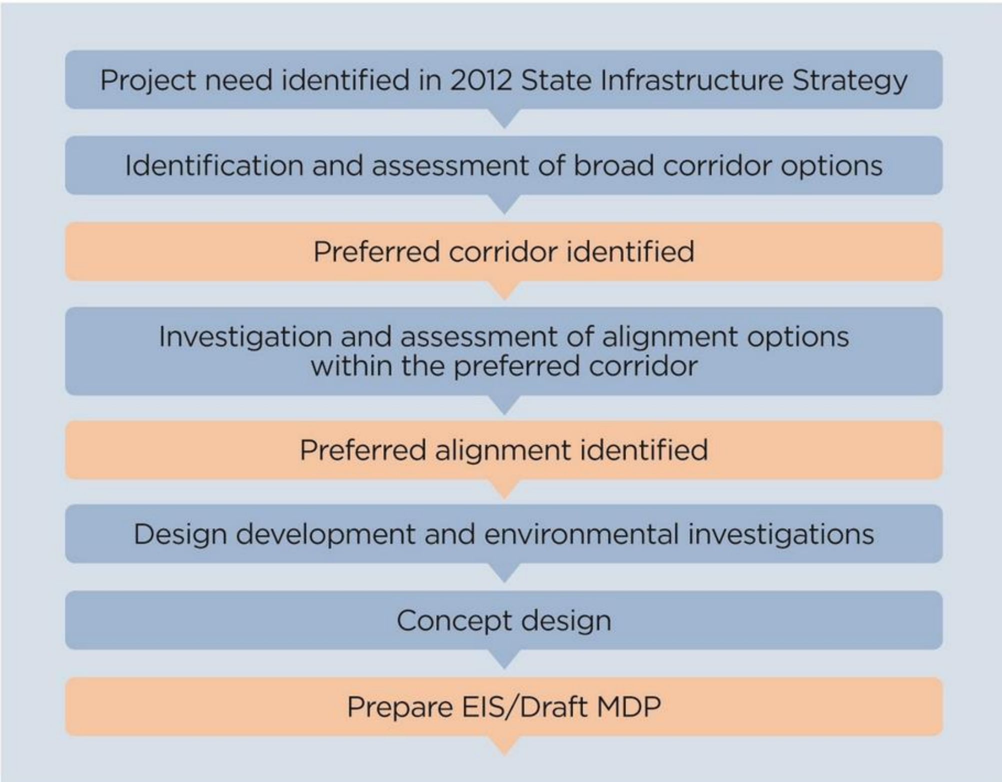

Figure 6.1 Project development process

6.2 Summary of project background and objectives

The *NSW State Infrastructure Strategy* (Infrastructure NSW, 2012) identified investments and reforms likely to have the greatest positive impact on NSW over the next 20 years. The strategy's vision for 2032 included completing Sydney's strategic road network to improve connections between Western Sydney, Sydney Airport and Port Botany, south and south-western Sydney, and other centres along Sydney's global economic corridor.

The opportunity to create a new road connection to Sydney Airport was identified during early planning for the WestConnex program of motorways. During this process it was identified that a new interchange at St Peters would create an opportunity to improve access to Sydney Airport and Port Botany. In 2015, the WestConnex Updated Strategic Business Case (Sydney Motorway Corporation, 2015) identified 'Sydney Gateway' as a proposed new road link from the proposed new St Peters interchange to the Sydney Airport and Port Botany precinct. The Updated Strategic Business Case identified that this new link was needed to fully achieve the enhanced transport connectivity, social and economic benefits of the NSW Government's substantial investment in developing the WestConnex program of works.

The NSW Government has committed to delivering the Sydney Gateway road project to realise the full benefits of its substantial investment in new Sydney motorways. The following project objectives have been identified:

- Objective 1: Improve connectivity to Sydney Airport terminals by providing direct high capacity road connections that will cater for forecast growth in passenger and air freight volumes
- Objective 2: Support the efficient distribution of freight to and from Sydney Airport and Port Botany to logistic centres in Western Sydney
- Objective 3: Improve the liveability of Mascot town centre by reducing congestion and heavy vehicle movements on the local road network.

The project also needs to support the planning objectives for Sydney Airport as defined by the *Sydney Airport Master Plan 2039* (the Master Plan) (see section 3.6.4). Further information on the strategic context and need for the project is provided in Chapter 5 (Strategic context and project need).

6.3 Consideration of strategic alternatives

Six potential strategic alternatives were considered:

1. Improvements to public transport
2. Improvements to the road network
3. Improvements to rail freight
4. Demand management
5. Do nothing/do minimum
6. New high capacity road link/s (the project).

Each alternative was analysed to assess how well it could meet the project objectives. The outcome of these considerations is discussed below.

6.3.1 Alternative 1 – Improvements to public transport

Buses

Sydney has a large bus network, but only three bus routes (400, 420 and 420N) directly service Sydney Airport. Shuttle buses are used for access between the airport, hotels and parking stations. Bus journey times in and around Sydney Airport are heavily influenced by general traffic congestion. This makes buses a less desirable option for airport access than other modes, including rail and active transport (for airport employees) that are more consistent in their journey time. In addition, public buses that access Sydney Airport do not cater for passengers with luggage, making them a less attractive option for travellers.

Even with a substantial increase in bus services and bus patronage to the airport, the three project objectives would not be fully satisfied as bus services cannot address freight and distance transport needs. Bus service improvements alone would not address the congestion issues associated with the projected growth and expansion of Sydney Airport and Port Botany. Accordingly, bus service improvements alone are not a viable alternative to the project.

However, bus access is an important part of an overall transport strategy for the precinct. Transport for NSW's Sydney's Bus Future program and the *Future Transport Strategy 2056* (Transport for NSW, 2018c), provides for improved bus access to Sydney Airport, with improved east–west and southern links. The Sydney Airport Master Plan also provides for improved infrastructure for buses, including improvements to terminal access roads, and a proposed new ground transport interchange near Terminals 2/3. A description of planned improvements to bus services in the vicinity of Sydney Airport is provided in section 5.1.4.

Proposed improvements to bus network and interchange facilities would complement the project in meeting future transport needs for passengers and airport employees. As part of the overall transport solution, the project would also support improved bus access by improving bus travel times and reliability on existing routes and improving traffic flows on arterial roads.

Passenger trains

The rail network is a key component of the vision for Sydney's future metropolitan planning and transport network as outlined in *Future Transport Strategy 2056* (Transport for NSW, 2018c). The number of passengers on the rail network is expected to almost double over the next 20 years.

Sydney Airport already has excellent rail access via an underground airport rail line (the T8 Airport and South Line) introduced into Sydney's suburban rail network in 2000. This line services both Terminal 1 and Terminals 2/3, has frequent services and is well patronised. It provides a direct link between Sydney Airport, Mascot, Green Square, the Sydney central business district and south-western Sydney. As described in section 5.1.4, Transport for NSW's *More Trains, More Services* program provides for an increase in rail services on the Sydney Trains network, including along the T8 Airport and South Line.

While an increase in rail services will not satisfy the project objectives, future rail improvements (both passenger and freight) would be complementary to the project and will form part of a strong multimodal solution to Sydney's transport needs.

Analysis of public transport as an alternative to the project

The key customer markets identified for the project include dispersed and long distance passenger movements, air and container freight, and commercial services and businesses. The travel patterns and needs of these customers are highly dispersed and diverse. These customers have highly varied requirements when it comes to the transfer of goods and services, including transporting containerised freight by rigid and articulated trucks, and transporting air freight by light trucks, vans, utility vehicles and cars. Public transport is not a viable solution for freight transport.

No combination of feasible public transport alternatives, such as heavy or light rail options, bus corridor enhancements and/or additional services, were identified that would meet the diverse range of customer needs and predicted growth for travel associated with Sydney Airport and Port Botany, or address the project objectives as effectively as the project itself.

6.3.2 Alternative 2 – Improvements to rail freight

By 2036, freight moved in NSW is forecast to increase to 618 million tonnes (see section 5.1.2). Air freight handled by Sydney Airport is predicted to increase by about 58 per cent, from 643,000 tonnes in 2017, to around one million tonnes in 2039. The amount of container freight handled by Port Botany is predicted to significantly increase over the next 15 or so years, from about 14.4 million tonnes in 2016, to about 25.5 million tonnes in 2036.

To manage the increased freight volumes, the Australian and NSW Governments have identified clear objectives to increase the share of freight moved by rail, from 17.5 per cent in 2016 to 28 per cent by 2021 (Transport for NSW, 2018a; Infrastructure Australia, 2019). In addition, NSW Ports has set a target of 40 per cent of total freight volumes to be transported to/from the port by rail by 2036. This represents a substantial increase compared with the current 14 per cent share of freight moved by rail (NSW Ports, 2015).

The Botany Rail Line forms part of the metropolitan rail freight network, which links to regional and national networks. The existing line has a section of single-track between Mascot and Botany that forms a bottleneck limiting the number of rail movements per day and preventing use during track maintenance.

A project to duplicate this section of track is being progressed by ARTC under a separate planning application (the Botany Rail Duplication project). This would remove the bottleneck, facilitating an increase in the volume of rail freight that could be moved to Port Botany. Other projects that will facilitate an increase in freight rail transport include a new intermodal freight terminal at Moorebank (Moorebank Intermodal Terminal) and the proposed upgrading of the Southern Sydney Freight Line at Cabramatta (the Cabramatta Loop project). In addition, the NSW Government is investigating, or has committed to, projects to improve rail freight capacity through segregation of freight and passenger lines. These projects will address bottlenecks and competition for rail space in those areas of the network where freight and passenger rail share the same tracks. These projects are described in the *NSW Freight and Ports Plan 2018–2023* (Transport for NSW, 2018a).

Analysis of rail freight transport as an alternative to the project

The rail freight network does not support the needs of air freight transport through Sydney Airport. Air freight is currently transported by road and there is no facility to load air freight onto the freight rail network. In addition, around 90 per cent of freight entering Port Botany has a destination within 60 kilometres of the port, and the volume of freight moving through the port exceeds the capacity of the rail network. Even with further upgrades to the rail freight network it would be impossible to transfer all freight to rail.

While rail is cost effective for long distance transport of goods to regional centres, Sydney’s freight, service and business task relies extensively on a dispersed point-to-point transport connection to customers within the metropolitan area. This task is best addressed by road transport.

Ongoing improvements to the rail freight network, including the Botany Rail Duplication project, will enhance the movement of freight by rail, but will not be sufficient to meet the identified project objectives, or to supplement rail freight transport by road. The Sydney Gateway road project and the Botany Rail Duplication project are complementary, and both projects are needed to support the diverse freight transport requirements through this precinct as well as predicted future growth. Accordingly, improvements to rail freight alone would not be a feasible alternative to the project.

6.3.3 Alternative 3 – Improvements to the existing road network

The arterial road network around Sydney Airport serves a mix of established land uses, including aviation, commercial, industrial and residential. A substantial program of road works has recently been undertaken in this area, including the Airport East and Airport North precinct upgrade projects (see section 5.1.4). Limited road reservations and the proximity of existing developments constrain the ability to provide additional widening and upgrades. Further incremental improvements to the surrounding arterial road network may assist in the short term; however, overall reductions in congestion are likely to be comparatively minor and potentially short term.

Analysis of improvements to the existing road network as an alternative to the project

Further arterial road improvements would potentially improve some of the congestion issues in the area in the short term and assist with improving amenity in Mascot (including in the town centre). However, incremental improvements to the existing network would not fully address existing or future congestion issues and would not satisfy all project objectives. Importantly, improving the existing arterial road network would not improve access and connections to/from Sydney Airport and Port Botany into Sydney’s motorway network.

Accordingly, further improvements to the existing road network in the vicinity of Sydney Airport would not provide a feasible alternative to the project.

6.3.4 Alternative 4 – Demand management

Demand management is the application of management measures to reduce transport demand. This can include measures to reduce trip lengths, reduce trip frequency and make various other transport mode options more attractive than use of the road network. Demand management initiatives may include:

- Land use planning policies that promote urban consolidation and the establishment/development of centres to reduce the need for travel
- Policies that restrict parking in new developments to encourage use of alternative transport
- Intelligent transport systems that improve transport operation and management of clearways and transit lanes, and provide greater priority to public transport over general traffic
- Pricing of transport options to reduce travel demand.

Sydney Airport, Port Botany and surrounding commercial areas are important travel demand generating precincts. Population growth, combined with the growing freight task in the Sydney metropolitan area, will result in a continued demand for use of roads providing access to these important areas. If nothing is done, the continued demand for access to these precincts, through and around these precincts would result in additional, prolonged congestion as population and freight movements both increase.

Demand management measures may help to reduce general traffic congestion and spread the demand for peak travel to less congested time periods. However, demand management measures alone are unlikely to directly impact the volume or time of movement of passengers catching scheduled flights.

Analysis of demand management as an alternative to the project

Demand management could help to spread the demand for peak travel to less congested periods. However its effectiveness is likely to be limited by constraints such as:

- The availability and proximity of other travel modes to the user’s origin and destination
- Limited opportunity (for many) to access flexible working arrangements needed to take advantage of ‘time of day’ tolling and transport pricing signals
- Travel time of day being dictated by flight schedules.

Although the introduction of demand management measures could contribute to relieving traffic congestion, the implementation of demand management measures alone would not satisfy any of the project objectives. Accordingly, demand management initiatives are not a feasible alternative to the project.

6.3.5 Alternative 5 – Do nothing/do minimum

A do nothing/do minimum approach would involve operating the existing road network around Sydney Airport in its existing configuration (including completing the current road upgrade projects described in section 5.1.4). This approach assumes that other recently approved components of the Sydney motorway network (including the M4 East, the M4-M5 Link and the New M5) are completed, but that the Sydney Gateway road project would not proceed.

Analysis of do nothing/do minimum as an alternative to the project

As a result of population, employment and urban growth, Sydney can expect worsening road network and traffic conditions if nothing is done. Doing nothing would also mean that the full benefits of the WestConnex program of works and other projects to enhance Sydney’s motorway network would not be realised. These benefits include linking major employment centres in the ‘global economic corridor’ to each other and to the wider city. Linking these employment and business centres is critical in supporting the ongoing creation of jobs. Sydney Airport and Port Botany are both key locations in this important economic corridor.

Not addressing Sydney's future transport requirements is not a feasible alternative, as Sydney is home to two-thirds of NSW's manufacturing sector, with many of the state's major aviation, pharmaceuticals, biotechnology, electronics and automotive industries based in Western Sydney. These businesses and the State economy require efficient road network connectivity between the Sydney Airport and Port Botany precincts and Western Sydney.

A do nothing or do minimum alternative would lead to worsening congestion and would not address existing and future transport needs (see Chapter 5 (Strategic context and project need)) and the project objectives. Accordingly, this is not considered to be a feasible alternative to the project.

6.3.6 Alternative 6 – The Sydney Gateway road project

The project, as part of the ongoing improvements to the Sydney motorway network, is a key part of a broader strategy to meet NSW transport needs and address congestion pressures. It would deliver new high capacity road connections between Sydney's motorway network and Sydney Airport and would meet the identified project objectives set out below:

Objective 1: Improve connectivity to Sydney Airport terminals by providing high capacity direct road connections that cater for forecast growth in passenger and air freight volumes

The project would enhance connections and access to Terminals 1 and 2/3 and improve access to Sydney Airport's freight handling facilities. It would cater for current and future traffic growth, supporting passenger and freight movements to and from the airport.

Objective 2: Support the efficient distribution of freight to and from Sydney Airport and Port Botany to logistic centres in Western Sydney

The project would deliver a new high capacity road connection between the Sydney motorway network and Sydney Airport and towards Port Botany. By linking directly to the enhanced Sydney motorway network, the project would improve travel times to Western Sydney and other important freight destinations.

Objective 3: Improve the liveability of Mascot town centre by reducing congestion and heavy vehicle movements on the local road network

By providing extra capacity on the arterial road network, improving intersection performance, and creating a direct link to the Sydney motorway network, the project would reduce congestion and provide improved routes for freight traffic. This would reduce congestion and heavy vehicle movements on the local road network and through the Mascot town centre, improving amenity and liveability.

Forecast benefits associated with completing the project include:

- Faster trips on non-arterial roads in the study area – with daily average speed forecast to increase and vehicle distance travelled forecast to reduce
- Improved road network productivity
- Reduced travel times on key corridors
- Reduced traffic on sections of the arterial road network
- Reduced traffic on roads in Mascot.

Analysis of the Sydney Gateway road project

Constructing and operating the project would meet the strategic needs identified in the project objectives. Of all the alternatives considered, constructing a new high capacity road link (the Sydney Gateway road project) is the only one that satisfies all of the project objectives set by the NSW Government. It also supports the Master Plan.

6.3.7 Summary comparison

A summary comparison of strategic alternatives is provided in Table 6.1.

Table 6.1 Comparison of strategic alternatives

Alternatives	Objective 1 *Improve connectivity to Sydney Airport terminals by providing high capacity direct road connections that cater for forecast growth in passenger and air freight volumes*	Objective 2 *Support the efficient distribution of freight to and from Port Botany and Sydney Airport to logistic centres in Western Sydney*	Objective 3 *Improve the liveability of Mascot town centre by reducing congestion and heavy vehicle movements on the local road network*	Supports the Sydney Airport Master Plan
1. Improvements to public transport	Does not achieve	Does not achieve	Does not achieve	Partially achieves
2. Improvements to rail freight	Does not achieve	Partially achieves	Partially achieves	Does not achieve
3. Improvements to the road network	Does not achieve	Partially achieves	Partially achieves	Partially achieves
4. Demand management	Does not achieve	Does not achieve	Partially achieves	Partially achieves
5. Do nothing/do minimum	Does not achieve	Does not achieve	Does not achieve	Does not achieve
6. Sydney Gateway road project	Achieves	Achieves	Achieves	Achieves

KEY: Achieves project objective; Partially achieves project objective; Does not achieve project objective

6.4 Project corridor and alignment options

6.4.1 Design constraints

The Sydney Airport and Port Botany precincts are highly developed and space for a new road link is limited by existing land uses and the complex operational requirements of key stakeholders including Sydney Airport, airlines and freight operators, NSW Ports, ARTC and others. Areas required for the safe operation of aircraft are also a significant constraint to development in areas close to the airport.

Sydney Airport, Port Botany and many of the businesses in this precinct provide services that are critical to the economy and are highly sensitive to the disruptive effects of infrastructure construction.

A key goal of project development is to minimise impacts on road network operation, transport, freight and business services in this precinct during both construction and operation. Sydney Airport and Port Botany must also remain readily accessible for air travellers, passengers and freight during project construction.

Careful consideration of site specific constraints, along with other engineering and environmental constraints, have been key to developing a feasible concept design. Key site-specific constraints are briefly outlined below.

- Alexandra Canal:
  - Contamination – 'Alexandra Canal Sediments' is a listed contaminated site under the *Contaminated Land Management Act 1997* (NSW). Construction within the canal would have the potential to disturb contaminated canal bed sediments and may impact water quality. The former

Tempe landfill area and other historic contamination of land and groundwater poses challenges for excavation and tunnelling.

  - Flooding – The canal is tidally influenced and is the major floodway draining areas in and around the study area, including Tempe, St Peters, Alexandria, Mascot and Sydney Airport. Potential minor obstructions of the lower reaches of the canal may result in substantial upstream flooding impacts.
  - Heritage – The canal is a significant historical feature and is subject to a number of heritage listings, including on the State heritage register. Heritage considerations include the fabric of the canal walls in certain sections and the 'open sky' character of the canal.
- Hazards to aviation operations – The airspace, and other systems required for safe aircraft operation at Sydney Airport, are defined by exclusion zones (known as the prescribed airspace), which limit the maximum height and location of structures in defined areas around the airport. Additionally, there are limits on proposed developments in the vicinity of runways to minimise potential air turbulence that could adversely affect aircraft, particularly on take-off and landing.
- Botany Rail Line – Minimum vertical and horizontal clearances to the rail tracks are required to maintain satisfactory levels of safety and safeguard the line for future expansion. This affects the elevation of bridge crossings as well as the location of bridge piers and clearances in key locations.
- Former Tempe landfill – On-going management of land previously used for waste disposal at Tempe relies on the continued functioning of specific infrastructure to manage leachate, landfill gas and other environmental issues. The integrity of installed management systems needs to be maintained during and after construction. Minimising the extent of project interfaces with the landfill would reduce geotechnical and environmental risks as well as waste management issues.
- Business impacts – The study area contains a number of established businesses that service the airport and port and are located to be close to these facilities. With the limited availability of industrial land in the area, these businesses may be difficult to relocate.
- Utilities – The project site contains a number of areas where utilities are prevalent, including utilities that are critical to airport operations and trunk gas mains servicing large areas of Sydney and Port Botany.
- Open space and recreation areas – The study area contains important recreational and open areas that are highly valued by the community, including Tempe Recreation Reserve, Tempe Wetlands, the off-leash dog exercise area in Tempe Lands, and the Tempe Golf Range and Academy.

6.4.2 Corridor study area

To facilitate access to Sydney Airport, and beyond to Port Botany, the project needs to:

- Connect to the road and tunnel infrastructure being constructed for the New M5 and M4-M5 Link at St Peters interchange
- Cross Alexandra Canal
- Link with the existing road network surrounding the airport at appropriate locations.

The corridor study area is shown on Figure 6.2. The study area can be broadly divided into two areas by Alexandra Canal:

- Land to the east of Alexandra Canal and north of Qantas Drive in Mascot (coloured pink in Figure 6.2)
- Land to the west of Alexandra Canal in Tempe and St Peters (coloured green in Figure 6.2).

The area to the east of the canal in Mascot (the pink area in Figure 6.2) is characterised by the following:

- Road congestion due to a mix of local and through traffic, including freight vehicles
- Large number of significant business operations that cannot be disrupted and are not easily relocated (including the Qantas headquarters)
- Significant future development opportunity and high value land.

Locating the project in this area would result in significant business impacts and higher cost compared to locating the project to the west of Alexandra Canal (the green area in Figure 6.2). Locating the project in the area to the north of Qantas Drive would also:

- Have more substantial impacts on the functioning of the local road network during construction
- Present constructability challenges, including a requirement for a complicated interchange in the constrained area around Robey and O'Riordan streets and the Botany Rail Line
- Deliver a poor alignment for connection to the new St Peters interchange.

Locating the project to the west of Alexandra Canal would also impact businesses of economic and strategic importance (particularly empty container storage) and impact recreation and open space areas. However, it was considered that there would be less potential for business impacts in this area compared to east of Alexandra Canal. It was also considered that, while there would be impacts on open space during construction, there would be an opportunity for the long-term enhancement of open space once the project is completed.

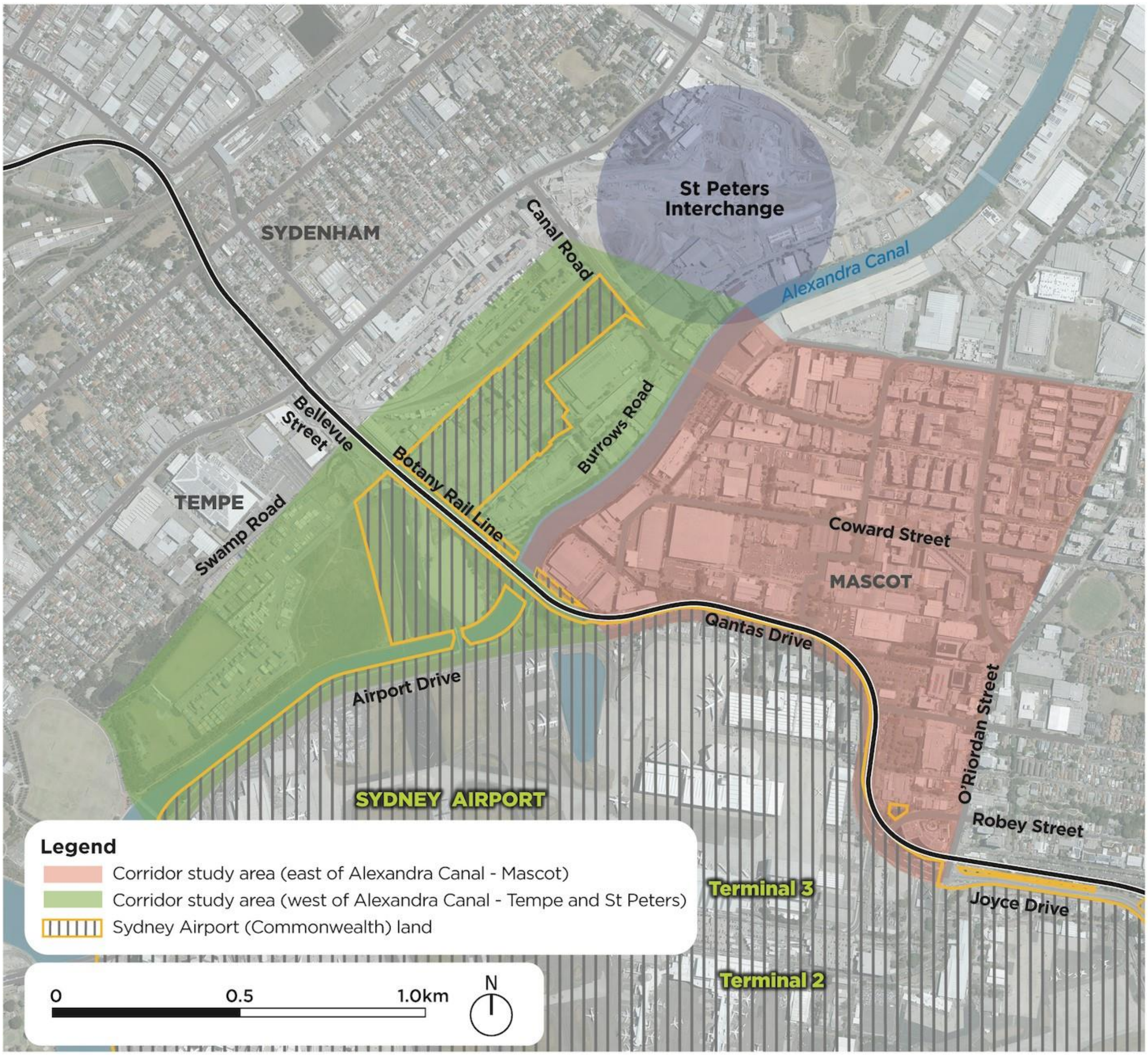

Figure 6.2 Corridor study area

6.4.3 Construction method – consideration of surface and tunnel options

Surface and tunnel solutions were both considered. Surface alignments would be difficult and challenging to construct due to the need to:

- Cross the Botany Rail Line, potentially at a number of locations, without disrupting freight rail movements
- Cross Alexandra Canal at least once, while minimising heritage and environmental impacts
- Avoid impacts on Sydney Airport and aviation operations
- Minimise impacts on the existing road network and essential utilities
- Avoid or minimise environmental, social and flooding impacts.

Tunnel solutions would avoid or reduce most of the above issues and reduce long-term visual impacts. However, there are many challenges associated with tunnelling in this location. Due to the very deep sandy sediments and high groundwater table in this area, geotechnical conditions are not ideal for tunnelling and geotechnical risks would be significant. Open cut excavation would be required causing significant surface disruption along the full tunnel length during construction. Extensive land acquisition would also be required, increasing the likelihood of substantial business disruption.

Environmental impacts of cut and cover tunnelling would include impacts on Alexandra Canal, excavation, transport and disposal of large volumes of excavated spoil material, and the need to treat and dispose of large volumes of potentially contaminated groundwater. Tunnels would also be significantly more expensive, and require more energy to construct and operate over the life of the infrastructure.

On balance, tunnel options are not preferred for the following reasons:

- The short length and comparatively steep gradients required to pass under Alexandra Canal would result in sub-optimal road gradients
- The soft sands and high groundwater table present in the area provide poor geological conditions for tunnelling
- Parts of the area are flood prone area making it difficult to protect tunnels from flooding during construction and operation
- Shallow open cut tunnelling in poor ground conditions would require acquisition of significant land for tunnel construction and management of large volumes of soil and groundwater
- Achieving optimal vertical and horizontal alignment connections to St Peters interchange and into the existing road network would be difficult
- The comparatively high cost, higher risk (compared to surface construction) and long term energy use required to operate a tunnel
- The potential environmental and heritage impacts associated with open cut excavation across Alexandra Canal.

A similar decision that tunnelling would not be preferred was also been made prior to finalising the design of St Peters interchange. Accordingly, the design for St Peters interchange allows for a surface road connection linking the Sydney Gateway road project into the new M4-M5 Link tunnels. This decision was reviewed and confirmed during development of the concept design for the Sydney Gateway road project. If a tunnelling solution had been preferred for the Sydney Gateway road project, a redesign of St Peters interchange would be required.

Both surface and tunnel options would have construction challenges. However, on balance, a surface road is considered to be easier and safer to construct. A surface roadway is preferred as it would:

- Reduce heritage and environmental impacts
- Avoid generating large quantities of spoil
- Minimise exposure to contaminated land and groundwater associated with open cut excavation

- Deliver superior road network connections and road geometry
- Reduce operational energy requirements
- Have a relatively lower cost and construction risk.

A summary comparison of tunnelling and surface construction methods is provided in Table 6.2.

Table 6.2 Comparison of tunnel and surface construction methods – support for project goals

Design/project goals	Tunnels	Surface construction
Optimise connection to St Peters interchange	Moderate support	Strong support
Optimise transport outcomes (network interfaces, gradient and alignment)	Poor support	Strong support
Support airport operations and Airport Master Plan	Moderate support	Strong support
Minimise environment and heritage impacts	Poor support	Moderate support
Minimise business impacts	Poor support	Moderate support
Optimise constructability	Poor support	Moderate support

KEY: Strong support Moderate support Poor support

6.4.4 Surface corridor options

Options considered

Six surface corridor options were considered as shown on Figure 6.3.

The light blue and purple corridor options were not preferred as they do not optimise connections into St Peters interchange (as currently designed and being constructed), would impact a large number of difficult to relocate businesses, and adversely impact the banks of Alexandra Canal.

The green corridor option was not preferred as it would also impact a large number of businesses in the established Mascot business precinct to the north of Qantas Drive, as well as in St Peters and Tempe.

The red corridor option was not preferred due to its relatively poor alignment and the potential impacts on Sydney Airport land and operations. In particular, the need to construct a large interchange at the connection with Airport Drive and Qantas Drive would adversely impact land used for aircraft maintenance operations.

The dark blue corridor option performs reasonably well except for a poor level of support for airport operations and future land uses under the Master Plan. This is because it would require a single, large road network interchange, which would take up substantial airport land in close proximity to the main north–south runway.

All options could include upgrading Qantas Drive and the access to Terminals 2/3 so this was not a deciding factor. All options would result in some unavoidable environmental and social impacts, particularly during construction, due to the size of the project footprint and extent of construction activity required to build a major new road link in a constrained urban area. All options also have potential heritage impacts due to the close proximity to Alexandra Canal, which is listed on the State heritage register.

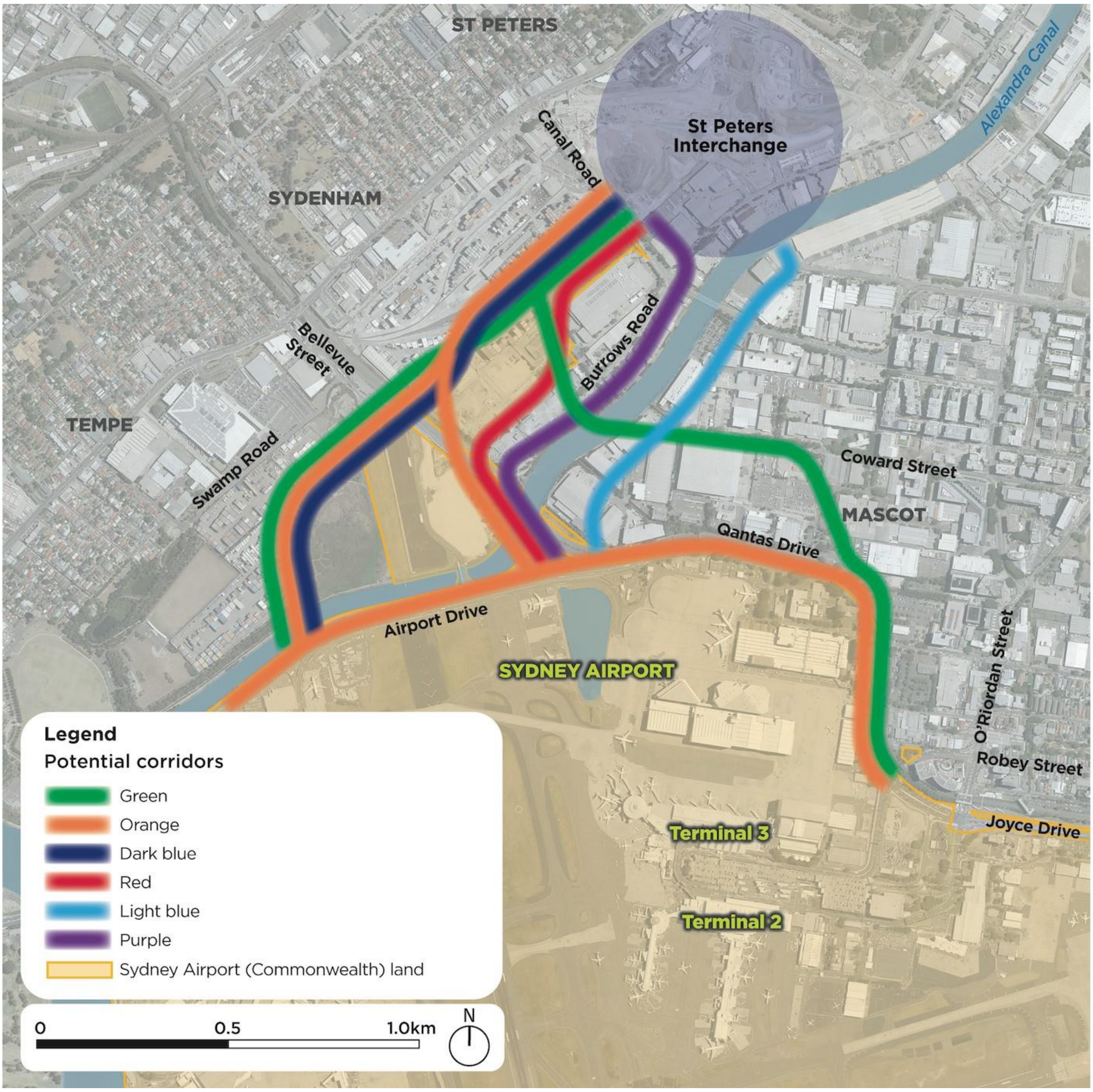

Figure 6.3 Potential corridor options

Preferred corridor option

In the comparative assessment, it was considered that the light blue and purple corridor options performed slightly worse than other options against the goal of minimising environmental and social impacts. This is because their alignment follows the bank of Alexandra Canal for a considerable distance, increasing the likelihood of more substantial impacts to the canal (including visual and heritage impacts) than for other options.

Overall, the orange corridor option was preferred as this option would provide:

- Superior road geometry and transport outcomes
- Reasonable support for Sydney Airport operations and future planning in accordance with the Master Plan
- Good connectivity with the existing design of St Peters interchange
- Moderate potential business, flooding, environmental and social impacts.

The orange corridor option was carried forward for further design development.

A summary comparison of issues associated with the surface corridor options is provided in Table 6.3.

Table 6.3 Comparison of surface corridor options – support for project goals

Corridor option	Support the Sydney Airport Master Plan and airport operations	Optimise road alignment and driver experience	Connect with St Peters interchange	Minimise potential business impacts	Minimise potential flooding impacts	Minimise potential environment and social impacts
Light blue	Poor support	Moderate support	Poor support	Poor support	Poor support	Poor support
Green	Strong support	Moderate support	Strong support	Poor support	Moderate support	Moderate support
Purple	Poor support	Moderate support	Poor support	Poor support	Poor support	Poor support
Red	Poor support	Poor support	Strong support	Moderate support	Poor support	Moderate support
Dark blue	Poor support	Moderate support	Strong support	Moderate support	Moderate support	Moderate support
Orange	Strong support	Strong support	Strong support	Moderate support	Moderate support	Moderate support

KEY: Strong support Moderate support Poor support

6.4.5 Potential alignment options

Further design development was undertaken to identify potential alignment options broadly within the preferred orange project corridor. All options would include improved access to Terminals 2/3.

Alignment options within the preferred corridor

Four alignment options were developed to explore differences between:

- Having one or two connections to the existing road network (at Airport Drive/Qantas Drive)
- Continuing to use or bypass Airport Drive
- Potential project footprints, including the number of bridges over Alexandra Canal, and associated impacts on Sydney Airport facilities and other land, existing businesses, open space and the former Tempe landfill.

Different locations for crossing the Botany Rail Line and Alexandra Canal, and different aspects of network functionality, were explored as different potential alignment options were developed.

Two options (options 2 and 4) allow for only one connection to the existing road network. This would require a larger interchange area to accommodate all traffic movements. These options are shown on Figure 6.4.

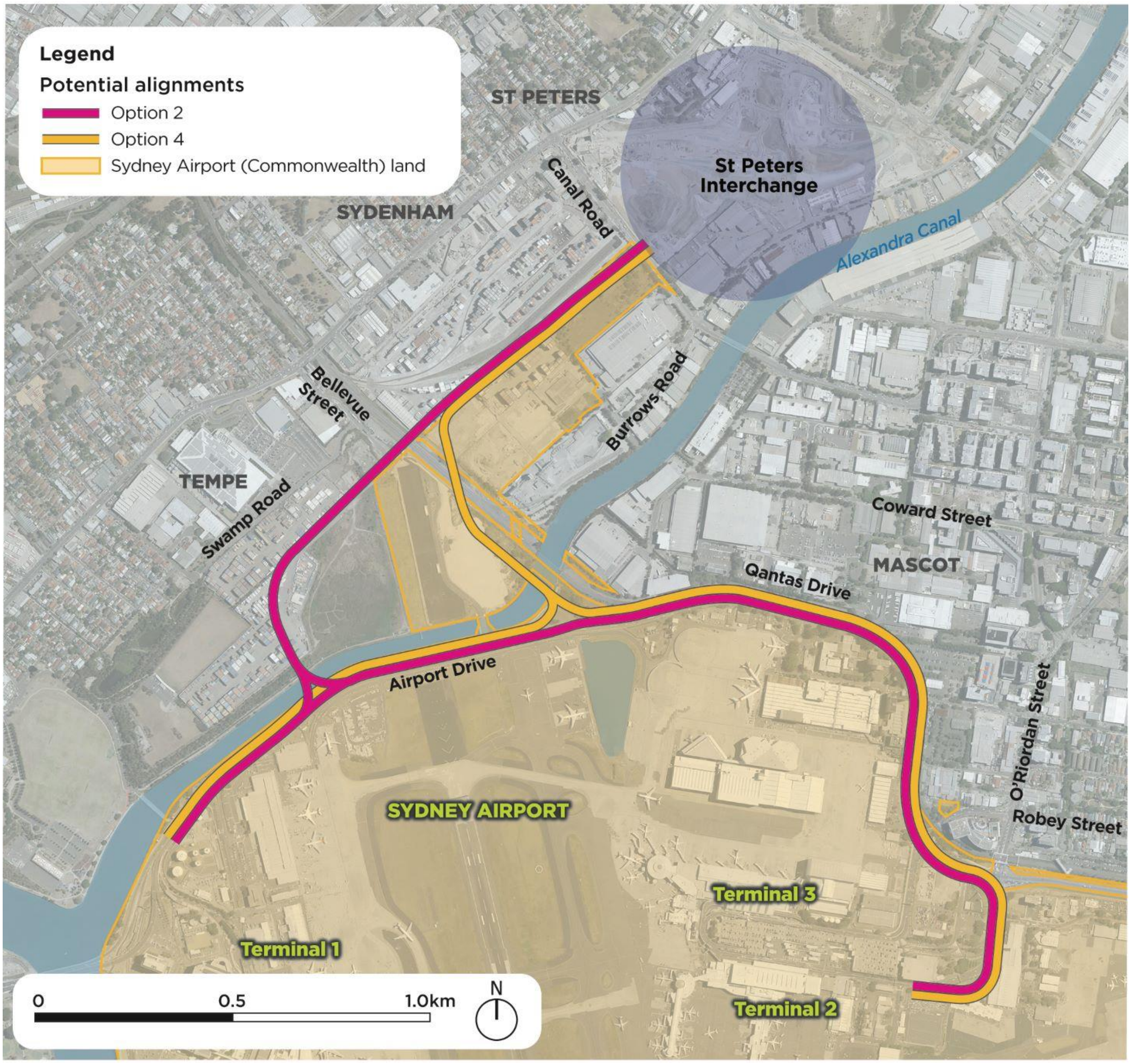

Figure 6.4 Potential alignment options with one connection to the existing road network

Two options (options 1 and 3) have two connection points with the existing road network. This would reduce the footprint of each intersection and separate traffic accessing Terminal 1 and Terminals 2/3. These options are shown on Figure 6.5.

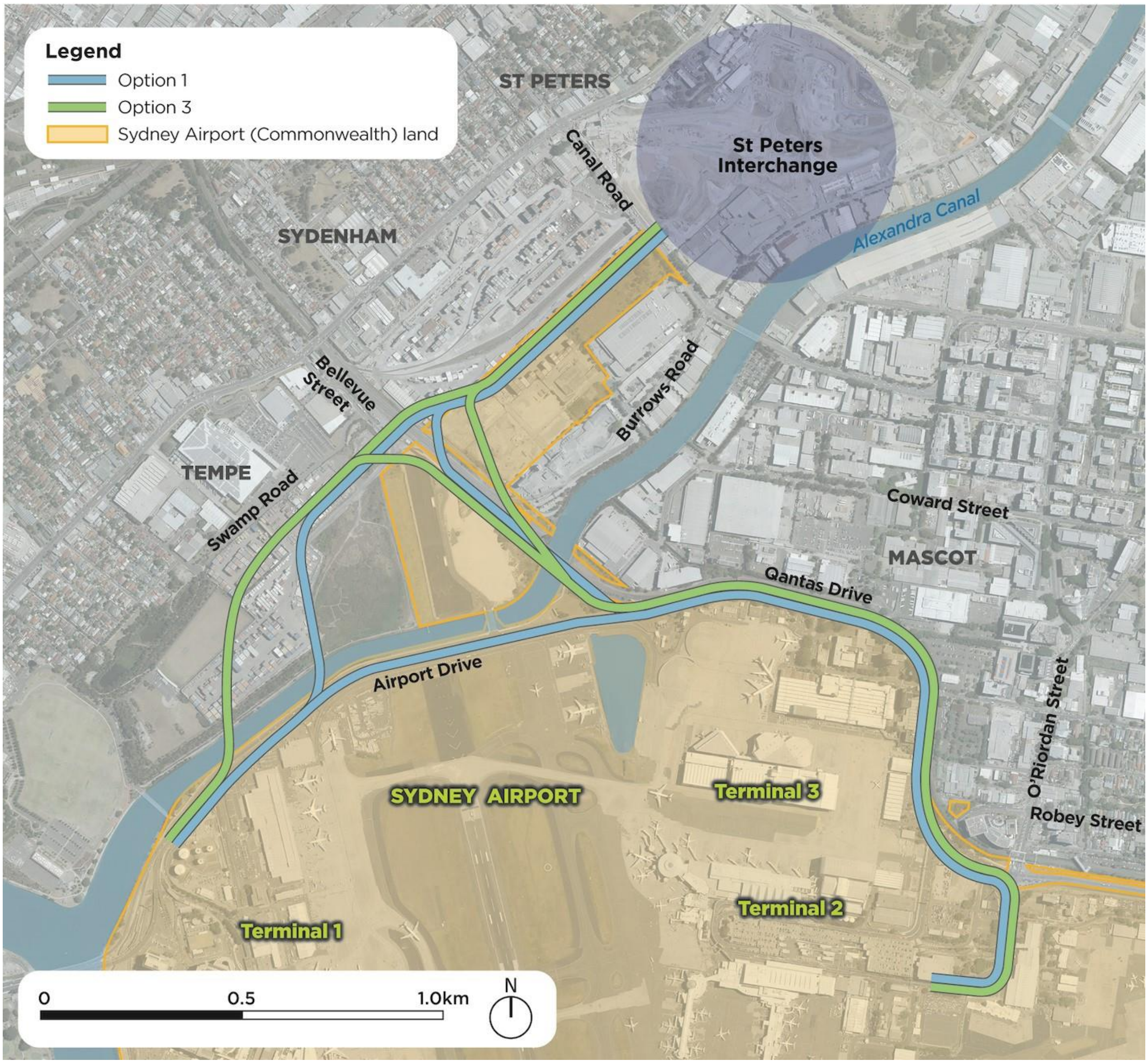

Figure 6.5 **Potential alignment options with two connections to the existing road network**

A summary comparison of the alignment options is provided in Table 6.4.

Table 6.4 Comparison of alignment options within the preferred corridor

Feature/alignment	Option 1 (light blue)	Option 2 (pink)	Option 3 (light green)	Option 4 (yellow)
Bypass Airport Drive	No	No	Yes	No
Connections to road network	Two	One	Two	One
Impacts to public open space	No	No	Yes	No
Impacts on former Tempe landfill	Yes	Yes	Yes	No
Business impacts	Yes	Yes	Yes	Yes
Number of canal crossings	Two	One	Two	One
Environment, social and heritage impacts	Yes – management required	Yes – management required	Yes – management required	Yes – management required

Connection to the existing road network

The key difference between these alignment options is whether the project would link into the existing road network at a single large interchange, or whether traffic would be split between two connections. This choice affects road network functioning, project footprint and driver experience.

Options 2 and 4 have one connection to the existing road network. This would be a single, large interchange to cater for all traffic movements accessing Terminal 1, Terminals 2/3 and towards Port Botany. This would require substantially more Sydney Airport land. It would also be more difficult to construct, with more disruption of existing traffic during construction.

Providing two separate connections to the existing road network (options 1 and 3) allows for different routes to access Terminal 1 and Terminals 2/3. This allows for simplified intersection footprints, thereby reducing land requirements, improving constructability and reducing traffic disruption during construction. Splitting traffic between separate network interfaces serving the two terminal precincts would also simplify wayfinding for drivers and deliver improved long-term transport capacity.

Providing two connections to the existing road network is preferred because it would:

- Enable a better long term transport outcome
- Simplify wayfinding
- Improve the driver experience
- Simplify construction and staging of temporary road network adjustments during construction
- Reduce the complexity of network interfaces
- Reduce the area of airport land required for network interface construction and operation.

However, it is a more expensive solution due to the need for additional pavement and separate bridge connections.

Options 1 and 3, which provide two network connections, were shortlisted for further design development and consideration.

6.4.6 Preferred alignment

Assessment of shortlisted alignment options

The two shortlisted alignment options (options 1 and 3) are shown on Figure 6.5. These two alignments were compared against the desired project outcomes, including:

- Optimise traffic/transport outcomes (promoting efficient transport of freight, minimising impacts on Mascot town centre, and minimising impact on the existing road network)
- Optimise safety
- Optimise connections to Sydney Airport
- Minimise impacts on airport operations and future airport expansion opportunities
- Minimise impacts on businesses and acquisition of private land
- Minimise impacts on the environment and community
- Maximise the opportunity to create a positive 'Gateway to Sydney' urban design experience
- Improve constructability and reduce traffic impacts during construction.

A key difference between the two shortlisted options is whether Airport Drive remains in use for general traffic (option 1) or whether a bypass is created (option 3). Important considerations regarding whether to retain or bypass Airport Drive for general traffic use include:

- Large trucks passing near the end of the north–south runway on Airport Drive currently conflict with Sydney Airport's prescribed airspace, introducing a hazard to aviation operations and the general public
- Airport Drive is owned by the Commonwealth and the NSW Government has no power to acquire this land without agreement
- The Master Plan includes reference to converting Airport Drive to airport operations only.

Both options 1 and 3 enhance connections to Sydney Airport by providing dedicated routes to Terminal 1 and Terminals 2/3. With respect to the route between Terminal 1 and Terminals 2/3, option 3 requires vehicles to traverse a longer route. However, the additional journey length and duration is considered to be relatively minor.

With respect to safety outcomes, there is a significant difference between the two options. Bypassing Airport Drive removes public safety risks associated with incursions into Sydney Airport's prescribed airspace caused by large trucks on Airport Drive. While a significant incident has not occurred in this area, the current alignment of Airport Drive places a large number of vehicles in close proximity to the public safety area at the end of the runway. The potential outcome of an adverse safety incident in this location would be extremely serious. There is an opportunity to address this issue as part of the project by adopting option 3, which creates a bypass of this section of Airport Drive. Accordingly, a design which avoids ongoing intrusions into the prescribed airspace and diverts traffic away from close proximity to the end of the runway is preferred, as it provides the most desirable safety outcome.

Option 1 does not support the Master Plan. It does not allow for the section of Airport Drive at the end of the north–south runway to be closed to general traffic. This is an important consideration for Sydney Airport, as this is a key factor for future airport planning and operations.

Both options would have similar land requirements for construction and operation, and similar levels of impacts on businesses, the environment and the community. Measures to minimise and mitigate these impacts are provided in Part B of this document.

The opportunity to enhance public open space and the simplification of routes and wayfinding provided by option 3 was considered to offer improved 'Gateway to Sydney' urban design opportunities compared to option 1. Option 3 was also considered to offer improved constructability outcomes compared to option 1. This is a result of the greater height of the prescribed airspace above the Terminal 1 access bridge and the opportunity to construct most of the Terminal 1 connection and Qantas Drive extension off line, maximising traffic staging opportunities, and minimising disruption to the traffic network.

Earlier design schemes included additional road connections to/from Canal Road for both cars and trucks. However, traffic modelling indicated that such ramps would provide minimal traffic benefits compared with the estimated cost. Based on these investigations, a decision was made that the ramps would not form part of the reference design. Following feedback from the freight industry in 2019, Transport for NSW has been working with industry to explore options for dedicated heavy vehicle access onto the project at Canal Road. While these ramps do not form part of the reference design, there is sufficient space for ramps in this location in future should this be required.

Preferred alignment option

A comparative analysis of options 1 and 3 is summarised in Table 6.5.

Table 6.5 Comparison of shortlisted alignment options – support for design goals

Design/project goals	Option 1 (blue)	Option 3 (light green)
Optimise traffic and transport outcomes	Strong support	Strong support
Optimise safety	Poor support	Strong support
Optimise connections to Sydney Airport	Strong support	Strong support
Minimise impacts on Sydney Airport operations and support the Sydney Airport Master Plan	Poor support	Strong support
Minimise impacts on businesses and acquisition of private land	Moderate support	Moderate support
Minimise impacts on the environment and community	Moderate support	Moderate support
Maximise opportunity to create a 'Gateway to Sydney' urban design experience	Moderate support	Strong support
Optimise constructability (including minimising traffic impacts during construction)	Moderate support	Strong support

KEY: Strong support Moderate support Poor support

On balance, option 3, which bypasses the section of Airport Drive close to the end of the north–south runway, is preferred. This option removes an existing safety conflict, supports the Master Plan, provides improved constructability, and provides simpler operational wayfinding and connections. The preferred option is shown on Figure 6.6.

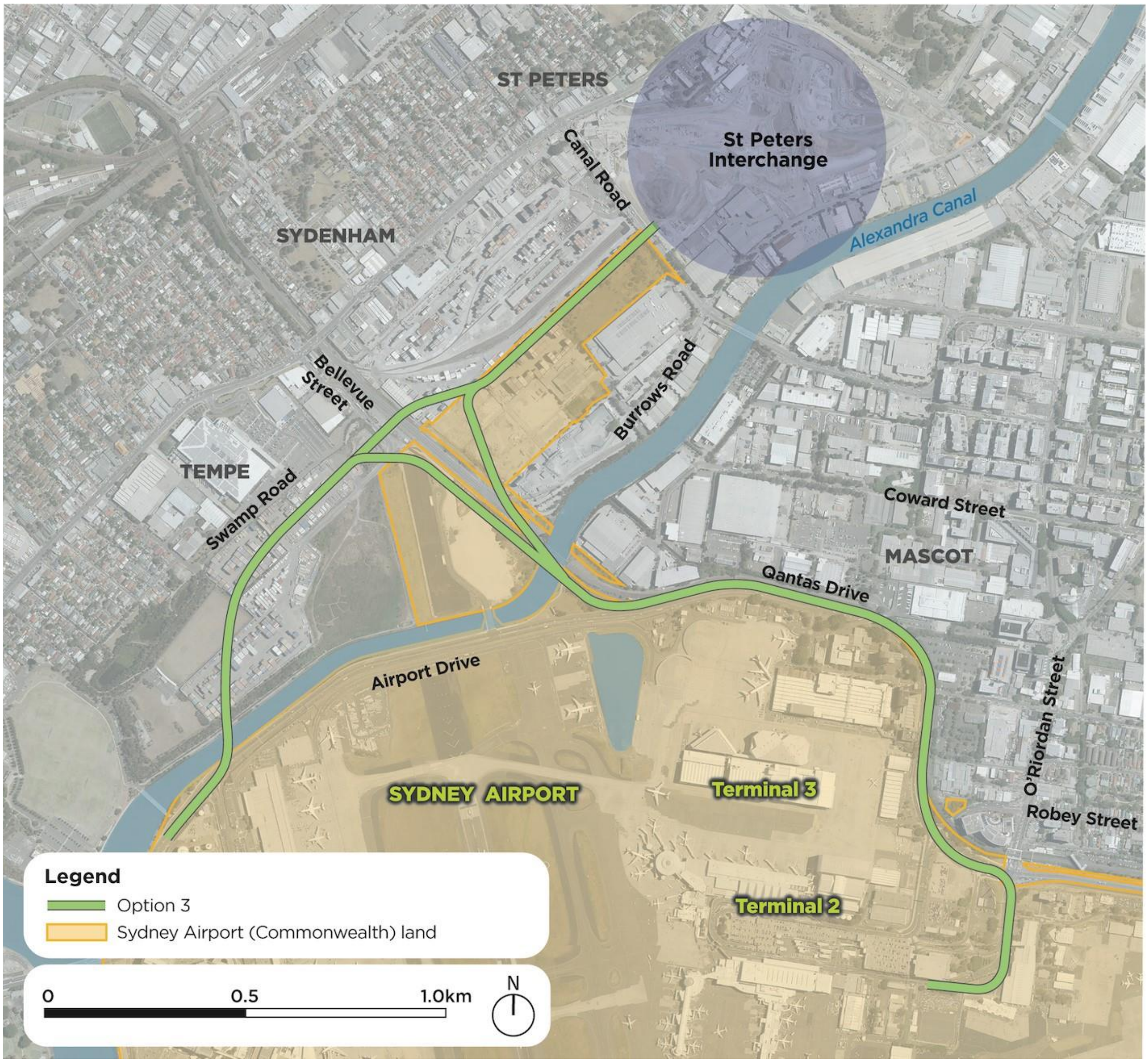

Figure 6.6 Preferred alignment option

6.5 Refining the design of key project features

Following identification of the preferred alignment, further design work was carried out to refine the design of key project features.

This section describes options considered as part of the design development process for:

- Locating a bridge across Alexandra Canal to connect to Terminal 1
- Designing the bridges over Alexandra Canal
- Minimising excavation into the former Tempe landfill
- Managing excavated landfill material
- Relocating the active transport link
- Drainage outlets at Alexandra Canal
- Access to Terminals 2/3.

6.5.1 Location of the bridge to Terminal 1

The prescribed airspace around Sydney Airport limits the height of structures in certain areas (see section 2.2.1). This creates a significant constraint for the design and operation of new overpasses and bridges, including those crossing the Botany Rail Line and Alexandra Canal in close proximity to the end of the north–south runway.

The location and alignment of the bridge to Terminal 1 (the Terminal 1 connection bridge) was moved to a more southerly location to:

- Avoid impacts on the prescribed airspace
- Improve constructability
- Maintain the existing Link Road access to the international freight terminal
- Minimise disruption to existing traffic
- Minimise construction time.

A more southerly alignment for the bridge provides more height for cranes to operate without penetrating the prescribed airspace. It also allows an improved road geometry, with a higher vehicle speed and a better driver experience, compared to a location further north or perpendicular to the canal. A more southerly alignment also creates sufficient space to construct a dedicated access link to Sydney Airport's freight terminal near Terminal 1 and the proposed location of additional freight facilities on the western side of Alexandra Canal.

A more southerly alignment was identified as the preferred alignment as it provides:

- Superior constructability
- Reduced traffic impacts during construction
- Improved road geometry and customer experience
- Superior freight transport outcomes.

Disadvantages of a more southerly bridge alignment include closer proximity to sensitive receivers and more impact on public open space, Tempe Lands and the former Tempe landfill.

6.5.2 Design of the bridges over Alexandra Canal

The preferred corridor and alignment options described in section 6.4 includes new bridges over Alexandra Canal, providing connections to Terminal 1, Qantas Drive and the international freight terminal.

The location (spacing) of bridge piers is an important consideration in the development of cost-effective bridge designs, in addition to other constraints (see section 6.4.1). An important consideration for this project was whether to locate piers within Alexandra Canal. The length of the bridge spans required to pass over the canal range from about 55 metres (for the freight terminal access bridge) to 90 metres (for the Terminal 1 connection, Qantas Drive and terminal link bridges).

Placing bridge piers within the canal would reduce the bridge deck thickness and reduce cost. However, flood modelling undertaken to support the concept design identified that placing piers within the canal would cause an unacceptable increase in flood levels. To mitigate this potential impact, a large amount of land would be required to provide floodwater storage. This would result in additional land requirements.

Locating bridge piers in the canal would also have heritage impacts, and could mobilise contaminants in the canal bed sediments during construction and operation. To avoid and minimise these potential impacts, bridges have been designed without supporting piers in the canal. If this were to change as a result of further design development, additional assessment would be required.

Assessment of bridge design options

A series of bridge options were identified and considered for each crossing location. Each option was ranked using a multi-criteria assessment against agreed engineering, construction, environmental and cost criteria. The assessment criteria included:

- Functional performance (including impacts on utilities and other infrastructure)
- Environmental impacts and urban design outcomes
- Constructability (including safety and staging considerations)
- Implementation and delivery risk
- Estimated whole of life cost.

A multi-disciplinary workshop was held to review each bridge design option and collaboratively score the relative performance of each option against the assessment criteria. A summary of the options considered, and the reasons for selection of the preferred bridge option for each crossing, are provided in the following sections.

Terminal 1 connection bridge

The Terminal 1 connection bridge provides access to Terminal 1. It is located near the south-western end of the project site. It needs to span over Alexandra Canal and the Sydney Water desalination pipeline, connect with Airport Drive, and provide eight traffic lanes (four lanes in each direction).

The following options were considered:

- Option 1: Twin, tied arch steel bridges with bridge decks suspended from concrete-filled steel tubes
- Option 2: V-tower cable-stayed bridge (with thin eight lane deck)
- Option 3: Cable-stayed bridge (with thicker eight lane deck)
- Option 4: Twin balanced cantilever concrete bridges (with four lanes on each deck). This option would not require any elevated supporting structures but would require piers to be installed on the western side of the canal between the canal wall and the desalination pipeline.

The key differences between the options in relation to the assessment criteria are summarised below:

- Functional performance: Options 2 and 3 have had limited previous Australian application. Option 4 would provide the desired clearance of the desalination pipeline.
- Environmental impacts: All options would avoid piers in Alexandra Canal. All options would require some excavation within the former Tempe landfill.
- Constructability: Option 4 would be the simplest and quickest to construct and involve standard construction methodologies widely used in NSW and Australia. Options 1, 2 and 3 would be more complex to construct. Options 2 and 3 would be the most difficult to construct with additional time and cost risk.
- Constructability (staging): Option 4 involves constructing two bridges, allowing each bridge to be completed separately, providing greater flexibility to stage traffic movements during construction (discussed in section 8.4.3).
- Implementation: Option 1 would require temporary support towers to install the arches. Additionally, assembly of the bulk steel elements for option 1 would potentially result in greater delivery risk relative to the other options.
- Whole of life cost: Options 2 and 3 would be relatively more expensive compared with other options. Option 4 would have the lowest whole of life cost.

Option 4 (twin balanced cantilever concrete bridges) performed strongly in the areas of functional performance advantages, constructability benefits, and lowest whole of life costs. Option 4 was selected as preferred as it performed best against the identified assessment criteria.

Figure 6.7 illustrates the preferred bridge option for the Terminal 1 connection bridge (option 4).

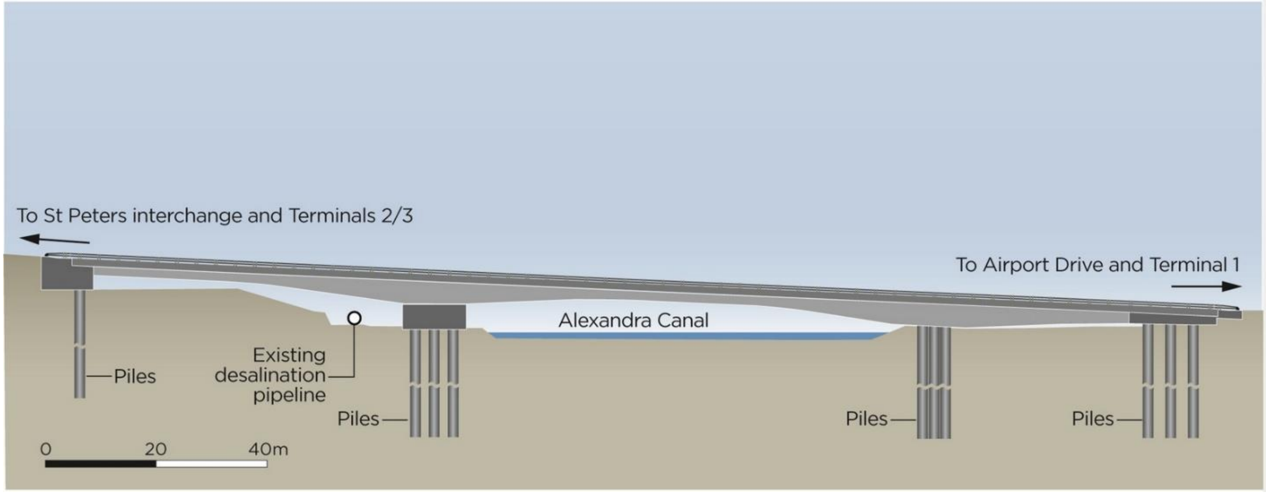

Figure 6.7 Preferred balanced cantilever concrete bridges for the Terminal 1 connection bridge

Freight terminal access bridge

This bridge forms part of the freight terminal access located to the north of the Terminal 1 connection bridge. It needs to cross Alexandra Canal and the desalination pipeline, connect to Airport Drive, and provide four traffic lanes and a shared path.

The following options were considered:

- Option 1: Two span, steel box girder and pre-stressed plank bridge – consisting of a single box girder bridge over the canal and desalination pipeline, with a plank and girder span on the western side of the canal
- Option 2: Two span, continuous steel box girder bridge.

Cable-stayed bridge options were also considered but not shortlisted, as they would be significantly more expensive to construction and ensure they conform to aviation safety requirements. The key differences between options 1 and 2 in relation to the assessment criteria are summarised below:

- Functional performance: Option 2 would provide the desired clearance to the desalination pipeline required by the asset owner
- Environmental impacts: Option 2 would result in less excavation from the former Tempe landfill.

No significant differences were identified in constructability, implementation or whole of life cost. On balance, Option 2 (two span, continuous steel box girder bridge) was selected as preferred as it performed best against the assessment criteria.

Figure 6.8 illustrates the preferred bridge option for the freight terminal access bridge (option 2).

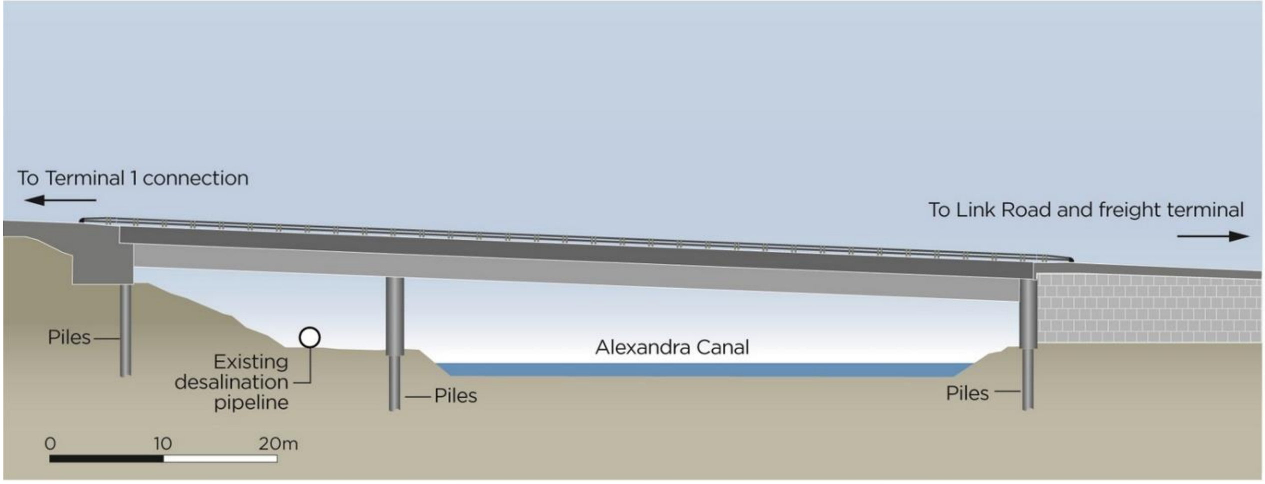

Figure 6.8 Preferred steel box girder bridge for the freight terminal access bridge

Qantas Drive bridge

This bridge forms part of the Qantas Drive upgrade and extension. It needs to cross Alexandra Canal, pass over the eastbound terminal link and the Botany Rail Line, and provide six traffic lanes.

The following options were considered:

- Option 1: Single concrete box girder bridge with plank and girder spans over the Botany Rail Line and the northern lands access
- Option 2: Twin, steel box girder bridges.

Balanced cantilever concrete and cable-stayed bridge options were also considered, but not shortlisted, as they would be significantly more expensive. The key differences between options 1 and 2 are summarised below:

- Environmental impacts: Option 2 would generate less spoil (which could potentially be contaminated) and would be aesthetically similar along its entire length providing a better urban design and visual outcome. In contrast, option 1 would appear as a combination of different structures leading to poorer urban design outcome and greater visual impact.
- Constructability (footprint): Option 1 would require access to and use of more construction work areas compared with option 2. Some of these additional areas would be required to be located within adjacent facilities, further extending the project construction footprint. Option 1 may also take longer to construct than option 2.
- Implementation: Option 2 would have a lower delivery risk as it would require a more limited site area and not require access to adjacent properties.

On balance, option 2 (twin, steel box girder bridges) performed best against the identified assessment criteria. Option 2 was selected as preferred as it performed strongly in the areas of implementation risk, constructability. It would also be would be more consistent visually along its length leading to improved urban design outcomes.

Terminal link bridge

This bridge forms part of the eastbound terminal link. It is located below, and to the north of, the Qantas Drive bridge. It needs to cross over Alexandra Canal and provide two traffic lanes.

The following options were considered:

- Option 1: Cable-stayed bridge
- Option 2: Truss bridge
- Option 3: Twin, tied arch bridges – with bridge decks suspended from concrete filled steel tubes.

The key differences between the options in relation to the assessment criteria are summarised below:

- Environmental impacts: Option 2 would be the best fit within the landscape and provide the greatest consistency with other bridges
- Constructability: Options 2 and 3 would be the only options that would facilitate the continued use of the section of shared user path east of Nigel Love bridge during construction
- Constructability: Option 1 would be most difficult to construct with higher cost and program risks
- Whole of life costs: Option 1 would be most expensive. Option 3 would have the lowest whole of life cost.

Options 2 and 3 performed similarly in the assessment. Overall Option 3 was preferred due to its lower whole of life costs and visual appearance relative to the two adjacent bridges.

Figure 6.9 illustrates the preferred bridge option for the terminal link bridge (option 3).

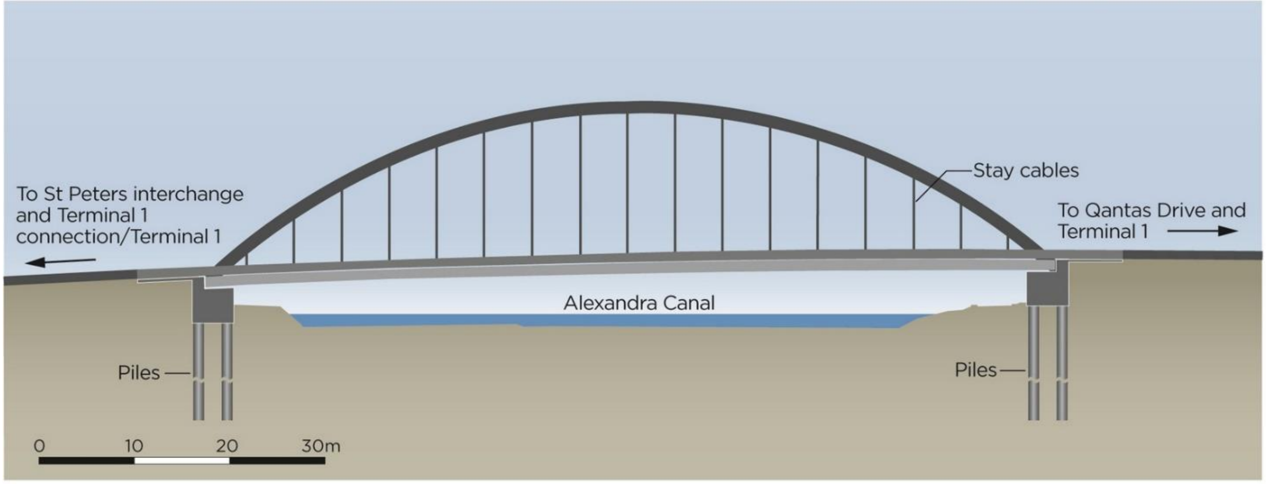

Figure 6.9 Preferred tied arch bridge for the terminal link bridge

6.5.3 Minimising excavation into the former Tempe landfill

The project crosses the former Tempe landfill. To construct the Terminal 1 connection, about 90,000 cubic metres of waste material would need to be excavated, with a new landfill cap and new road infrastructure placed over the top.

Design refinements to minimise the amount of waste excavation included:

- Raising the northern approach to the freight terminal bridge
- Raising the northern approach to the Terminal 1 connection bridge
- Using an innovative foundation design that acts as both the foundation for the road and a new cap for leachate and landfill gas.

To minimise the potential for environmental impacts, the road alignment was kept as high as possible. This would reduce excavation into the former Tempe landfill, while still providing adequate clearance to prevent vehicles penetrating Sydney Airport's prescribed airspace.

6.5.4 Management of excavated landfill material

Two options were considered for managing excavated landfill materials:

- Option 1: Remove for disposal at a landfill
- Option 2: Retain on site in new waste 'cells'.

The location of the project on a former landfill site provides an opportunity to reduce the project's total environmental impact by re-emplacing waste material on the project site.

Re-emplacing excavated waste material on site could avoid up to around 4,500 truck movements associated with disposal and save limited space in other licenced landfill sites.

Re-emplacement would also create opportunities for new landscaping features such as mounds, lookouts, and new areas for active and passive recreation. To reduce the overall project environmental impacts, retaining and re-emplacing some of the excavated waste materials on site in the form of one or more emplacement mounds is proposed. Final decisions on the location and size of the mound(s) would be made with reference to aviation safety considerations, including potential impact on air movements and windshear, and Council's requirements for future use and design of open space.

It is anticipated that a combination of retaining some excavated landfill material in mounds on site and removing the rest to an offsite landfill would be required.

6.5.5 Relocation of the active transport link along Alexandra Canal

Location and key design constraints

The project would impact the existing off-road shared cycle and pedestrian path adjacent to Airport Drive and Alexandra Canal (the Alexandra Canal cycleway). This path is part of a popular regional cycle route extending from Wolli Creek Station to Coward Street, Mascot, where it connects to shared paths on Bourke Street, Bourke Road and Gardeners Road.

Part of the shared path adjacent to Airport Drive and Alexandra Canal would need to be relocated because the section of Airport Drive to the north of the freight terminal access would be closed to non-airport traffic on completion of the project in accordance with the Master Plan.

Four potential options relocate the active transport link were considered as shown on Figure 6.10.

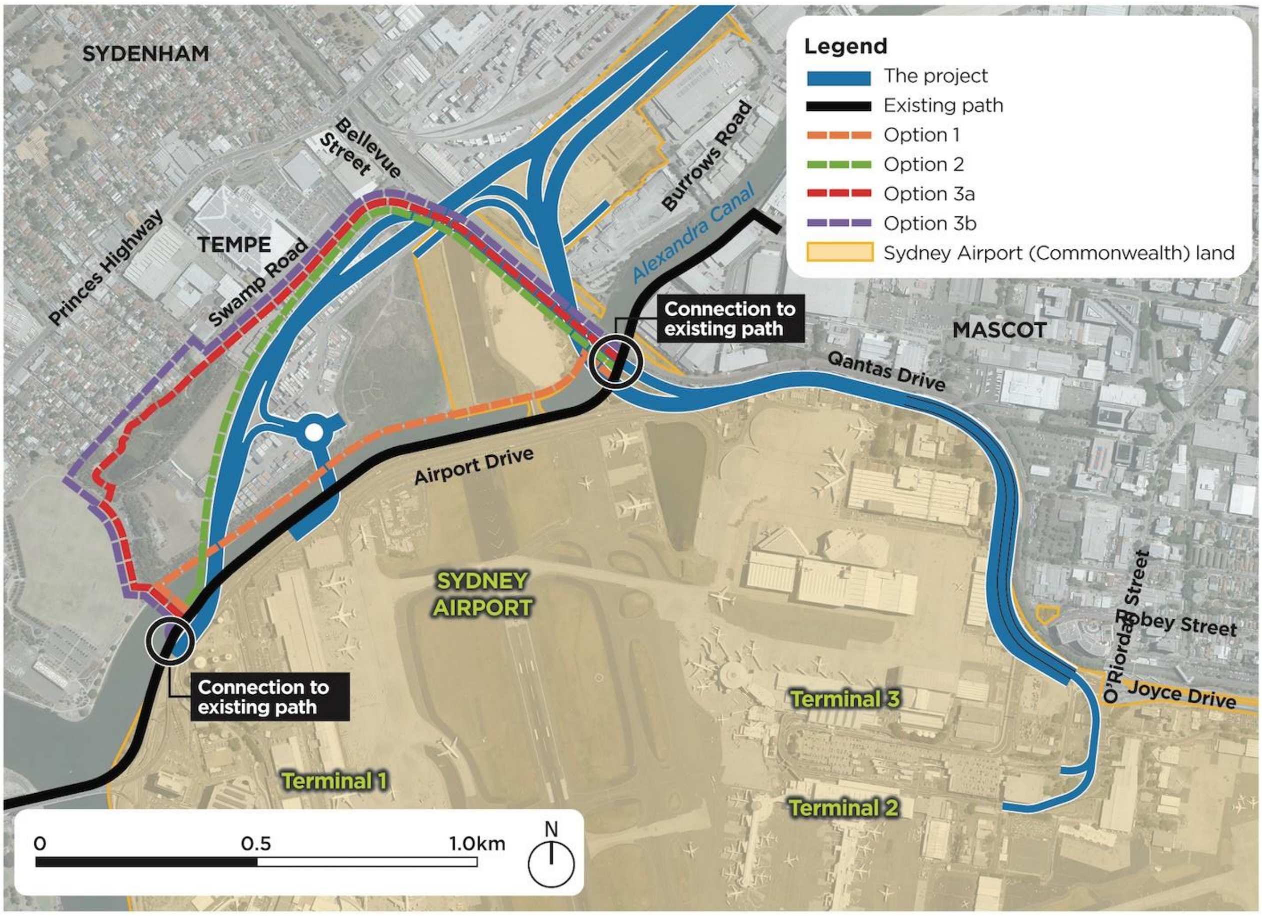

Figure 6.10 Options for relocating the active transport link

The following options for relocating the active transport line were developed and considered during 2018 and 2019, with input from relevant stakeholders, bike users and the community:

- Option 1 – on the western side of Alexandra Canal, along the desalination pipeline easement. Underpasses of the Terminal 1 connection, freight terminal access and Nigel Love bridges would be required.
- Option 2 – along the Terminal 1 connection and the eastbound terminal link roads
- Option 3a – via the eastern edge of the Tempe Recreation Reserve and through the Tempe Wetlands, connecting to Swamp Road in Tempe and the eastbound terminal link
- Option 3b – similar to option 3, via the eastern edge of the Tempe Recreation Reserve, connecting to the southern end of South Street in Tempe, and via Swamp Road and the eastbound terminal link.

All options would be longer than the existing route.

Selecting the preferred route was influenced by consideration of the following functional requirements:

- Existing shared path at Coward Street – the route needs to connect to the existing shared path
- Alexandra Canal – the route needs to cross the canal at one or more locations
- A positive user experience – noting that a shorter route, lower inclines and canal views contribute to a positive user experience.

The following constraints were also considered:

- The Sydney desalination pipeline – access requirements and maintenance clearances around the pipeline on the western bank of Alexandra Canal need to be maintained

- Land ownership and access issues – including compensation to acquire land or amend existing easements and ensuring sufficient access is available for future maintenance activities
- Safety – including crime prevention through environmental design (CPTED) principles (particularly opportunities for passive surveillance) to provide adequate levels of safety for users.

Consultation was undertaken with stakeholders and the community, including bike groups, local councils, residents and community groups. Following consideration of bike users' needs and requests, option 1 (western side of Alexandra Canal) was selected as the preferred route. This option would provide the shortest, flattest route, and a similar level of amenity to the existing route. This route would be suitable for commuters and leisure users, and would maximise the experience of canal views, which was strongly requested by all user groups.

6.5.6 Drainage outlets in Alexandra Canal

The efficient removal of stormwater from the roadway is necessary to provide safe driving conditions for motorists. The drainage design for the project is principally governed by the location and geometry of the new road infrastructure and the ability to either connect to existing stormwater drainage or a receiving watercourse.

Within the project site, Alexandra Canal is the main floodway for catchment stormwater. Investigations were undertaken of the capacity of drainage infrastructure both within and adjacent to the canal catchment. The investigations concluded that there was limited capacity within adjacent catchments without substantial network augmentation, which would not be cost-effective. Additionally, to either divert stormwater to another catchment or to connect to these networks, would require a large land area and long lengths of new stormwater drainage infrastructure, which would be impractical and prohibitively expensive.

Given it is not feasible to drain local stormwater to adjacent catchments, two options were considered to use the existing local drainage network, including existing outlets into Alexandra Canal:

- Option 1 – augment existing stormwater outlets in their current location, and if augmentation is not possible, provide additional (new) outlets
- Option 2 – consolidate existing outlets and, where possible, remove surplus outlets.

In reviewing these options, consideration was given to a range of construction, engineering and environmental issues, including:

- The heritage significance of the canal, particularly the original sandstone fabric of the canal walls in some locations
- Potential (additional) flooding impacts
- Disturbance of contaminated sediments in the canal due to stormwater discharges during operation (energy dissipating structures may be required)
- Construction methods and the potential to temporarily disturb sediments during construction.

Based on the results of flood and drainage modelling of the catchment, option 1 was identified as a feasible solution because the existing drainage system is already near capacity.

The proposed drainage design would involve enlarging and reusing four existing drainage outlets, constructing five new outlets and reusing one existing outlet. Some disturbance within the canal would be necessary during construction.

6.5.7 Access to Terminals 2/3

Improving vehicle access to Terminals 2/3 is critical to the success of the project. The existing intersections on Qantas Drive used to access Terminals 2/3 are capacity constrained and located in areas where opportunity for further expansion is limited by the adjacent Botany Rail Line.

Two grade-separated ‘flyover’ options to improve access to Terminals 2/3 were investigated and are described below.

Option 1 - A central flyover

Option 1 comprises a new two lane flyover, from Qantas Drive into Sir Reginald Ansett Drive, linking to the existing elevated access to the departure areas at Terminals 2/3. Traffic accessing Terminals 2/3 from the west would be grade-separated on a viaduct, passing over other traffic on Qantas Drive, avoiding the need to travel through the existing at-grade intersection. This option is shown on Figure 6.11.

As the flyover enters the airport, additional lanes and ramps would be added to distribute traffic to departures, arrivals and the future new ground transport interchange. This flyover has two sub-options that differ according to where they enter the proposed new transport interchange.

Advantages of option 1 include:

- Shortest and most direct link to Terminals 2/3 for traffic using the project
- Allows the majority of traffic to access Terminals 2/3 under free flow conditions
- Least expensive.

Disadvantages include:

- Limited space for vehicle queuing and management within the Terminals 2/3 precinct
- More difficult to construct under traffic.

Option 2 - Joyce Drive flyover

Option 2 is a flyover loop linking Joyce Drive to the eastern end of Ross Smith Avenue. Entry to Terminals 2/3 would be via a flyover and ramp to ground level on Ross Smith Avenue. There would also be a possible future opportunity to extend a viaduct along Ross Smith Avenue for additional capacity. This option would make Ross Smith Avenue a main airport entry route that could support a range of services and provide enhanced opportunities for vehicle and queue management. Option 2 is shown on Figure 6.11.

An enhanced entry along Ross Smith Avenue would also support traffic access from General Holmes Drive. Traffic from O’Riordan Street would be provided with a free left turn at Joyce Drive. A separate lane would connect with the viaduct.

Advantages of option 2 include:

- Enhanced capacity to accommodate future vehicle management and volume growth
- Lower risk of vehicle queues extending onto the external road network.

Disadvantages include:

- Traffic on the Sydney Gateway road project would not be removed from the existing capacity-constrained intersections on Qantas Drive
- Larger project footprint
- More expensive
- Increased travel distance for vehicles travelling to/from the airport via the Sydney Gateway road project.

Despite being more difficult to construct under traffic, option 1 is preferred as it:

- Provides the quickest travel time for vehicles accessing Terminals 2/3 to/from western Sydney
- Removes traffic from the existing constrained at-grade airport access intersections on Qantas Drive
- Provides traffic light free access for the majority of vehicles.

Option 1b was selected as the preferred option for the project as it would facilitate superior internal movements within the future transport interchange.

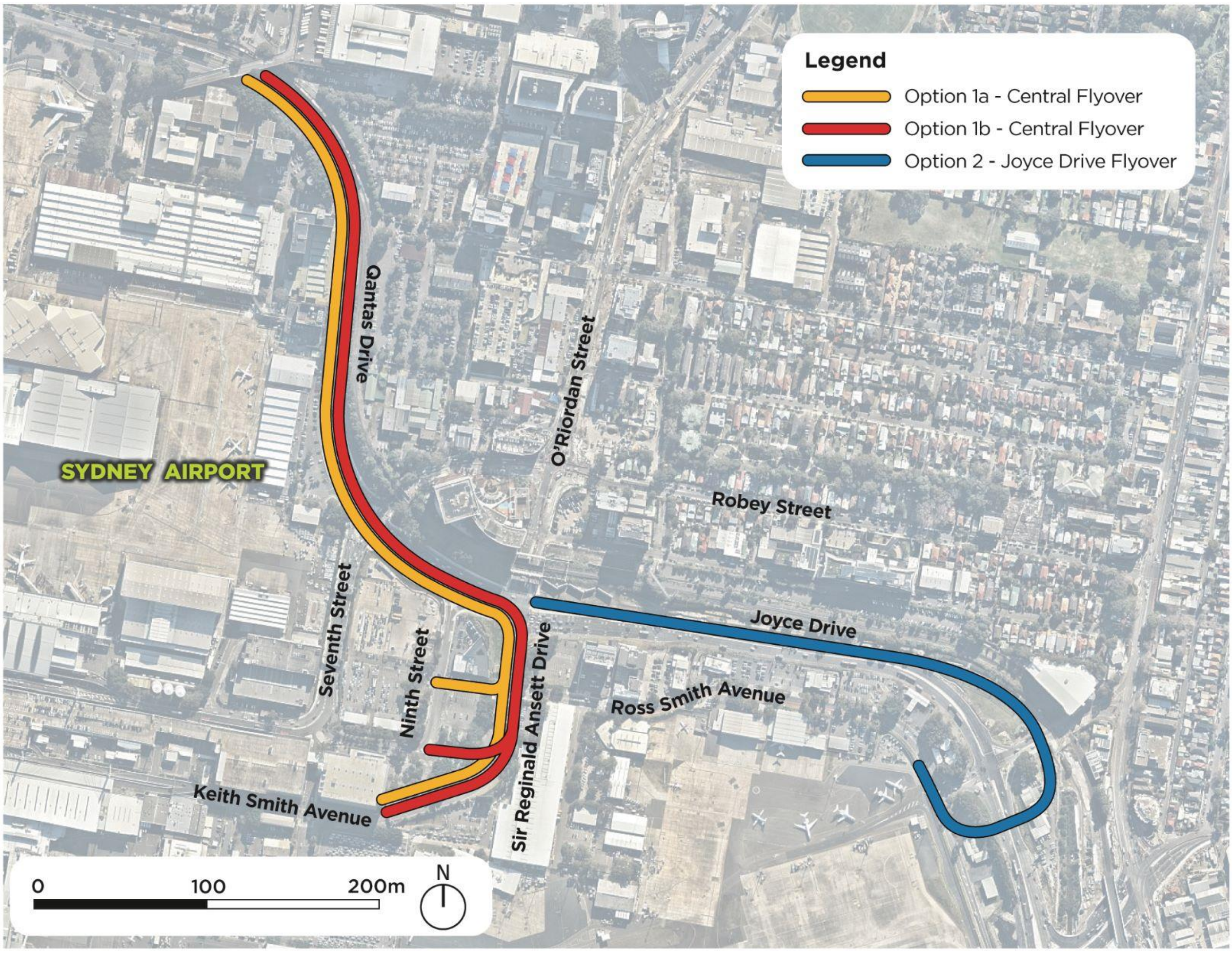

Figure 6.11 Terminals 2/3 flyover access options