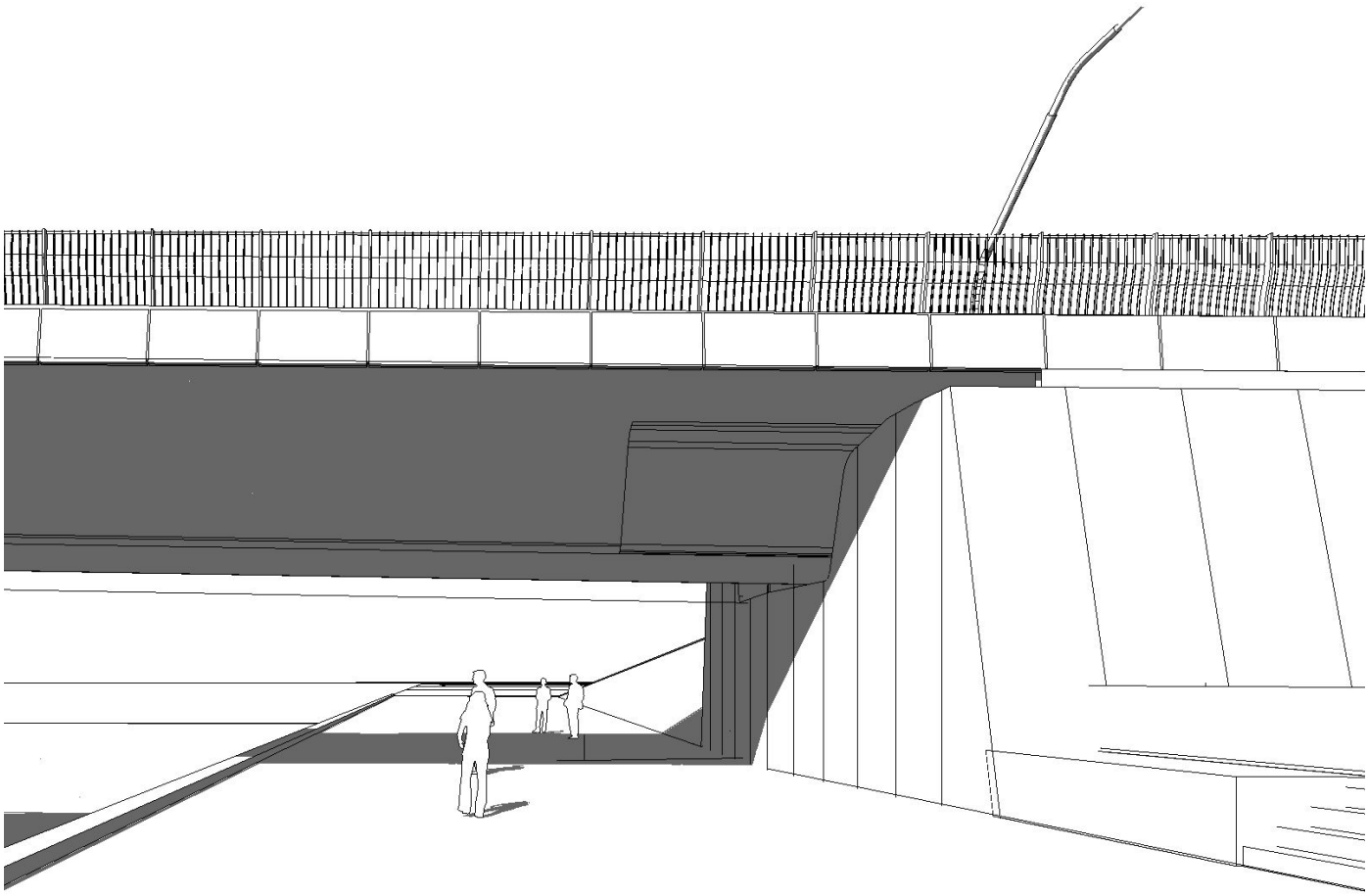
Homebush Bay Bridge | Environmental Assessment

PART C

Assessment of environmental impacts



7 Environmental risk analysis

This Chapter provides an overview of the potential environmental impacts associated with the proposed bridge, and outlines the mitigation measures to be implemented to minimise these impacts. It specifically addresses the requirement of the Director General that the environmental assessment must include:

- An environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures.
- An appropriately detailed impact assessment of any additional key environmental impact that is identified through the environmental risk analysis.

7.1 Risk analysis approach

The following methodology was used to identify and assess the potential environmental issues associated with construction and operation of the proposed bridge:

- Identify all relevant potential environmental impacts of the development, including the key issues outlined in the Director General's requirements.
- Assess each of the potential environmental impacts using a risk assessment model, taking into consideration their likelihood and consequence.
- Outline potential mitigation measures to address the potential environmental impacts, and assess the likely residual environmental impacts after the mitigation measures are to be applied.

The risk assessment model used to assess the potential environmental impacts is shown in Table 7.1. This model provides the basis for the detailed assessment of key environmental issues provided in this environmental assessment.

Table 7.1 – Environmental risk assessment model

Risk category	Description
A	May have high or moderate impacts. Detailed assessment necessary to determine the level of potential impact and to develop appropriate measures to mitigate and manage the impacts.
B	May have high or moderate impacts. These can be mitigated by the application of standard environmental management measures.
C	Have low impacts. These can be managed by standard environmental management measures.

7.2 Risk analysis findings

The results of the environmental risk analysis are summarised in the Table 7.2. The environmental assessment of the issues identified in this table are presented in Chapters 8 to 18.

Table 7.2 – Environmental risk analysis findings

Issue	DGR key issue? (Y/N)	Potential impacts	Analysis – proposed mitigation measures and impacts remaining after their application	Risk category	Location in the report
Traffic management and access	Y	Construction / Risk of traffic congestion as a result of construction activities, particularly at the Wentworth Point construction site. / Temporary interruptions to pedestrian and cyclist access on Shoreline Drive and to the footpath that runs parallel to the Rhodes foreshore.	/ The construction environmental management plan would include a preliminary vehicle access route into the site. Large vehicles would deliver outside of peak periods when feasible and reasonable. / A pedestrian and cyclist route based on safe public paths would be formed around the proposed work sites.	A	Chapter 8 Appendix G
		Operation / Risk of increased traffic congestion on the local road network. / Potential for unauthorised vehicles (e.g. private cars) to use the bridge.	/ The potential bus operation across the bridge (up to 20 buses per hour in the AM peak period) is unlikely to substantially change the level of service of key intersections. / The bridge would include signage and CCTV video surveillance.	A	

Issue	DGR key issue? (Y/N)	Potential impacts	Analysis – proposed mitigation measures and impacts remaining after their application	Risk category	Location in the report
Public domain	Y	Rhodes / Risk of unsafe environment for bridge users due to the mix of pedestrians, cyclists and buses at the Rhodes landing. / Potential interruption of the north–south foreshore pedestrian and cyclist path.	/ The north–south foreshore pedestrian and cyclist path would remain uninterrupted. / The landing would be sloped to provide good visibility for bridge users. / The raised crossing treatment for pedestrians and cyclists would have signage to indicate the shared pedestrian and cycling environment. / Signage would be installed to convey bus-only and cyclist-only access on Gauthorpe Street, west of Shoreline Drive.	A	Chapter 9 Appendix H
		Wentworth Point / Risk of providing poor visibility to drivers and cyclists travelling along the westbound bridge lane and merging with the one-way traffic travelling west from Foreshore Boulevard. / Potential interruption of the north–south foreshore pedestrian and cyclist path.	/ Uninterrupted foreshore access would continue, with pedestrians and cyclists able to travel under the bridge along the foreshore path. / A roundabout would be provided to manage bus-only and bicycle-only access to and from the bridge and manage the merging of buses and bicycles with other traffic. This would allow most of Footbridge Boulevard to act as a normal street. / Signage would allow for bus-only access to the bridge for vehicles travelling west to Rhodes. / The grade-separated landing of the bridge at Wentworth Point would allow buses and cyclists to merge directly into the street network without potential conflict with pedestrians and cyclists travelling along the foreshore path. / Cycling access to the bridge would follow on-street cycle paths to continue to the bus lanes on the bridge. / Pedestrians would access the bridge from the north, with connections from footpaths adjacent to and through the proposed park and from the foreshore arrival square.	A	
Visual amenity	Y	/ Risk of delivering a bridge with unacceptable visual impacts in the local and regional area.	/ Photomontages from representative vantage points show visual impacts are likely to be minor. The bridge has been designed with aesthetic values that fit well with the visual setting of the Homebush Bay area.	A	Chapter 10 Appendix H
Overshadowing	Y	/ Risk of bridge structures, including embankments and ramps, creating significant overshadowing on existing and proposed public domain, open space, foreshore areas and residential uses.	/ Shadow diagrams of the bridge structure, embankments and ramps at Rhodes and Wentworth Point show impacts would be minimal and contained to the immediate area beside and below the bridge. / The bridge would not overshadow residential areas.	B	Chapter 10 Appendix H

Issue	DGR key issue? (Y/N)	Potential impacts	Analysis – proposed mitigation measures and impacts remaining after their application	Risk category	Location in the report
Climate change	Y	/ Impacts on the structural integrity of the bridge. / Coastal inundation at bridge landing points at Rhodes and Wentworth Point. / Increased restrictions on maritime navigation due to reduced clearance beneath the bridge.	/ Bridge collapse and inundation would be unlikely to occur as the majority of the superstructure would be above the 2,000 year ARI event. / Landing points would be designed to meet existing sea level rise predictions as a result of climate change. / Appropriate maritime clearances has been allowed.	B	Chapter 11
Navigation and safety	Y	Construction / Risk of direct impact of vessels during placement of new bridge piles and piers. / Risk of physical obstruction of vessels from the use of construction barges.	/ The construction environmental management plan would address the management of maritime traffic with procedures and impact-reduction measures to be adopted during construction. / Exclusion zones would be marked around critical areas of construction activities and floating construction plant. / Boat operators would be sent alerts about ongoing construction activities through the issue of a proclaimed Marine Notice via RMS. / Temporary Aids to Navigation would be provided where required (e.g. lighted buoys to mark exclusion zones).	B	Chapter 12
		Operation / Reduced transit options from the north to south side of the bay. / Restriction of vessels with an air draft larger than can be permitted by the navigation channel bridge clearance height. / The bridge would be a new impact hazard for vessels in the bay. / Impact on rowing course proposed by Rowing NSW.	/ A main navigation channel would be provided, and an appropriate vertical and horizontal clearance would be set. / Permanent Aids to Navigation would be provided on the bridge as per the relevant standards. / There would be allowance for the six lanes of the proposed Rowing NSW course to pass under the western bridge spans, as well as sufficient height clearance. / During Rowing NSW events, temporary exclusion zones would be set up around the rowing course and the pier extents would be marked.	C	

Issue	DGR key issue? (Y/N)	Potential impacts	Analysis – proposed mitigation measures and impacts remaining after their application	Risk category	Location in the report
Soils and contamination	Y	Construction / Water related construction activities: there is a risk that piling operations disturb, intercept and expose contaminated material and acid sulfate soils. / Land-based construction activities: there is a risk that excavations could intercept and expose contaminated soils and acid sulfate soil material. / Risk of material and soils coming into contact with site workers, discharging from the site into Homebush Bay and affecting aquatic flora and fauna. / Risk of fuels stored onsite being released into the environment.	/ The construction environmental management plan would include a contamination monitoring program, inspection routines, reporting protocols, roles, responsibilities, chain of command, contingency response protocols, etc. / An acid sulfate soils management plan would be prepared in accordance with the *Acid Sulfate Soil Manual* (ASSMAC, 1998). / The piles would be driven through the soft sediments and then into the bedrock. The driven pile construction technique would minimise sediment disturbance in the bay, including the remediated area to the east. / Approximately 0.5m cover of pea gravel or similar would be placed in the piling locations prior to works. The gravel would fill capping voids if they occurred. / A sediment boom and curtain would be installed around barge works sites for over-water pile installation. / A sediment control device would be installed during high-tide periods. It would be designed to rise and fall with the tide to prevent sediments disturbed during the piling works dispersing in Homebush Bay. / Contamination and acid sulfate soils in excavation spoil would be stored, characterised and assessed, and treated and disposed at an appropriately licensed facility. / Contaminated material could be managed by placement at depth, with appropriate capping using imported clean fill and pavement. / Stored fuels would be placed in appropriate containers with secondary containment. / Road materials, such as milled or excavated pavement material, would be classified prior to off-site disposal.	A	Chapter 13 Appendix I Appendix J
		Operation / Risk of acid sulfate soils damaging the bridge foundations and other underground structures.	/ Corrosion inhibitors would be used in the bridge's concrete mix to prevent corrosion from acid sulfate soils and other agents.	B	

Issue	DGR key issue? (Y/N)	Potential impacts	Analysis – proposed mitigation measures and impacts remaining after their application	Risk category	Location in the report
Sediments and water	Y	Construction / Risk of runoff from construction sites being released to Homebush Bay without any treatment. Runoff may potentially contain fuels, oils, grease, chemicals, hydraulic fluids, contaminated sediments and acid sulfate soils. / Risk that surface waters that discharge via stormwater drains along the construction site may be contaminated.	/ The construction environmental management plan would include sediment and erosion control measures in accordance with requirements of *Managing Urban Stormwater: Soils and Construction 4th Edition* (Landcom, 2004). / The construction environmental management plan would include emergency spill management response protocols. / Staging activities would minimise land disturbance. / Vehicle access would be restricted to designated and stabilised entry and exit points. / Clean runoff from upstream areas would be diverted around disturbed construction areas. / Control measures – and, in particular, discharges from sediment basins – would be monitored to ensure compliance with regulatory requirements. / Also, refer to measures for 'soil and contamination'.	A	Chapter 14
		Operation / Risk of accidental spills, including fuels, oils, grease, chemicals, hydraulic fluids and other liquids. (No raw sewer pipes would be carried by the bridge.)	An operation plan for the bridge would be prepared. It would include environmental management procedures related to the operation of the bridge including: / Operation and maintenance of gross pollutant traps and drainage system. / Operational incident response during major spills.	B	

Issue	DGR key issue? (Y/N)	Potential impacts	Analysis – proposed mitigation measures and impacts remaining after their application	Risk cate-gory	Location in the report
Noise and vibration	Y	Construction / Construction activities could affect noise-sensitive receivers (residents and people in parks). Noise management levels would be exceeded at Rhodes during piling, pile capping, pier and road construction. / Vibration during construction could damage property.	/ The construction environmental management plan would include measures for construction noise and vibration mitigation. / Vibration predictions found that construction vibration impacts on buildings are expected to be insignificant. / Rhodes and Wentworth Point residents would be kept informed and up to date with the proposed schedule of works in order to maintain good community relations and proactively managing expectations and adverse reactions. / Workers and contractors would be regularly trained to use equipment in ways to minimise noise. / All plant and equipment would be turned off when not in use. / Whenever possible and relevant, site staff would implement the noise mitigation measures outlined in British Standard (BS) 5228.1 and Table C1 of Australian Standard (AS) 2436.	A	Chapter 15 Appendix K
		Operation / Noise levels would exceed the daytime criterion by up to 5 dB during AM peak periods for receptors close to the bridge.		A	
Flora and fauna	Y	/ Potential for impact on aquatic ecology from mobilisation of bottom sediments during piling. / Risk of minor impacts on terrestrial ecology from land-based construction works.	/ Refer mitigation measures listed in 'Soil and contamination' and 'Sediments and water'.	A	Chapter 13 Chapter 14 Chapter 16 Appendix I Appendix L
Wind and wind-wash effects	Y	/ Risk that high wind speeds could impact on the bridge structure and bridge users (e.g. wind-wash).	/ The bridge would be designed as per AS 5100 part 2, which relates to bridge design loads. / The bridge would have balustrades on the northern and southern edges and between the cyclist and pedestrian lanes, a raised central section with a relatively streamlined edge and below-deck sections at the low end sections enclosed with precast panels. These features would alleviate wind-wash effects on bridge users.	B	Chapter 17 Appendix M

Issue	DGR key issue? (Y/N)	Potential impacts	Analysis – proposed mitigation measures and impacts remaining after their application	Risk cate-gory	Location in the report
Scouring	N	/ Risk of scouring over the bridge piers from the swiftly moving water. It could potentially scoop out scour holes that in the long term may potentially compromise the integrity of the bridge.	/ A conservative design current velocity of 0.5 m/s would be adopted for the bridge design.	C	Section 18.1
Crime prevention through environmental design	N	/ Risk of vandalism and personal threat during times of low activity (e.g. evenings). / Risk that solid surfaces, walls and other spaces could be targeted for graffiti.	/ Clear sight lines would be provided from the street and pedestrian areas as well as along pedestrian routes and bicycle paths. / Higher lighting levels at potential areas of crime risk would allow recognition of facial features, especially at night. / Symbolic and physical barriers would indicate areas nominated for increased levels of activity and casual surveillance, as well as areas where public access is discouraged. / The bridge would create a sense of place and amenity, with a key distinction between public and transitional realms. / Targets for vandalism and criminal activity would be minimised through the selection of materials and finishes, and active and passive security measures.	B	Section 18.2 Appendix H

Issue	DGR key issue? (Y/N)	Potential impacts	Analysis – proposed mitigation measures and impacts remaining after their application	Risk cate-gory	Location in the report
Waste minimisation and management	N	Construction / Construction would generate wastes, such as excavation wastes, vegetation wastes, demolition waste, packaging materials, liquid wastes, sewage effluent and general wastes and recyclables. Operation / Users of the bridge would create waste (e.g. litter).	Construction Operation	B	Section 19.3
Green house gases	N	/ Emission of greenhouse gases associated with the construction and operation of the bridge would contribute to climate change impacts.	/ Emission of greenhouse gases during construction would be approximately 5,737 tCO_2e. / The bridge would create a link between Rhodes and Wentworth Point. This would encourage a shift away from car use and towards public transport by residents, particularly at Wentworth Point.	B	Section 18.4

Issue	DGR key issue? (Y/N)	Potential impacts	Analysis – proposed mitigation measures and impacts remaining after their application	Risk category	Location in the report
Cumulative impacts	N	/ Concurrent construction activities may potentially lead to cumulative traffic, access and noise impacts in the Homebush Bay area. / Bus traffic generated by the bridge would potentially add to the traffic generated by existing and future developments at Rhodes, Wentworth Point and the Homebush Bay area.	/ Consultation with Auburn City Council, City of Canada Bay Council, Sydney Olympic Park Authority and relevant development application proponents would be required during the preparation of the construction environmental management plan. / Bus traffic volumes generated by the bridge would have little effect on the local and regional road network. The traffic volume generated is unlikely to change substantially the level of service of key intersections in Rhodes and Wentworth Point. / The proposal responds to the need for more sustainable transport options to the Homebush Bay area and would result in an overall net benefit to the community.	C	Section 19.5

8 Traffic management and access

This Chapter addresses the traffic management and access issues related to the proposed Homebush Bay Bridge. In particular, it responds to the following Director General's requirements on traffic management and access:

- Details of the short-, medium- and long-term population that form the potential catchment for potential use of the bridge for walking, cycling and public transport.
- The number of public transport services required to meet the NSW State Plan targets for public transport use and local needs. Cross-regional bus services should be specifically considered and accommodated now and into the future.
- Details of the existing and future transport networks, traffic generation and circulation (existing and future) on the surrounding road network, with particular attention given to traffic and access connections to Rhodes, Wentworth Point and the Sydney Olympic Park precinct, and the broader Sydney metropolitan area.
- Details of the traffic volumes likely to be generated during construction and operation, and an assessment of the predicted impacts of this traffic on the safety and capacity of the surrounding road network, including access to Concord Road and Homebush Bay Drive.
- Details of the proposed traffic management measures to prevent simultaneous two-way movement and usage by other motor vehicles and safety of pedestrians and cyclists using the bridge.
- Details and analysis of the proposed access to the project, in particular the suitability and capacity of local roads for use by regular public transport services, and the level of service of key intersections.
- Construction traffic access to the project and associated management measures.
- Demonstrate how the project facilitates the efficient movement of public transport services to meet the needs of existing and future residents served by the proposal, including the needs of special events at Sydney Olympic Park, having regard to efficient travel speed and road safety.
- Demonstrate how the project would quantitatively contribute towards achieving the NSW Government targets of increasing the share of commuter trips made by pubilc transport (to and from the Sydney CBD and to and from Parramatta CBD), increasing the proportion of total journeys to work by public transport in Sydney Metropolitan Region and increasing the mode share of bicycle trips.

This Chapter draws on information provided in a traffic management and access assessment report, prepared by Arup, to accompany this environmental assessment (refer Appendix G). The report:

- Provides a detailed assessment of traffic management and access issues associated with the future population and context of the Homebush Bay area and the proposed Homebush Bay Bridge.
- Responds to the Director General's requirements and the goals of the NSW Government, SOPA, and Auburn and Canada Bay councils.
- Highlights requirements and standards to be incorporated in the bridge design.

- Assesses impacts of the bridge on traffic, pedestrians and cyclists.
- Identifies mitigation and management measures.

8.1 Existing traffic and access conditions

The history of the Homebush Bay area with its industrial uses up until the early 1990s and the legacy of the Sydney Olympic Games 2000, have left the area with limited access opportunities to support emerging communities on the Rhodes peninsula and Wentworth Point.

This section provides an overview of the road network, traffic conditions, public transport and mode share.

8.1.1 The road network

The road networks serving Wentworth Point and Rhodes are outlined below and shown in Figure 8.1.

Wentworth Point

The road network serving Wentworth Point includes:

- The M4 Motorway (Metroad 4), which provides a connection between Wentworth Point and Parramatta, Penrith and the city.
- Hill Road and Bennelong Parkway, which connect Wentworth Point to Australia Avenue and Holker Street within Sydney Olympic Park. Hill Road also provides the single entry point to the northern areas of Wentworth Point.
- A 'fine-grained' road network in the southern area of Wentworth Point, which serves residential development in the area. It is expected that a similar street network will be established in the remainder of the suburb to the north as former industrial sites are redeveloped.
- Surrounding arterial roads and intersections into Sydney Olympic Park, which are susceptible to congestion and delays during peak periods.

Rhodes

The road network serving Rhodes includes:

- Homebush Bay Drive (Metroad 3), which is a key arterial connection between Rhodes, Ryde, and the M4.
- The local road network of western Rhodes, to which vehicular access is limited by the north–south rail line.
- Key access points off Homebush Bay Drive at Oulton Avenue to the south; and access points off Concord Road at Lewelleyn and Blaxland roads and Mary and Averill streets to the north.

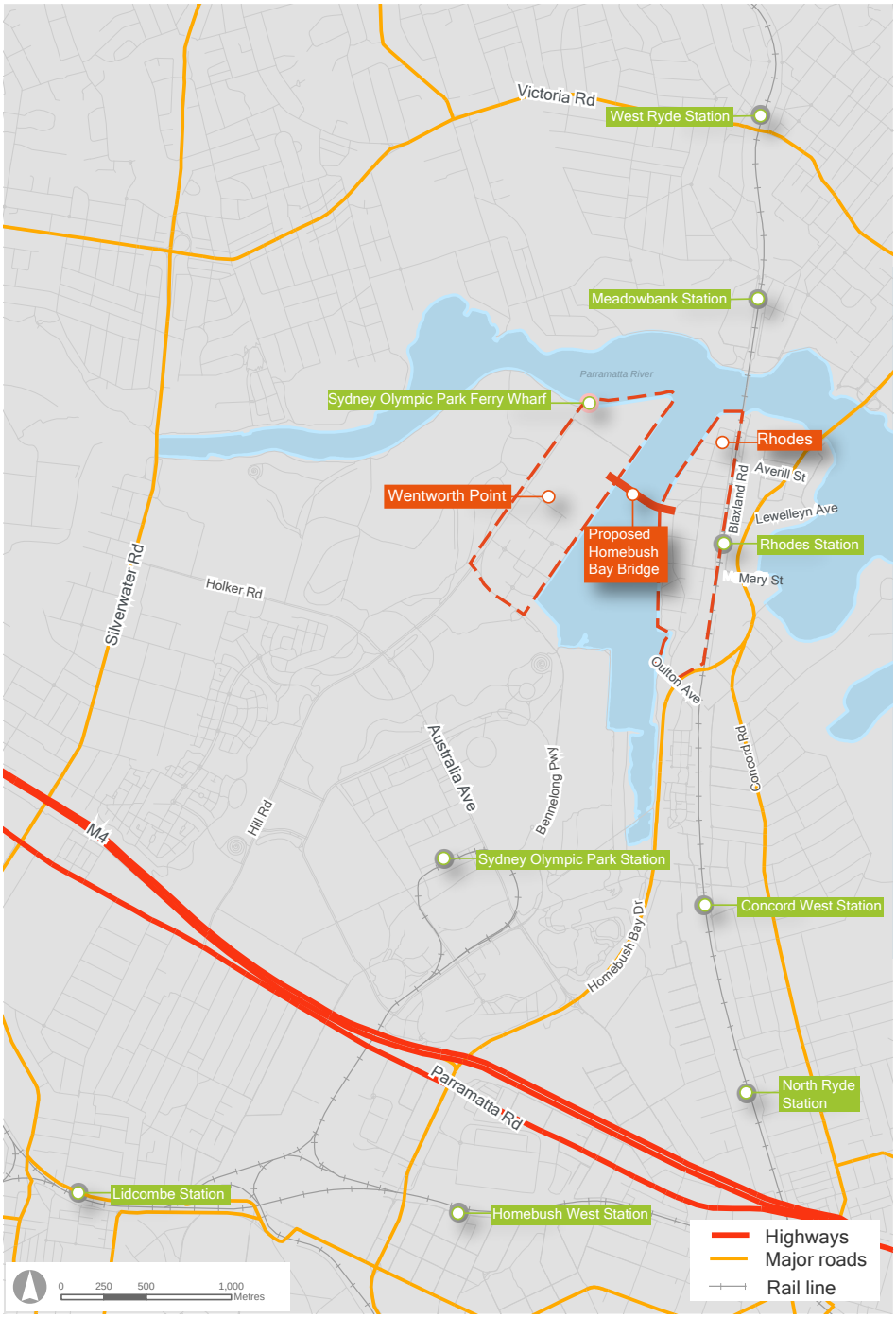


Figure 8.1 – The transport network serving the Homebush Bay area

8.1.2 Road performance

The performance of an intersection is quantified in terms of 'level of service' (LOS) (Table 8.1), which is an index of the operational performance of traffic at an intersection and is based on the average delay per vehicle. Levels of service range from 'A' (very good) to 'F' (highly congested) travel conditions. Generally it is desirable to aim at achieving a level of service of 'C' or better at all major road intersections. However, in practice, it is reasonable for some intersections to operate at level of service 'D' at peak times.

Road performance analyses have been conducted for two previous studies:

- *Traffic Impact Assessment Wentworth Point Precinct Maritime Concept Plan, Homebush Bay* (Traffix, July 2010).
- *Meriton Apartments Proposed Residential Apartment Development Lot 101 and 102 Walker Street, Rhodes – Assessment of Traffic and Parking Implications Report* (Transport and Traffic Planning Associates, May 2010).
- These analyses suggest that the following intersections are at or beyond capacity with delays in either the AM or PM peak periods:
  - Holker Street and Silverwater Road.
  - Hill Road and the M4 off ramp.
  - Hill Road and Great Western Highway and Bombay Street.

The analyses suggest that the Homebush Bay area has intersections with poor levels of service during peak periods, causing congestion and delays on the road network.

Given this road congestion, it will be crucial to provide viable transport options to limit private vehicle use and limit further congestion impacts on the road network.

Table 8.1 – Level of service (RMS definitions)

Travel conditions	Level of service	Average delay per vehicle (s)
Very good	A	< 14.5
Good	B	14.5 ≤ 28.5
Satisfactory	C	28.5 ≤ 42.5
Near capacity	D	42.5 ≤ 56.5
At capacity	E	56.5 ≤ 70.5
Over capacity	F	70.5

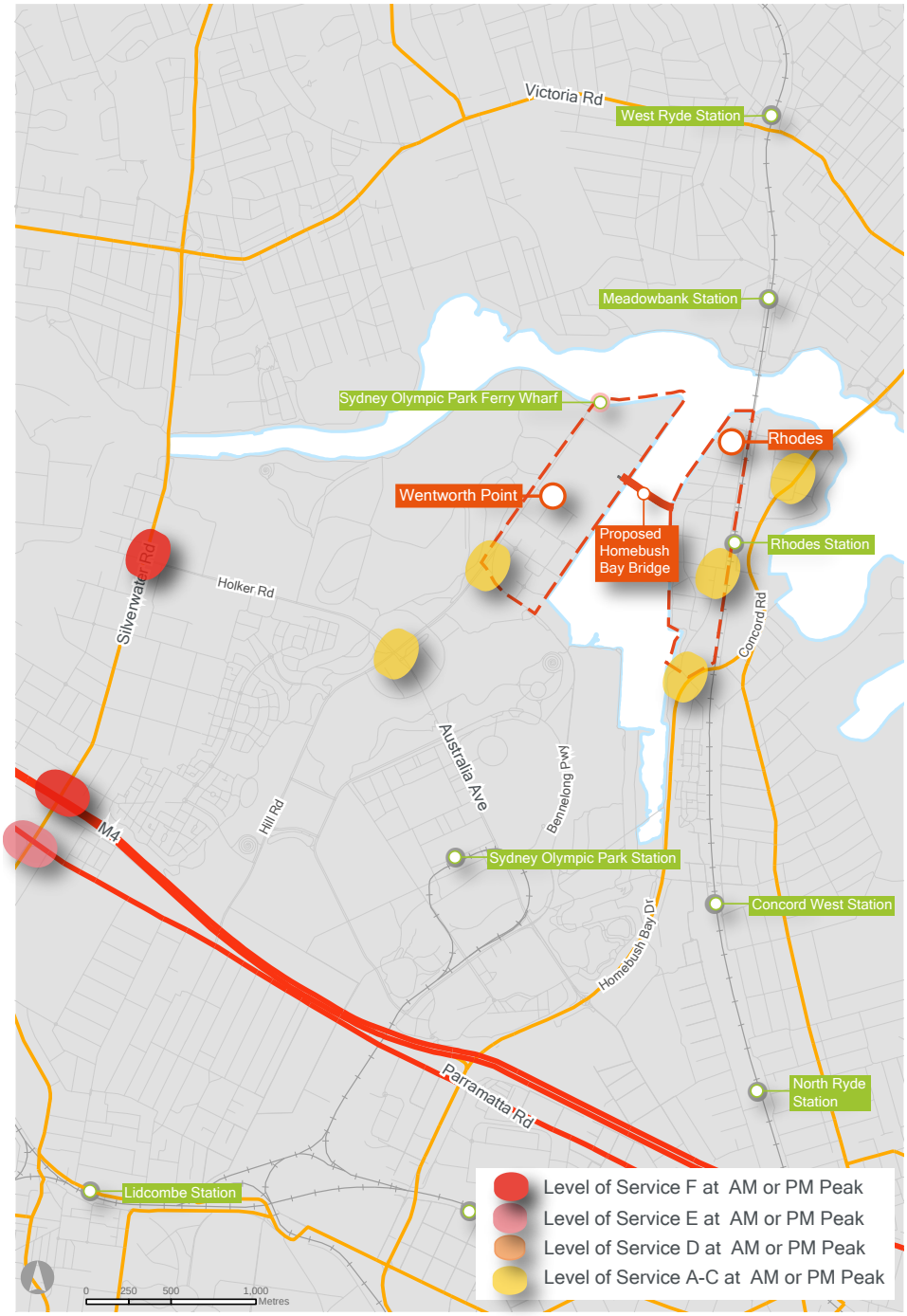


Figure 8.2 – Existing road network performance at Wentworth Point (Source: Traffix, 2010 and Traffic and Transport Planning Associates, 2010)

8.1.3 Public transport

The public transport networks near Homebush Bay are summarised below and shown in Figure 8.3 and Figure 8.4

The assessment of public transport infrastructure in the area identified that improving the connections between Rhodes and Wentworth Point would provide residents in both precincts with access to a wider range of public transport routes.

Rail services

The Homebush Bay area is served by Rhodes and Olympic Park railway stations. Wentworth Point is currently isolated from the regional rail network:

- Olympic Park station is about 2.5 kms away.
- Rhodes station is within an 800 m radius of the Wentworth Point area. However, due to the barrier of Homebush Bay and the Millennium Parklands, travel via the road network to Rhodes station involves a journey of about 6.7 kms, as shown in Figure 8.3.
- Concord West station is about 2.5 kms away.

Ferry services

The Sydney Olympic Park ferry wharf is located on the northern edge of Wentworth Point, on the Parramatta River. The ferry service provides public transport access along the river, between Circular Quay wharf (to the east) and Parramatta wharf (to the west). The current ferry service journey time is about 50 minutes to Circular Quay and 30 minutes to Parramatta.

Ferry services run about every 25 minutes in the AM peak periods from Olympic Park ferry wharf.

Bus services

Bus services in the Homebush Bay area provide access for Wentworth Point to the Olympic Park ferry wharf, Sydney Olympic Park station and Burwood station. The 533 bus runs through Rhodes station, providing a connection from Rhodes to Ryde and Burwood. Bus networks in the broader area connect Olympic Park station with Lidcombe, Burwood and Parramatta.

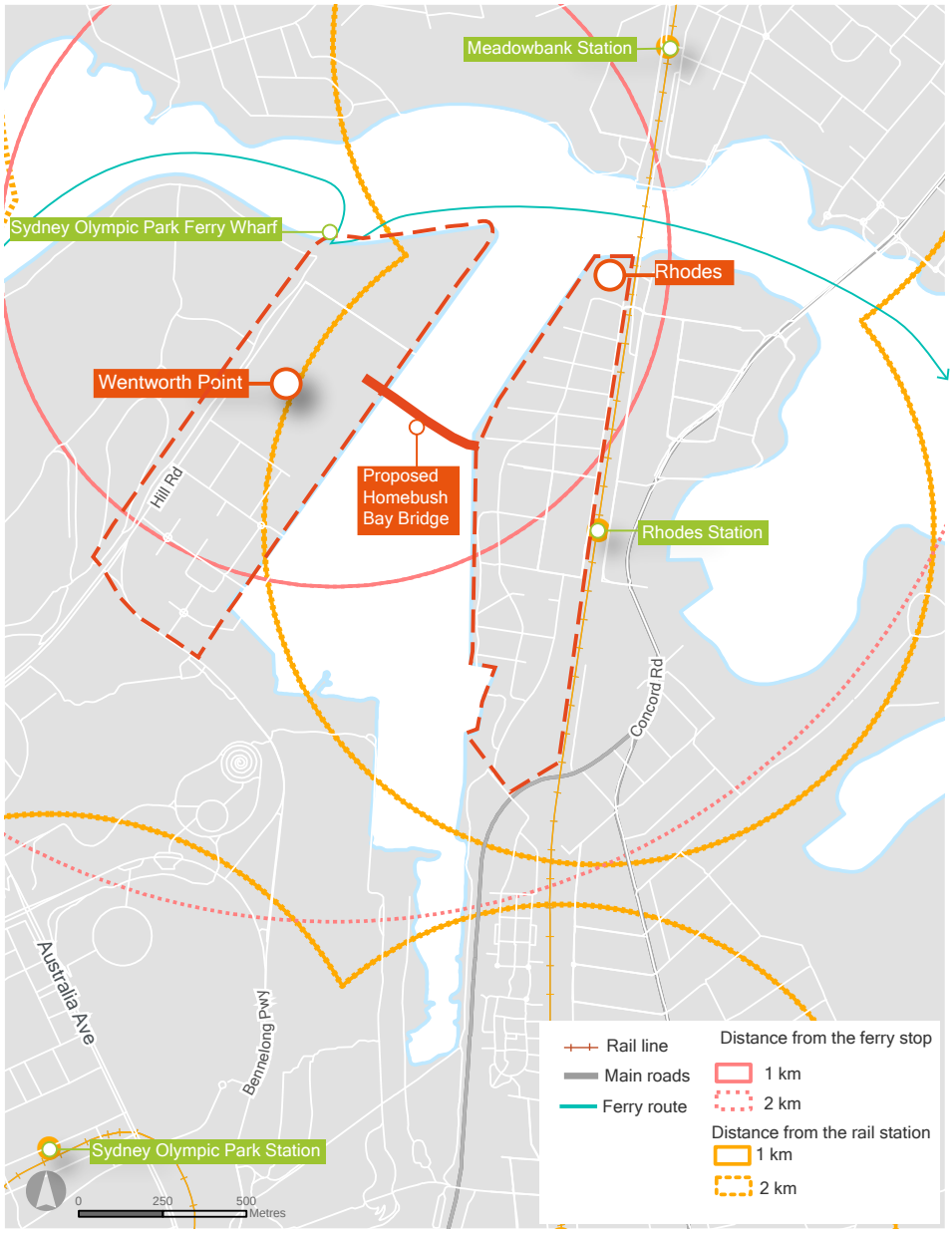


Figure 8.3 – Existing rail and ferry transport network

Figure 8.4 – Existing bus network

8.1.4 Existing mode shares

The existing journey-to-work mode shares for the Rhodes and Wentworth Point precincts are shown in Table 8.2 and Table 8.3. These precincts were defined using travel zone boundaries. Travel zone boundaries are geographic areas defined by the Transport Data Centre. Travel zones are smaller than statistical local areas but generally larger than Census collector districts and have specific transport characteristics (i.e. they usually have only one freeway or transport interchange).

Wentworth Point

In 2006, Wentworth Point had a population of 1,363 people. As shown in Table 8.2:

- 84% travelled to work by private car or truck as either the driver or passenger.
- 10% travelled to work by train.
- 2% travelled to work by ferry.

Table 8.2 – Wentworth Point travel zone mode shares. (Source: ABS, 2006)

Description of mode (one method)	Total	%
Car (car driver, car passenger, truck)	588	84
Train	74	10
Ferry	14	2
Walked only	14	2
Bus	8	1
Bicycle	9	1
Taxi	0	0
Motorbike	0	0
Other	0	0
Total	707	100

Rhodes

In 2006, the Rhodes travel zone had a population of 990 people. As shown in Table 8.3:

- 57% travelled to work by private car or truck as either the driver or passenger.
- 32% travelled to work by train – the high proportion of train travel is due to proximity of Rhodes station to residential areas.
- 11% walked to work – this is a significant proportion of people and is due to the proximity of Rhodes Corporate Park and Rhodes Shopping Centre.

In comparison to the Wentworth Point Travel Zone, the Rhodes Travel Zone displayed significantly lower journey to work travel by car based modes.

Table 8.3 – Rhodes travel zone mode shares. (Source: ABS, 2006)

Description of mode (one method)	Total	%
Car (car driver, car passenger, truck)	75	57
Train	41	32
Walked only	14	11
Bus	0	0
Ferry	0	0
Taxi	0	0
Motorbike	0	0
Bicycle	0	0
Other	0	0
Total	130	100

8.2 Future population growth

The population of the study area is expected to grow substantially over the next decade, as indicated by recent forecasts.

The Transport Data Centre (2009) forecasts that the population of the Rhodes travel zone will increase from 990 in 2006 to 9,291 in 2026.

The *Homebush Bay West DCP* (2004) outlines the development expected for the Homebush Bay area (now referred to as Wentworth Point). Under the *Homebush Bay West DCP* (2004), 6,996 dwellings were approved. A proposal to increase development at Wentworth Point by approximately 20% is currently being assessed. Graf International (2011) forecasts that Wentworth Point's population will grow from 2,818 in 2010 to 11,425 in 2023.

Population forecasts for Wentworth Point for the years 2011, 2016 and 2023 are summarised in Table 8.4. Table 8.4 presents a forecast for the total number of dwellings under the existing *Homebush Bay West DCP* as well as the total number of dwellings under an uplift proposal for the Wentworth Point development.

Table 8.4 – Dwelling forecasts under the uplift proposal for Wentworth Point 2011 – 2023. (Source: Summary of Graf International, 2011)

Development area	Total dwellings		
	2011	2016	2023
Wentworth Point: Lots 8,9,10,18 and 21 (Based on permissible development under Homebush Bay West DCP)	0	1,200	2,250
Wentworth Point: Lots 8,9,10,18 and 21 (Based on uplift proposal)	0	1,500	3,600
Other Wentworth Point developments	2,238	2,968	3,568
Total (Based on permissible development)	**2,238**	**4,168**	**5,818**
Total (Based on uplift proposal)	**2,238**	**4,468**	**7,168**

8.3 Assessment of potential impacts

8.3.1 Construction stage

Potential impacts during construction would include the generation of land-based construction traffic, particularly at the Wentworth Point construction site, and temporary interruptions to pedestrian and cyclist access to Shoreline Drive and to the footpath that runs parallel to the Rhodes foreshore.

These construction impacts are assessed below.

Construction traffic

Construction materials and equipment would be transported and delivered by road. Maritime-based deliveries are not contemplated as part of the proposal.

Construction would generate vehicle trips primarily on the Wentworth Point side for construction of the main bridge. The Rhodes construction site would be used for construction of the approach bridge and approach road from Shoreline Drive and is expected to generate lower volumes of construction traffic. Proposed construction site locations are shown in Figure 8.5.

Access to Wentworth Point for construction traffic would be via Hill Road and the M4 Motorway for traffic from the west. For construction traffic from the west, access to Wentworth Point would be via Silverwater Road and Holker Street, then Hill Road.

Access to Rhodes for construction traffic from the north would be via Concord Road, Averill Road, Cavell Avenue, Leeds Street, Walker Street then Gauthorpe Street. For construction traffic from the south, access to Rhodes would be via Homebush Bay Drive, Rider Boulevard, Mary Street, Walker Street then Gauthorpe Street.

Vehicles accessing the construction sites during construction would mainly comprise private vehicles for workers. Heavy vehicles – including articulated vehicles such as precast girder delivery trucks and heavy rigid vehicles such as concrete trucks – are also expected to access the site.

A concrete batching plant may be temporarily installed during construction, but regular deliveries of raw concrete materials would still be expected to occur.

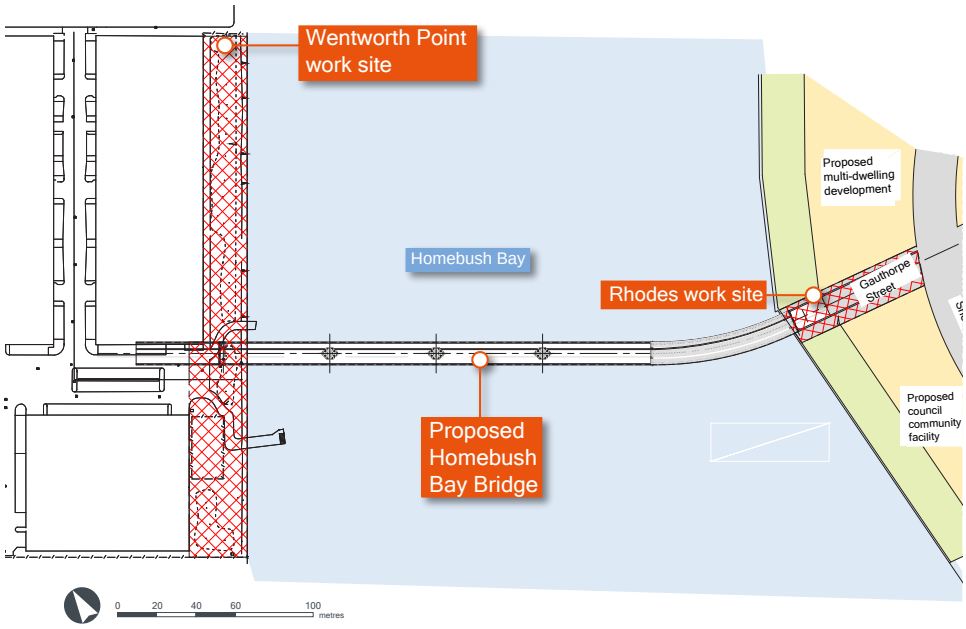


Figure 8.5 – Construction site locations

Table 8.5 outlines the approximate traffic volumes during the construction stages. Other heavy machinery such as cranes would be delivered to the construction site in the preliminary stage. Heavy materials or equipment such as girders or heavy machinery are likely to be delivered in outside of peak traffic hours.

Table 8.5 – Approximate traffic volumes

Stage	Vehicle type*	Estimated number of round trips to site
Earth works/foundations	Excavators (carried by trucks)	4 in total
	AV, HR equipment deliveries	5–10 per week
	HR concrete agitators (pier)	10–20 per week
	Vans/cars	25–50 per day
Bridge construction (precast girders)	AV steel delivery trucks	1–3 per week
	AV girder delivery trucks	10–12 per day
	HR concrete agitators	5–6 per day
	HR concrete pumps	1–2 per day
	Vans/cars	25–50 per day
Bridge deck construction (in-situ concrete pour)	AV steel delivery trucks	4–6 per week
	HR concrete agitators	25–50 per week
	HR concrete pumps	1–2 per day
	Vans/cars	25–50 per day
Finishing works	HR equipment deliveries	2–6 per week
	Vans/cars	25–50 per day

* AV: articulated vehicles; HR: heavy rigid vehicles. Note: Estimates are based on examples of similar recent worksites for a construction period of about 24 months.

It is estimated that the construction traffic associated with the bridge at Wentworth Point would increase by a maximum of 100 round-trips to the site per day during the busiest construction stage (200 trips on the road network per day). If up to 25% of the daily traffic occurred in the peak hour, this would increase the existing Hill Road traffic of 600 vehicles per hour by 50 vehicles to a total of 650 vehicles per hour. This additional traffic would be only a minor proportion of existing traffic, so road network performance is unlikely to change substantially.

It is assumed that up to 50 workers per day would access the Wentworth Point construction site in any given stage. Nominated parking areas would be established, with the construction site providing up to 35 car spaces on site or on a nearby site (to be agreed in detailed design) as there are few parking opportunities in the surrounding streets. The number of cars should be kept to a minimum by encouraging workers to access the site using public transport, or by encouraging car sharing.

The Rhodes site would be a secondary construction site and would attract fewer heavy vehicles than Wentworth Point. Less than 50 vehicles in the peak hour would be generated on the surrounding road network during the busiest construction stage, so road network performance is unlikely to change substantially. Parking for up to 10 vehicles would be considered within the site to minimise the impact on the surrounding streets.

Drivers wishing to access the site for any reason would need to report to the site office and receive parking instructions and guidance. As there are large residential areas around the site, special route instructions may be necessary for visitors to the site.

Impacts on pedestrians and cyclists

The proposed construction work site at Rhodes would create temporary interruptions to Shoreline Drive and to the footpath that runs parallel to the foreshore, as shown in Figure 8.5. Impacts on access for pedestrians and cyclists would be temporary and alternative routes would be provided. The temporary pedestrian and cycling route would be formed around the proposed work site, via Shoreline Drive. The temporary route would aim to maintain safe public access to the Rhodes promenade and the public wharf. Details of the actual route will be provided in the construction environmental management plan.

8.3.2 Operational stage

The proposed bridge would comprise a two-lane bus lane shared with bicycles and a separated footpath. It is expected that the bridge would be used for the following key bus, pedestrian and cycling movements:

Eastbound:

- Wentworth Point to Rhodes train station.
- Wentworth Point to Rhodes bus services.
- Wentworth Point to Rhodes retail and commercial facilities.
- Wentworth Point to proposed Rhodes community centre.

Westbound:

- Rhodes to Sydney Olympic Park ferry.
- Rhodes to Wentworth Point proposed maritime facilities.
- Rhodes to Sydney Olympic Parklands.
- Rhodes to Sydney Olympic Park centre and station.

The bridge would have few adverse impacts on the road, public transport, pedestrian and cycling networks, and would create a number of community benefits, as discussed below.

Mode share targets

Projected future mode splits for journeys to work from Wentworth Point and Rhodes as a result of the proposed Homebush Bay Bridge are presented below.

Wentworth Point

The *Wentworth Point Transport Management Accessibility Plan* (Cattell Cooper, December 2011) provides a journey-to-work transport mode split for Wentworth Point residents. This analysis displays a target mode share of 65% car travel as driver, 33% public transport and 2% other modes. Of the public transport trips, 86% are assumed to be made by rail and 14% by bus. This is shown in Table 8.6.

Table 8.6 – Target journey to work public transport distribution for Wentworth Point post - 2023. (Source: Cattell Cooper, 2011)

Mode	% Trips
Train Trips	**86%**
/ Train trips via Rhodes	82%
/ Train trips via Rhodes northbound	10%
/ Train trips via Rhodes southbound	72%
/ Train trips via Sydney Olympic Park	5%
Bus Trips	**14%**
/ Bus trips east	6%
/ Bus trips west	8%

The Wentworth Point TMAP (Cattell Cooper, December 2011) identifies that a bridge would be necessary to ensure that travel to and from Wentworth Point is sustainable. The analysis shows that the bridge would facilitate public transport (bus and train) travel sufficiently, resulting in a 35% mode split towards modes other than private car, which goes towards the NSW 2021 target of 28% public transport use to Parramatta, Sydney CBD and across the Greater Metropolitan Region.

In regards to journey to work travel behaviour changes in Wentworth Point, the proposed bridge would potentially increase the public transport mode share by 20% (from 13% in 2006 to 33% post 2023) and the walking/cycling mode share by 2% (from 0% in 2006 to 2% post 2023).

Rhodes

It is assumed that the future journey-to-work mode split for the Rhodes travel zone area would remain largely the same as public transport infrastructure is largely established in the area.

The one noteworthy change would be an increase in journeys to work by ferry due to better access to the ferry wharf via the proposed bridge. The forecast future mode split for Rhodes for the year 2023 is shown in Table 8.7.

Table 8.7 – Potential mode split for Rhodes travel zone

Mode	% Trips
Car driver/passenger	56%
Train	32%
Bus	0%
Ferry	2%
Other (bicycle and walking)	10%
Totals	100%

In regards to journey to work travel behaviour changes in Rhodes, the proposed bridge would potentially increase the ferry mode share by 2% (from 0% in 2006 to 2% post 2023).

Impact on public transport

The proposed bridge would allow for greater access to Rhodes station, Olympic Park ferry wharf, and bus routes at Rhodes. As highlighted by the *Wentworth Point TMAP (2011),* it is considered that the local transport network is reasonably satisfactory for an area in this part of Sydney.

The *Wentworth Point TMAP (2011)* provides an analysis of the rail services and ability to meet the rail service needs of the area as the most likely impact is on the capacity of the actual trains and train paths operating the service on the Northern Line, rather than on the access and interchange infrastructure. Rhodes station has been designed to accommodate growth, and the facilities have been assessed by the TMAP as adequate to cater for projected increases in bus movements and interchange.

The Homebush Bay Bridge provides a link available for existing and future bus routes to utilise to increase the provision of public transport services in the area. The provision of a bridge link across Homebush Bay presents possible scope for increased bus services in the area.

The *Wentworth Point TMAP (2011)* suggests that minor alterations to existing local bus routes to use the proposed Homebush Bay Bridge could cater for the public transport demand of the residents at Wentworth Point. A discussion of the potential bus links that could utilise the bridge is presented below.

Potential bus service over the bridge

This section presents a discussion of the bus services that could potentially use the bridge in the future.

The provision of a bus service is seen as integral to the development of Wentworth Point, to improve the connectivity of the area, and encourage the use of public transport by residents and visitors.

Transport authorities were consulted for this Environmental Assessment to identify future bus services over the bridge. No specific feedback on possible bus services over the Homebush Bridge or changes to existing routes around the area were provided. Bus routes are regularly reviewed through Transport for NSW and as the Homebush Bay area develops it is expected that Transport for NSW would review the bus routes in the area as part of their operations and consider the link provided by the Homebush Bay Bridge in the development of future bus routes.

The *Wentworth Point TMAP 2011* undertook an analysis of the bus services that could potentially use the bridge and recommended the extension of route 526 as shown in Figure 8.6.

The extended route 526 could operate to/from the Wentworth Point development and Rhodes station via Gauthorpe and Walker streets (pick up and set down southbound in Walker Street at Rhodes Station) with the service turning via Mary and Marquet Streets. The use of Marquet Street would offer easier bus manoeuvrability and avoid any grade issues.

Extension of the bus route 526 would mostly follow existing STA routes to avoid impacts on local roads and intersections and to cater for safe bus turning movements.

The impacts of the potential extension of bus route 526 on local roads and the capacity of local roads to support bus turning movements is discussed in the following section.

Figure 8.6 – Possible bus route 526 extension

Impact on local roads and bus turning movements

The proposed bridge provides an opportunity to facilitate a greater number of trips made by non-motorised transport modes in order to limit the impact of the growth of the communities on the road network. The proposed bridge also provides an opportunity to limit congestion of the road network by facilitating greater access to public transport.

The estimated frequency of bus movements over the bridge is presented in Table 8.8. Estimations are based on the projected future mode split for Rhodes and Wentworth Point (Refer to Table 8.6 and Table 8.7). The frequency is presented for the busiest time of the day (i.e. AM peak hour periods) for both diections.

Table 8.8 - Estimated bus operation (Source: Cattell Cooper, December 2011)

Timing	Type of vehicle	Estimated frequency (AM peak period in both directions)
Earliest year of opening 2016	Standard size bus	8–10 buses per hour
Year 2023	Standard size bus	20 buses per hour

Note: Future bus service provision would be based on demand.

Extension of the bus route 526 would mostly follow existing STA routes to avoid impacts on local roads and intersections and to cater for safe bus turning movements.

Figure 8.6 shows the possible extension to the 526 bus route. The bus would follow the proposed extended route either on a clockwise loop or an anti-clockwise loop.

Wentwoth Point

On the Wentworth Point side, the 526 bus route currently uses Hill Road to Sydney Olympic Park Ferry Wharf. The proposed Hill Road / Footbridge Boulevard intersection has been assessed and was found to be suitable to accommodate both left and right turning buses.

Footbridge Boulevard, between Hill Road and the bridge, will be an east-west road to be designed with sufficient width to accommodate bus movements.

Rhodes

On the eastern side of Homebush Bay, the bus route would use Gauthorpe Street between the bridge and Walker Street. Gauthorpe Street, Walker Street, Mary Street and Marquet Street are typical 12.8m wide roads that have sufficient width to accommodate bus movements. The bus route in Rhodes could follow either a clockwise or an anti-clockwise loop. The assessment of these two options is presented below.

Clockwise loop

For the clockwise loop, the bus route would make a number of right turns and would enable use of the existing bus stop on the railway side of Walker Street adjacent to Rhodes Station. All intersections were found to have sufficient width to accommodate right turn manoeuvres. The left turn from Marquet Street to Gauthorpe Street could also be accommodated.

It was found that buses turning right from Gauthorpe Street to Walker Street would not have priority and may be subject to delays at peak periods in the future as traffic volumes in the area increase.

Anti-clockwise loop

For the anti-clockwise loop, the bus route would make a number of left turns. Buses would use the existing bus stop on the western side of Walker Street adjacent to Rhodes Station. All intersections have sufficient width to accommodate the right and left turn manoeuvres.

Buses are unlikely to experience significant delays on the right turn from Gauthorpe Street to Marquet Street. Therefore, the anti-clockwise loop is considered more advantageous for the potential extension of bus route 526.

Impacts on the Rhodes bus/rail interchange area

The *Wentworth Point TMAP* noted that the potential extension of bus route 526 would utilise the Rhodes railway station bus stop facility located on the western side of Walker Street.

This bus stop facility has approximately 44m of kerb space available. Such space is considered sufficient to accommodate two simultaneous bus arrivals, plus some level of kiss and ride activity. Therefore the kerb space available on the western side of Walker Street is considered to be suitable for the additional buses that could be generated by an extension of the 526 bus route.

Controlling bus-only access

The proposal includes traffic management measures such as signs and CCTV video surveillance to enforce bus-only access to the bridge. In addition, the design of the approaches to the bridge at both Wentworth Point and Rhodes would integrate pedestrian and bicycle priority and prevent private vehicles entering the bridge.

No traffic signals are proposed at this stage.

Special events at Sydney Olympic Park

SOPA has advised special event buses would not use the proposed bridge in the short term. SOPA may conduct investigations for Sydney Olympic Park event buses to use the proposed bridge in the longer term if required.

Contribution to NSW targets

As noted in Section 2.2, the *NSW 2021: A plan to make NSW number one* (former *NSW State Plan 2010*) set the following targets relevant to the proposal:

- Increasing the proportion of total journeys to work by public transport in the Sydney Metropolitan Region to 28% by 2016.
- Increasing the share of commuter trips made by public transport:
  - to and from the Sydney CBD during peak hours to 80% by 2016.
  - to and from the Parramatta CBD during peak hours to 50% by 2016.
- Increasing the mode share of bicycle trips made in the Greater Sydney region at a local and district level to 5% by 2016.

Based on the work carried out by Cattell Copper (2011), it is predicted that from year 2023 the bridge would increase the proportion of total peak hour journeys by public transport in Wentworth Point to 33%. The bridge is also predicted to contribute to increase the share of peak hour journeys from Wentworth Point to Sydney to 80% and from Wentworth Point to Parramatta to 50%. The actual achievement of these targets is subject to the extension of existing public bus routes as recommended by Cattell Copper (2011) and summarised in this section (See Potential bus service).

It is likely that the numbers of pedestrians and cyclists on the Homebush Bay area would be higher as a result of the proposal given the likelihood of walking and cycling to access trains at Rhodes. Based on the existing journey-to-work data for Wentworth Point, it is estimated that the bridge would contribute to an increase in the total peak hour journeys by bicycle and walking to about 2%.

Therefore, it is considered the proposal would contribute to achieving the targets for public transport and bicycle trips outlined in *NSW 2021*.

8.4 Mitigation and management measures

8.4.1 Construction stage

The mitigation and management measures proposed to reduce impacts on traffic and access in the Homebush Bay area during bridge construction would include:

- Preliminary access route for traffic – To keep construction related traffic to a minimum on the surrounding roads, a preliminary access route into the site from the main access points such as the M4 Western Motorway has been designed (refer Figure 8.7). The route would be clearly marked by traffic control signage to ensure vehicles are following the correct route. This route would be further refined for the project's CEMP.
- Escorts for larger vehicles – Larger vehicles such as the AV girder delivery articulated vehicles would need to be considered when delivering to the site. When reasonable and feasible, these large vehicles would be delivering outside of peak periods to avoid impacts on the surrounding residential areas and the road network, and there may be a need for escort vehicles.
- Temporary pedestrian and cycling route – The construction of the bridge would create temporary interruptions to Shoreline Drive. A pedestrian and cycling route based on safe public paths would be formed around the proposed work site, via Shoreline Drive. The route would aim to maintain public access to the Rhodes promenade and the public wharf. Details of the actual route will be provided in the CEMP.

As construction would take place away from major trunk routes, there would be minimal impact to public transport, and no specific management measures would be required.

Figure 8.7 – Proposed routes for construction vehicles

8.4.2 Operation stage

No specific management measures for traffic and access would be required once the bridge starts operating.

9 Public domain

This Chapter describes the integration of the bridge with bus, pedestrian and cycle networks, and assesses the impact of the bridge landings on the public domain and surrounding development at Rhodes and Wentworth Point. It addresses the requirements of the Director General that the environmental assessment consider:

- The integration of the bridge with the existing and future pedestrian and cycle network in the local, regional and metropolitan context.
- The impact of the bridge ramps on existing and future shared-use pedestrian and cycle access along the foreshore of Wentworth Point and Rhodes.
- The design as it pertains to safety measures for pedestrian and cycle access on the bridge.

9.1 Existing environment

9.1.1 Pedestrian network

The pedestrian network in Rhodes and Wentworth Point is currently in transition, due to the continuing redevelopment of the Homebush Bay area.

In Rhodes, the street pattern in proximity to the bridge landing is typical of a residential neighbourhood complemented with a share pedestrian and cyclist path running parallel to the foreshore.

In Wentworth Point, the street pattern in proximity to the bridge landing reflects the warehouse uses on the site, with large blocks limiting the pedestrian permeability of the site.

The existing key attractors and generators of pedestrian activity are shown in Figure 9.1. These include public transport nodes, retail, community facilities and commercial uses near Homebush Bay. In addition, Homebush Bay is surrounded by a series of recreational areas including Sydney Olympic Park, Bicentennial Park and Badu Mangroves. The redevelopment at Rhodes and Wentworth Point will ultimately provide continuous pedestrian and cycling access along the foreshore of Homebush Bay.

Figure 9.1 highlights the following barriers to pedestrian movement:

- Nodes of activity are within a 400–800 m radius of Rhodes and Wentworth Point, but Homebush Bay presents a physical and perceptual barrier to access these areas.
- Industrial uses at Wentworth Point disconnect the foreshore walk from The Promenade to the Sydney Olympic Park ferry wharf.

Figure 9.1 – Existing and future pedestrian routes and nodes

9.1.2 Cycling network

There are extensive cycling facilities surrounding the Homebush Bay area, as shown in Figure 9.2. These include a strong network of off-road cycle paths in Sydney Olympic Park, with cycling access to the parklands to the east of Wentworth Point and the wetlands of Homebush Bay. There are also cycle paths and associated facilities being built to respond to development in Rhodes that will provide pedestrian and cycling access along the foreshore in the future.

Wide, sealed shoulders provide cycling access on surrounding local roads. Regional cycling connections in the area include:

- Parramatta Valley Cycleway.
- Cooks River Cycleway.

Figure 9.2 – Cycling connections

9.2 Assessment of potential impacts

9.2.1 Integration with the pedestrian and cycle network

The integration of the proposed bridge with pedestrian and cycle networks is illustrated in Figure 9.3 and described in the following sections.

It should be noted that movements on the bridge are direct with limited need for integration or conflicts whereby pedestrians are separated from bus and bicycle movements while bus and bike movements are compatible with clear view lines available to all modes that is not impeded by the cresting of the bridge because of the low and gradual slopes.

Rhodes

At Rhodes:

- The bus and cycle lanes on the bridge would join the street system at the intersection of Gauthorpe Street and Shoreline Drive, which would have two-way general traffic lanes.
- The footpath on the bridge would extend through the park to join with the street path system. A proportion of pedestrians would also choose to cross the bus and cycleway lanes and travel south along the foreshore and south-east to the community centre and beyond.
- The bridge landing would arrive at near ground level and within the foreshore park, requiring pedestrians, bikes and buses to travel across public open space before joining the street system at the intersection of Gauthorpe Street and Shoreline Drive.
- A bus stop could be located in the foreshore park, being an adequate distance from the Rhodes rail station, but also suitable for departures west across the proposed bridge to facilities at Wentworth Point, Newington and Sydney Olympic Park. Potential bus stops within the park, near the intersection of Gauthorpe Street and Shoreline Drive, could also assist in the accumulation of activity in this area when combined with the operation of the future community centre and proposed nearby corner shops as well as that of the street intersection in general. City of Canada Bay Council would determine the need and exact location of bus stops near the bridge landing.
- The cues for safe pedestrian travel are provided by the continuity of pathways from the bridge to those within the adjoining parks and streets. A single control point at grade provides for informed movement crossing the paths of busses and bicycles moving from the bridge to the intersection of Gauthorpe Street and Shoreline Drive. High levels of visibility and overlooking are available to the pedestrian at all times while they will be clearly visible from bikes and busses.
- The cues for bicycle movement is provided by the continuity of the bike and bus way from the bridge to the intersection of Gauthorpe Street and Shoreline Drive where they join normal local traffic conditions. Bicycles can join the dedicated bike paths in the foreshore open space system at the pedestrian crossing control point and have good levels of visibility at all times. Entering the bridge appropriately is capable of being clearly signposted as well as direct with little scope for confusion.
- The linear foreshore reserve would be characterised by a continuous pedestrian/

cyclists promenade about four ms wide at the water's edge that is punctuated by a variety of conditions created by street terminations. The promenade would interact frequently with pedestrian crossings at street terminations and elsewhere.

Wentworth Point

At Wentworth Point:

- The proposed bridge would land directly onto the elevated Footbridge Boulevard. This would allow the footpath from the bridge to directly connect to the path adjoining the large central park while the lanes carrying buses and cyclists would be able to transition into the trafficable lanes within the boulevard.
- The cues for safe pedestrian travel is provided by the continuity of pathways directly from the bridge to the street (Footbridge Boulevard) and park system without any potential for conflict given its grade separation from foreshore movements. There is no opportunity or incentive to prematurely cross the path of bikes or busses prior to entering the street and conforming to usual traffic safety norms.
- The cues for bicycle movement is provided by the continuity of the bike and bus way from the bridge to a roundabout on Footbridge Boulevard which manages merging from a foreshore one way street with the Boulevard. Entering the bridge appropriately is capable of being clearly signposted as well as being reasonably direct with little scope for confusion.
- Footbridge Boulevard connects directly to Hill Road. This is the closest intersection central to the proposed urban development and the westernmost extent of the proposed central park, which is planned to contain an urban square with associated shops, cafes and restaurants. This area could be suitable for bus stops given the level of after-hours activity, the central, well-connected location, and appropriate distance from the Sydney Olympic Park ferry wharf.

Overview of benefits for pedestrians and cyclists

The proposed bridge would integrate well with and greatly improve local and regional connectivity for both Rhodes and Wentworth Point (currently, pedestrians have to travel an indirect route around the foreshore to access each side of Homebush Bay). In particular, it would provide pedestrian connections to:

- A series of open space areas, including Sydney Olympic Park parklands.
- Retail opportunities at Rhodes shopping centre.
- Community facilities (such as the maritime school and rowing facilities at Wentworth Point and the community centre at Rhodes).
- Public transport nodes (Rhodes railway station, Sydney Olympic Park railway station and ferry wharf).

In addition, the bridge would integrate well with and significantly improve local and regional cycling networks by providing:

- A largely flat connection from Rhodes and Wentworth Point to a series of transport, retail and recreational uses within 2–5 km.
- A link to the Cooks River cycleway and Parramatta River regional cycling routes.

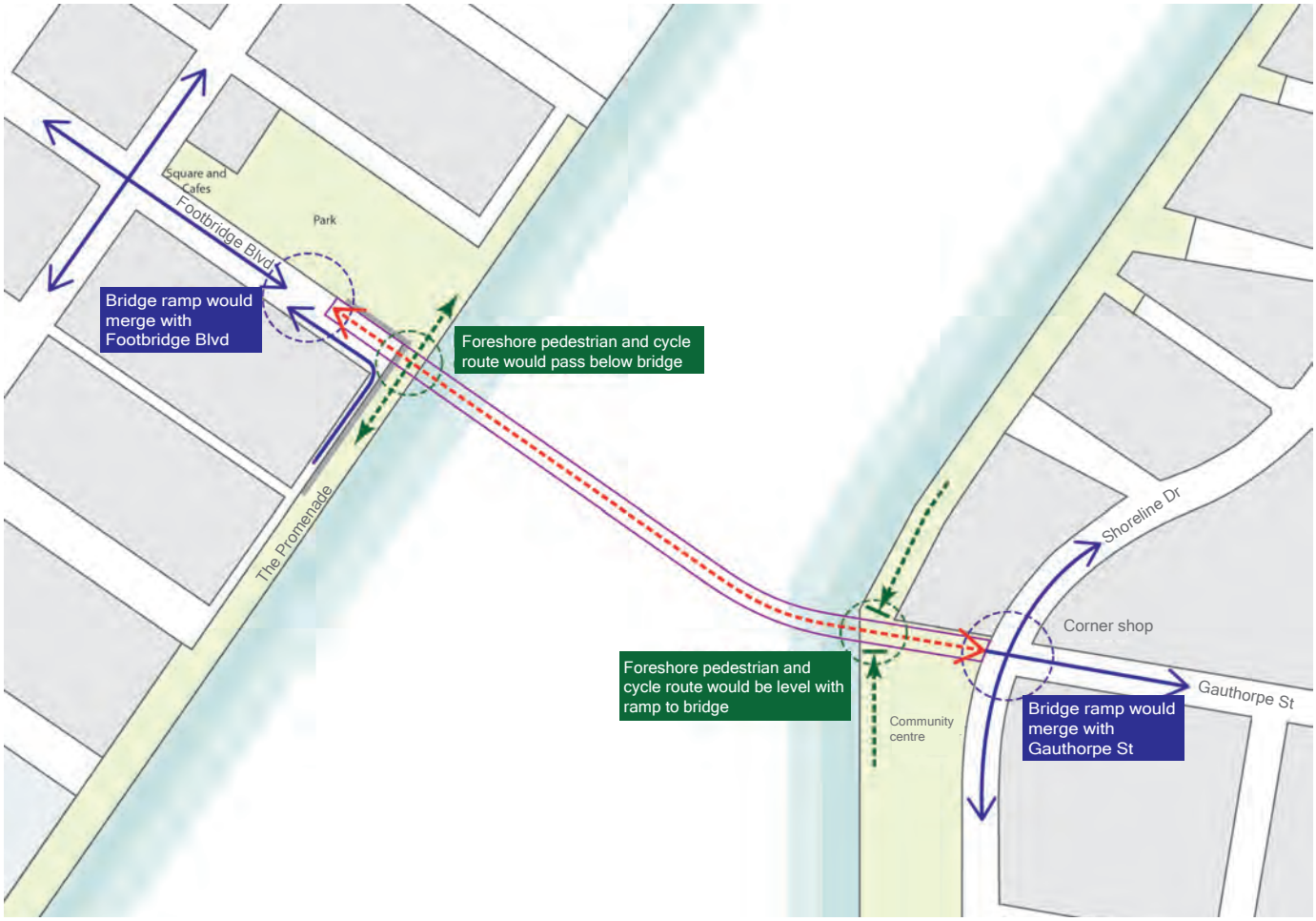


Figure 9.3 – Integration of proposed bridge with pedestrian and cycle networks

9.2.2 Impact of bridge landings on access and safety along the foreshore

This section identifies and assesses the potential impacts of the bridge landings on pedestrian and cyclist access along the foreshore and details design and safety measures to manage identified impacts (for foreshore access issues and management measures during construction, refer to Chapter 8).

The use of levels or grade separation provides opportunities for appropriate cues for the movement and merging of pedestrians, cyclists and buses.

The proposed design includes clear unambiguous pathways, high levels of visibility, appropriate signage and direct paths to convey the bus, cycling and pedestrian movements both on the bridge and at the Wentworth Point and Rhodes landings.

The bridge arrives at Rhodes at near ground level and within the foreshore park system requiring pedestrians, bikes and buses to travel across public open space before joining the street system at an intersection. The bridge approach extends approximately 15 metres onto the land until intersecting with the gradient of an

extended Gauthorpe Street and the foreshore pedestrian and bike pathways where movements are corralled and managed to remove conflict.

At Wentworth Point the bridge is grade separated from the foreshore reserve and the abutment is directly within a wide elevated street. This allows buses, bikes and pedestrians to merge directly into the street carriageways without potential pedestrian conflict albeit with the need to merge with traffic outside of an intersection.

High levels of visibility are available to all modes at all times, especially at potential points of conflict.

Rhodes

The bridge landing at Rhodes would have the following features to ensure safe access to the bridge and foreshore areas:

- Appropriate signage to convey bus-only and cyclist-only access on Gauthorpe Street west of Shoreline Drive.
- The dedicated cycle path adjacent to the foreshore at Rhodes would connect to the raised crossing treatment, using signage to indicate the shared pedestrian and cycling environment.
- Bicycle access to the bridge would follow on-street cycling paths to continue to the bus lanes on the bridge.

The proposed bridge landing arrangements at Rhodes would not interrupt pedestrian and cyclist access along the foreshore. However, the mixing of pedestrians, cyclists and authorised vehicles at the Rhodes landing has the potential to create an unsafe environment for bridge users. The design and safety responses to address this potential safety issue are described below and illustrated in Figure 9.4. An indicative sketch of the landing concept at Rhodes is shown in Figure 9.5. An artist impression of the bridge landing at Rhodes is provided in Appendix C.

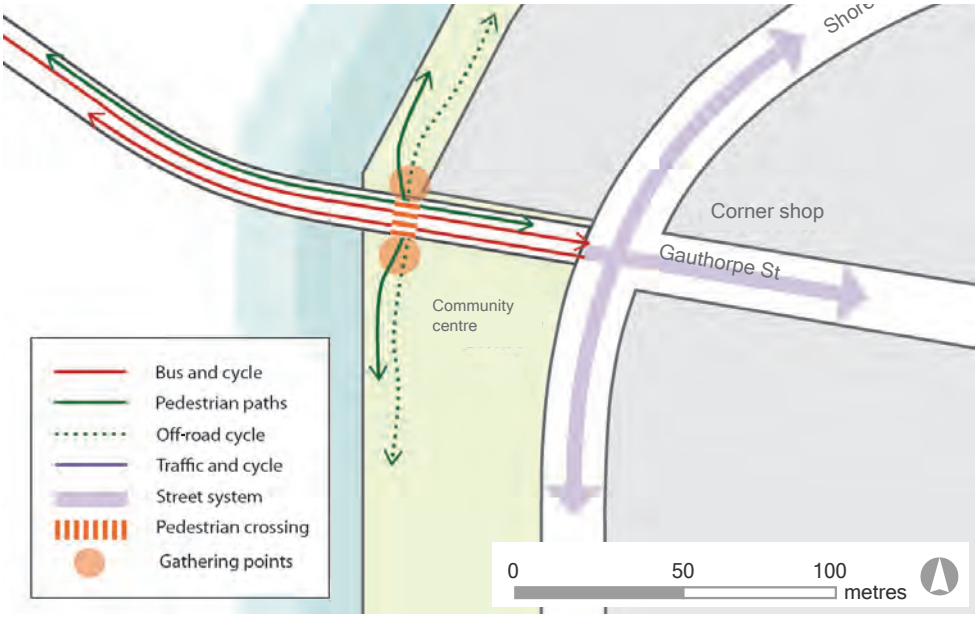


Figure 9.4 – Proposed landing at Rhodes

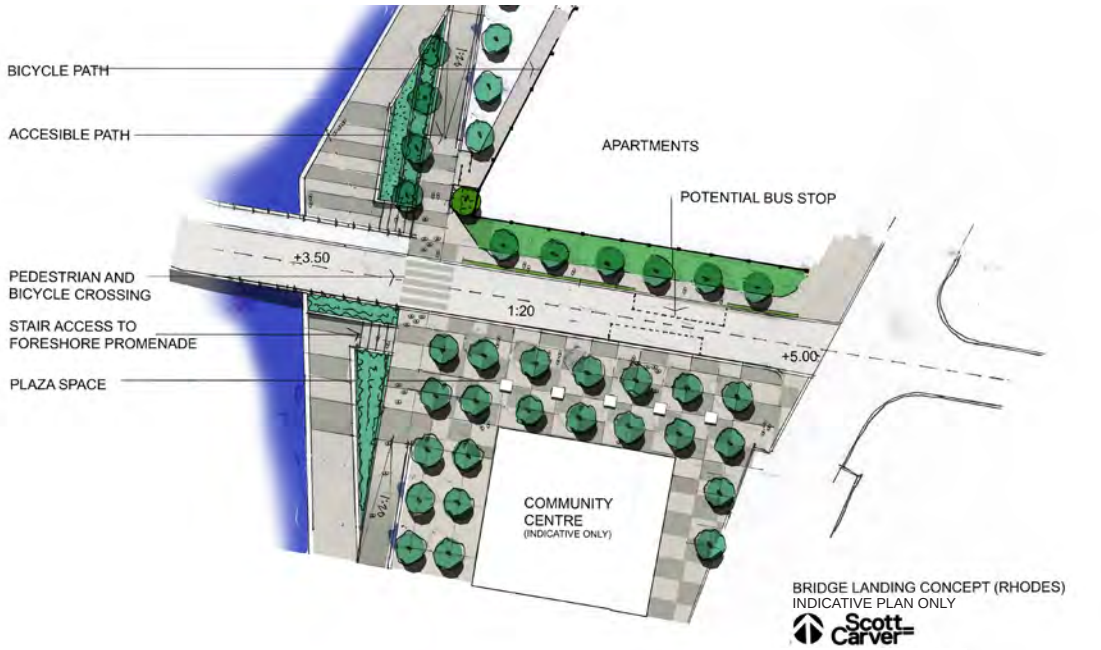


Figure 9.5 – Proposed landing at Rhodes

The proposed bridge would slope down towards Rhodes while the foreshore park would slope down towards Homebush Bay. Opposite slope directions would allow good visibility for pedestrians, cyclists and drivers. It would also allow the bridge landing level to be reconciled at the transition of the proposed pedestrian and cyclist crossing, which is considered to be a desirable condition given the need for an at-grade crossing of east–west and north–south movements of all transport modes.

As noted in Chapter 4 (Proposal description), there would be a minor level difference between the proposed bridge surface and the Rhodes foreshore promenade. This would take the form of a raised crossing treatment to manage movements from the bridge and north–south movements along the foreshore. The raised crossing treatment would slow and concentrate bridge and foreshore users into a single collection and decision point. It would help to slow cyclists and vehicles and ensure that cyclists travelling on the bus lanes would cross the opposing bus lane in a controlled manner. An schematic example of the proposed raised crossing treatment is presented in Figure 9.6.

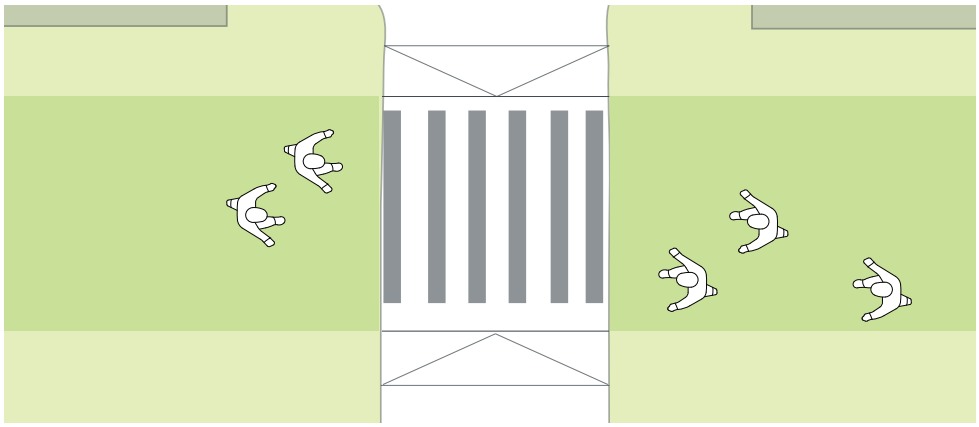


Figure 9.6 – Raised crossing treatment example

The concept design for the Rhodes bridge landing, including the raised crossing treatment, would be conducted as a joint exercise with the City of Canada Bay to complement the proposed community centre and foreshore park.

Wentworth Point

The bridge landing at Wentworth Point would have the following features to ensure safe access to the bridge and foreshore areas:

- Signage that would allow for bus-only access to the bridge for vehicles travelling west to Rhodes.
- The grade-separated landing would allow buses and cyclists to merge directly with the street network without potential conflicts with pedestrians and cyclists travelling along the foreshore path.
- Intersections beyond the bridge are envisaged to appear and function as a regular section of the road network, with standard traffic and pedestrian controls.
- There would be continuous pedestrian and cycling access along the foreshore, with pedestrians and cyclists able to travel under the bridge.
- Cyclists accessing the bridge would follow on-street cycle paths and continue to the bus lanes on the bridge.
- Pedestrians would access the bridge from the north, with connections from footpaths adjacent to and through the proposed park and from the foreshore square and cafes.

The foreshore pedestrian path and off-road cycleway would cross beneath the proposed bridge and therefore would not be interrupted by the proposal (refer Figure 9.7). The space under the bridge would have a minimum height from the foreshore promenade level of about four ms, which would maximise solar, weather and visual penetration of the undercroft area.

The westbound bridge lane would merge with one-way traffic travelling west from the Foreshore Street and arriving from a different level. This merging would potentially create poor visibility between drivers and cyclists. The proposed design solution to this impact would be to provide a roundabout that would manage bus-only and cycling-only access to and from the bridge. It would also manage the merging of buses and cycles with other traffic which would allow most of Footbridge

Boulevard to act as a normal street. A cul-de-sac type condition would be avoided because of the width of the boulevard (25 m), which would ensure that direct pedestrian paths would not be interrupted.

The pedestrian crossing would be located west of the proposed roundabout and allow pedestrians to safely cross between the northern and southern footpaths.

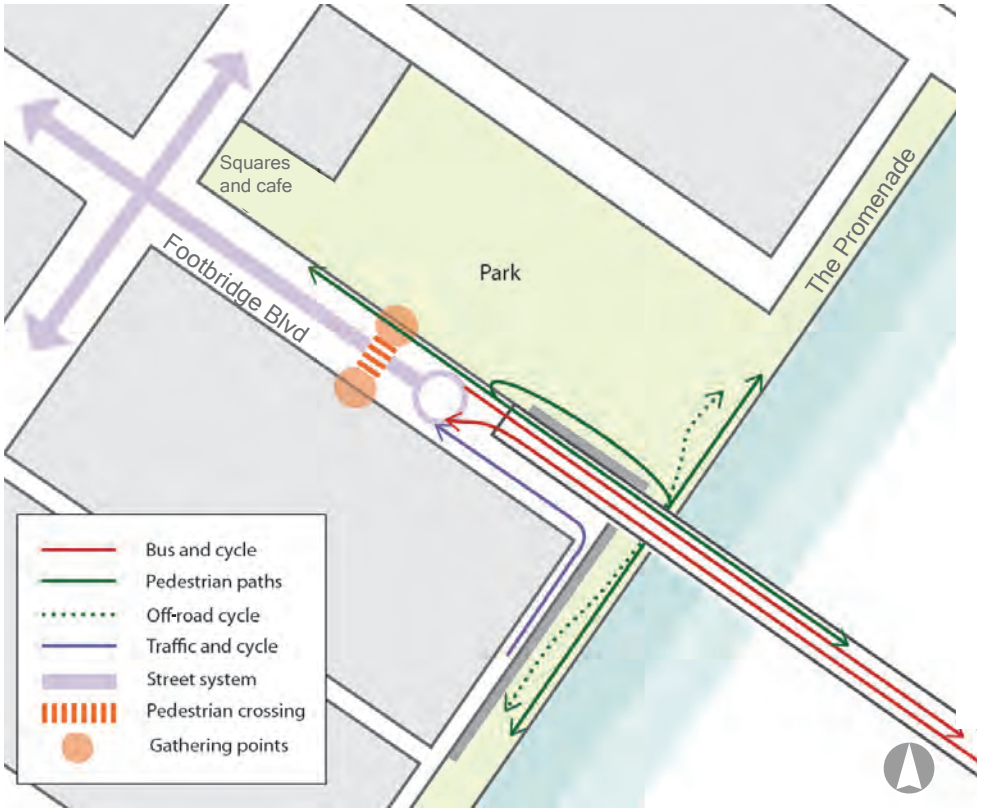


Figure 9.7 – Proposed landing at Wentworth Point

Overview of bridge landing arrangements

The proposed bridge landing arrangements would fit well with:

- The predicted pedestrian, cyclist and road conditions at Rhodes, including the access along the foreshore and proposed community centre.
- The predicted pedestrian, cyclist and road conditions at Wentworth Point, including the access along the foreshore.

An indicative sketch of the landing at Wentworth Point is shown in Figure 9.8. An artist impression of the bridge landing at Wentworth Point is provided in Appendix C.

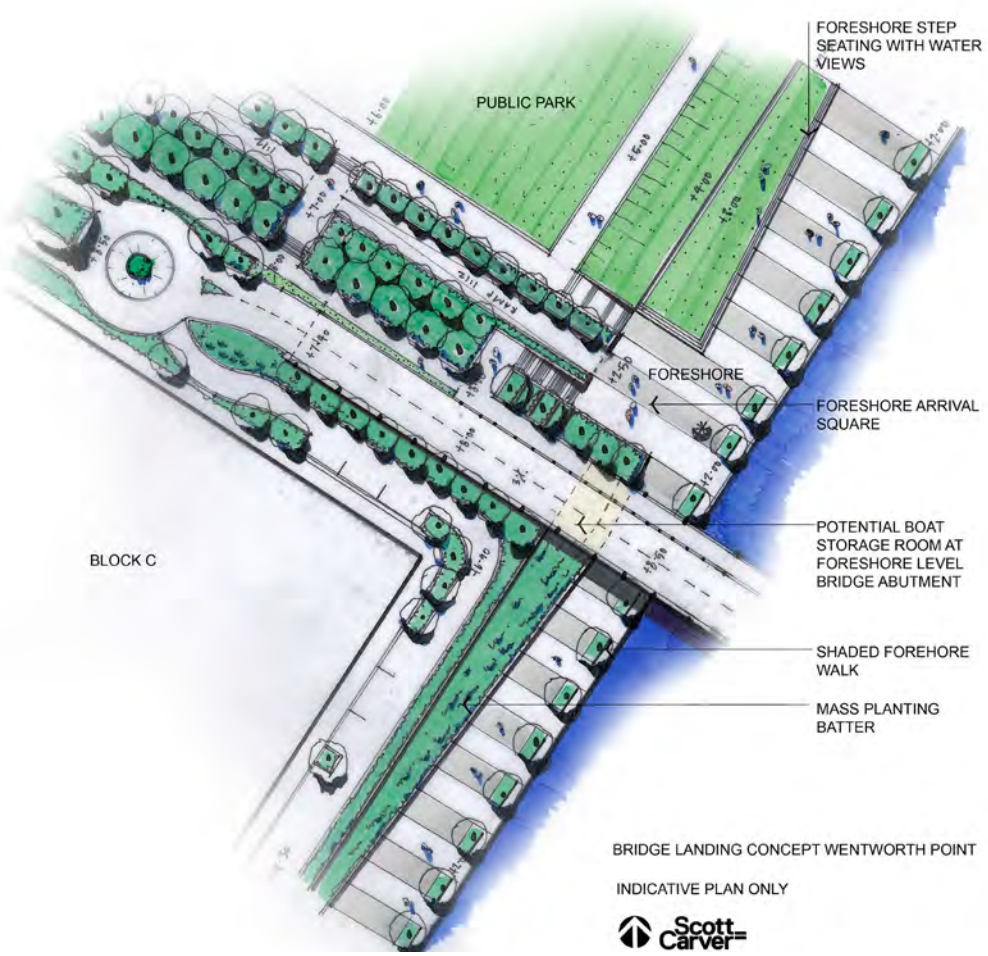


Figure 9.8 – Indicative bridge landing concept: Wentworth Point

9.2.3 Bus lane visibility assessment

An assessment of the visibility that would be experienced by bus drivers and cyclist travelling on the bus lanes of the bridge was undertaken.

The assessment took into account the 'coefficient of deceleration for buses' prescribed in Table 5.3 of *Ausroads Guide to Road design; Part 3: Geometric design* (2009) to determine whether the sight distance provided by the bridge bus lanes is sufficient for buses given the maximum travelling speed (50km/h) and the maximum gradient of the bridge (1:33).

The analysis found that at the crest of the bridge there would be a 30m bus lane section with a sight distance varying between 79m and 90m. The worst case scenario sight distance of 79m is considered to be acceptable for bus drivers to spot any potential road hazards and decelerate comfortably if required. Sight distance at the crest is also considered acceptable for cyclist using the bus lanes.

The remaining section of the bridge bus lanes is expected to have a sight distance greater than 90m which is considered desirable for buses and cyclist.

9.3 Mitigation and management measures

No mitigation or management measures are proposed.

10 Visual amenity and overshadowing

This Chapter provides a summary of the visual and shadow impact assessment prepared by Scott Carver to accompany this environmental assessment (refer Appendix H). It addresses the Director General's requirement that the environmental assessment provide:

- An assessment of the visual impact of the project (height, scale and lighting) on the local and regional area, particularly on:
  - Any adjoining landowners and landowners along the foreshore of Rhodes, Wentworth Park and Meadowbank.
  - Existing and future residential properties in Rhodes and Wentworth Point.
  - Water uses of Homebush Bay and the Parramatta River.
  - Significant vantage points in the public domain, in particular the Sydney Olympic Park precinct and foreshores of Homebush Bay, Bicentennial Park and Meadowbank Park.
- An assessment of the overshadowing impact of the bridge structure, embankments and ramps on existing and proposed public domain, open space, foreshore areas and residential uses.

10.1 Existing environment

Homebush Bay is visually defined by the adjacent foreshores of Rhodes peninsula to the east and Wentworth Point to the west. To the south, the bay is defined by mangroves along the northern part of Bicentennial Park and to the north by the shoreline of Meadowbank, which is also extensively covered by mangroves.

As an extension of the Parramatta River, Homebush Bay is a broad, shallow inlet reaching two kms south to the Badu Mangroves, which lie north of Bicentennial Park. About 1.4 kms from the head of the bay, Haslams Creek feeds in from the south-west corner under a bridge at Bennelong Road.

The north shore of the Parramatta River comprises a slope about one km deep up to the ridgeline formed along Victoria Road.

10.2 Assessment of potential impacts

10.2.1 Visual impact assessment approach

The visual assessment assesses visual impact by examining a series of representative viewpoints and evaluating them in terms of visual modification and visual sensitivity. These terms are described below.

Visual sensitivity

Visual sensitivity refers to viewers and their sensitivity to their visual environment. Generally, this is dependent upon:

- Viewers' interest in the visual environment (i.e. high, medium or low interest in their everyday visual environment).
- Viewers' duration and viewing opportunity (i.e. prolonged, regular viewing opportunities).

- The number of viewers and their distance from the source of the effect, where relevant.

Visual modification

Visual modification refers to the extent of change to the landscape and visual amenity that would occur as a direct result of the project from a given viewpoint. Assessment of these changes includes identification of:

- The nature of the change (i.e. degree of contrast, or integration of any new features with existing features).
- Context and quality of the views including the extent to which the proposals will be visible in the wider landscape (with consideration of the presence of intervening vegetation or features).
- The scale or degree of change (i.e. would the change be obvious or imperceptible with respect to loss or addition of features).

Views to the bridge

The Homebush Bay Bridge would have a high degree of visibility in the local area. At the same time it is very difficult to find a vantage point outside this basin where the bridge would be visible at all. Views to the bridge would be from the following locations:

- The landscape to the south of Homebush Bay includes Badu Mangroves and Bicentennial park and Sydney Olympic Park. Badu Mangroves and Bicentennial park would offer views only to walkers and cyclists at strategic lookouts along the shore of the Badu Mangroves. The urban development of Sydney Olympic Park is separated from the bay by The Brickpit and Haslams Creek so that only tall buildings would have long views, some 2.5 kms from the proposed bridge location.
- The north shore of the Parramatta River, which comprises a slope about one km deep up to the ridgeline formed along Victoria Road. Although this rising topography would suggest that there would be vantage points from which to see Homebush Bay, suburban development and trees effectively obscure such views. Views along the length of Homebush Bay can be seen from a couple of select positions in Meadowbank Park, on the foreshore and between breaks in the mangroves that line the shoreline.
- Future residential development along both shorelines (i.e. Rhodes and Wentworth Point).
- The Wentworth Point foreshore, which is a straight seawall about 1.4 kms long that will also function as a promenade; and the Rhodes foreshore. These foreshores would provide the public with views of the bridge. The scale of the bridge would grow as the bridge is approached along the foreshore.

Because the visual setting of the bridge is contained in the ways described above, three viewpoints are considered to be representative of the available vantage points. These are illustrated as follows:

- Viewpoint 1 – from Meadowbank Park between foreshore mangroves looking south along the reach of the Homebush Bay waterway.
- Viewpoint 2 – from the northernmost lookout along the Badu Mangroves

cycleway, looking north.

/ Viewpoint 3 – from the foreshore promenade of Wentworth Point, positioned to typify a view that changes while moving towards the bridge.

The viewpoints adopted for the photomontages for the visual impact assessment are presented in Figure 10.1. These viewpoints were chosen as they are representative of the majority of views from the public domain within the three general visual catchments of the bridge.

These viewpoints present the bridge as an object, its form and detail increasing in importance with proximity. However, the pedestrian promenades control the viewpoint to a line and these perceptions of the bridge differs little between specific places around the Bay and accordingly the photomontages provided are sufficient to assess its visual effect in these terms.

Schematic views provided in the Homebush Bay Bridge Urban Design Report (Refer to Appedix H) indicate the bridge's visual effect to receptors closer to the bridge. However, its more precise details would be subject to subsequent design processes.

Figure 10.1 – Location of representative viewpoints

10.2.2 Assessment of representative viewpoints

Viewpoint 1: from Meadowbank Park

This viewpoint is from Meadowbank Park between foreshore mangroves looking south along the reach of the Homebush Bay waterway. This viewpoint is considered to be representative of the views from:

- Meadowbank Park.
- Water users of Parramatta River and Homebush Bay (travelling north-south direction).
- Existing and future residential properties and land owners in the northern part of Wentworth Point and Rhodes foreshores.

The photomontage of the view from this viewpoint is presented in Figure 10.2.

Visual sensitivity

Views from the north would be confined to glimpses between foreshore mangroves and might, therefore, be considered of low sensitivity.

Nevertheless, the views that are available are also 'pause points' along a public cycleway and footpath and are therefore likely to be places from which the view might be appreciated and pondered. Views similar to this would also be seen from boats and the ferry, becoming a general part of a passing urban landscape.

The current situation affords distant views to the Badu Mangroves two kms to the south. Beyond the mangroves, the core of Sydney Olympic Park is visible 3.5 kms away. The dome of the Showground Exhibition Centre and the ANZ Stadium are iconic landmarks in the setting.

Visual modification

From Meadowbank Park, the proposed bridge would appear almost a km distant as a low-slung connection between the two shores. While the bridge deck would interrupt the view of the Badu Mangroves, their crown would be visible and create a foreground to the buildings of Sydney Olympic Park beyond.

Visual impact

The proposed bridge would settle into its context in a harmonious way. Both abutments would be visible, formalising a visual connection to each shore.

The proposed bridge would be read from here in almost a perfect elevation, its camber, supports and deck profile visible as a composition. From this direction the sun would light the edge of the deck in the morning with shadows emerging in the afternoon as the sun sweeps away from this north-east orientation.

Existing view

Figure 10.2 – Photomontage with bridge for viewpoint 1: Meadowbank Park

Viewpoint 2: from Badu Mangroves lookout (Bicentennial Park)

This viewpoint is from the northernmost lookout along the Badu Mangroves cycleway, looking north. This viewpoint is considered to be representative of the views from:

- Badu Mangroves (Bicentennial Park).
- Water users of Homebush Bay (travelling south-north direction).
- Existing residential properties and land owners in the southern part of Rhodes foreshore.

The photomontage of the view from this viewpoint is presented in Figure 10.3.

Visual sensitivity

Views from the south are only available to walkers and cyclists within the Badu Mangroves, from the lookout tower and from Shipwreck lookout.

From this viewpoint, Homebush Bay appears as a long stretch of water reaching towards Meadowbank, 1.9 kms away. In the winter, the sun bounces off the water surface, creating glare.

The open space at the end of Wentworth Point merges visually with the mangroves of Meadowbank beyond, making it hard to distinguish where Wentworth Point ends.

Visual modification

The bridge would interrupt the view of the Meadowbank foreshore, but the hills beyond and the ridgeline at Victoria Road would create a reference that informs the size of the bridge.

Visual impact

From Badu Mangroves, the view of the bridge would be distant, and its form would be too remote to register detail with the eye – the bridge would be incidental to the view. Over time, the planned dense urban development on both sides of the bridge would also serve to diminish its scale.

Existing view

Figure 10.3 – Photomontage with bridge for viewpoint 2: Badu Mangroves lookout

Viewpoint 3: from the Wentworth Point foreshore (daytime)

This viewpoint is from the foreshore promenade of Wentworth Point, positioned to typify a view that changes while moving towards the bridge. This viewpoint is considered to be representative of the views from the residential properties and land owners in Wentworth Point foreshore. The photomontage of the view from this viewpoint is presented in Figure 10.4.

Visual sensitivity

The current situation allows views across to the new, and growing, community of Rhodes peninsula, along to its northern extreme, with Meadowbank beyond appearing as a wooded treeline. The view of the bridge from this location would change as one progresses along the foreshore, with the form and detail increasing in importance when approaching the bridge.

Visual modification

The bridge would present as an element reaching towards Rhodes, its Wentworth Point abutment only visible when closer. The impact of the whole form would be diminished by virtue of this elevation being mostly in the shade. It would be defined by reading against the wooded embankments of Meadowbank to the north. The Meadowbank treeline would be visible.

Visual impact

The bridge would become a critical component from residential outlooks, particularly at night and a marker from which relative distances would be more discernable than under existing conditions. Each foreshore would be long, as a pedestrian experience, and the bridge would serve as a reference for progress, much the same as a headland does when walking along a beach. The lighting poles fixed to the southern side of the bridge would add interest and calibrate the length of the bridge as a counter rhythm to its structural supports.

Viewpoint 3: from Wentworth Point foreshore (night-time)

The photomontage for this viewpoint is presented in Figure 10.5.

Visual sensitivity

Homebush Bay at night is dark and generally unaffected by its surroundings. Recent residential development at Rhodes peninsula is demonstrating that both Rhodes and Wentworth Point would provide mutually attractive night-time views.

Visual modification

The bridge at night would define the connection between the two communities by virtue of its lighting poles and feature lighting of its supports. This is an important addition to the night-time view, a constant presence and reminder of the connectivity, promoting its use and thereby increasing its safety.

Visual impact

The overall visual impact would be that of an attractive foreground element against the lights of each residential community.

Existing view

Figure 10.4 – Photomontage with bridge for viewpoint 3: Wentworth Point foreshore

Figure 10.5 – Photomontage for viewpoint 3: Wentworth Point foreshore at night

10.2.3 Overall visual impact

Vantage points to view the bridge were sought from Victoria Road, Ryde near St Johns Church where Sydney Olympic Park can be seen, from the slopes of Meadowbank and from Bicentennial Park and Sydney Olympic Park. However, it should be noted that the bridge has very little visual impact in its broader setting as it would not be able to be seen from any of these locations except from tall buildings in Sydney Olympic Park some 2.5 km away.

Within Homebush Bay, the proposed bridge would be visible from most points along the east and west foreshores and future built communities, yet only from a few selected points among the mangroves to the north and south.

The bridge will be symbolic of and a functional part of Homebush Bay's urban amenity and is expected to be viewed in a positive light through the benefits it delivers.

The bridge profile would be kept as simple and low as is structurally and functionally possible to respond to its Bay setting and within the low horizon north and south of the Bay where there is low slung vegetation. The gradients on the bridge are set at acceptable maximums while creating required clearances underneath and the structural depth is minimised.

The number of structural supports in the water has been minimised to suit achievable spans and spacings that allow for planned rowing activities on the waterway as well as a visual permeability. These supports have been offset from the shorelines to create attractive interfaces with pedestrian promenades and to avoid blocking views at the water's edge.

10.2.4 Shadow impact assessment

Shadow impacts from the bridge would be minimal and contained to the immediate area of its influence as demonstrated by the shadow diagrams in Figure 10.6.

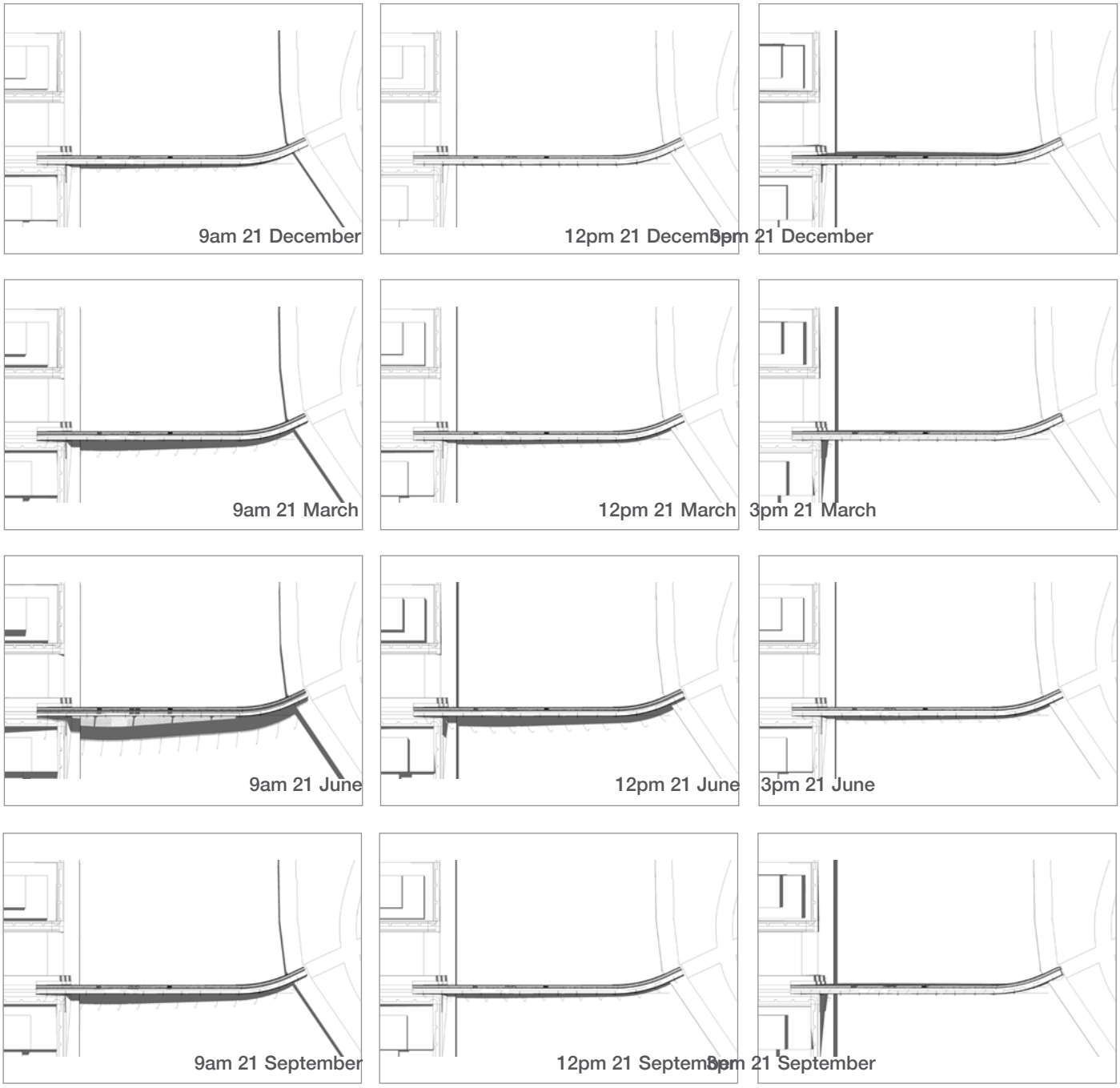


Figure 10.6 – Homebush Bay bridge shadow diagrams

Impacts on adjoining properties

The bridge would not have shadow impacts onto adjoining properties.

Impacts on water users

The main body of the bridge's shadow would fall on the water body of Homebush Bay. Bridge shadows would not have detrimental impacts on existing and future maritime activities.

Impacts on open space and foreshore

As shown in Figure 10.6 and Figure 10.7, the bridge abutment would be very close to ground level along the Rhodes foreshore and would cast a very slight shadow during the winter. This shadow would not have impacts on foreshore areas.

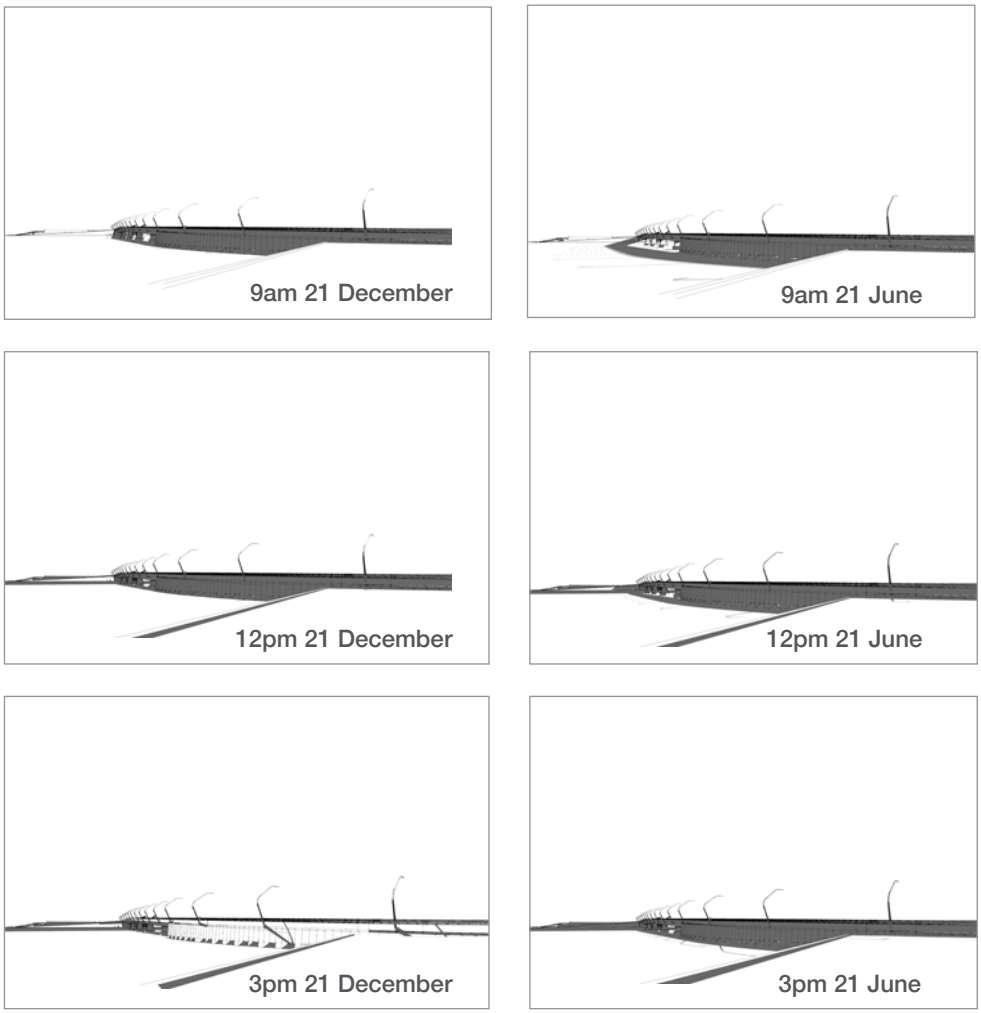


Figure 10.7 – Shadow diagrams for Rhodes abutment

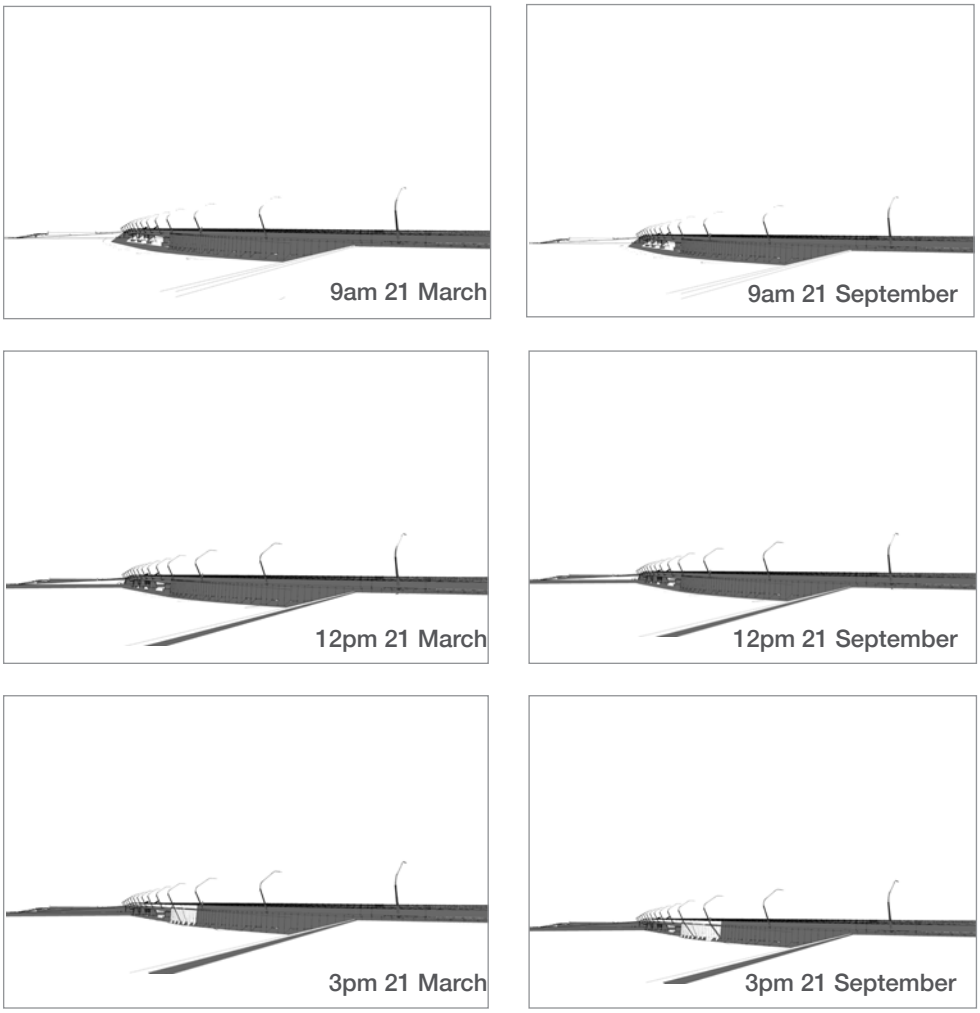


Figure 10.8 – Shadow diagrams for Wentworth Point abutment

The shadow diagrams in Figure 10.8 and Figure 10.9 illustrate the extent of shadowing from the bridge abutment on the Wentworth Point foreshore promenade (the perspectives are from south of the bridge). Along this foreshore, the bridge would pass over the foreshore boardwalk and create a shadow below. This shadow would be the width of the bridge and, while it would reach further to the south during winter, its aggregate width would not change.

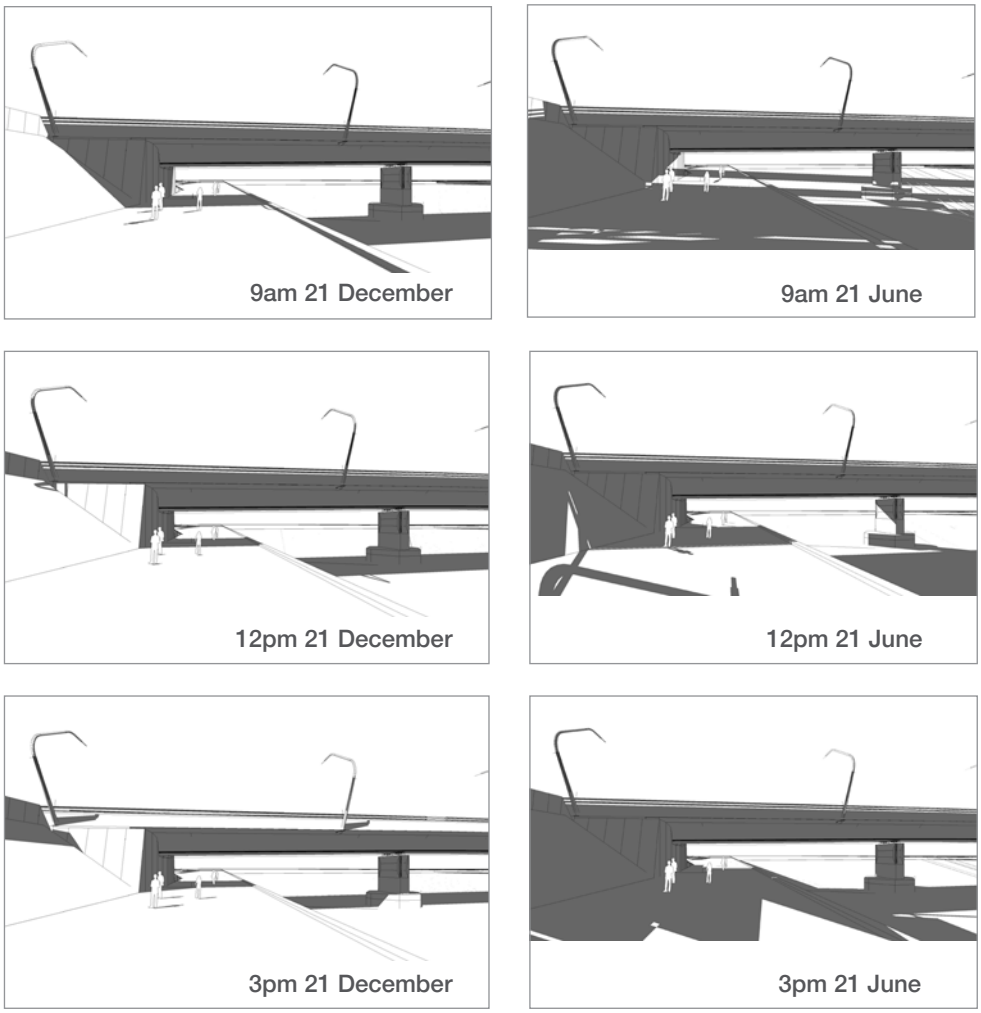


Figure 10.9 – Shadow diagrams for Wentworth Point abutment

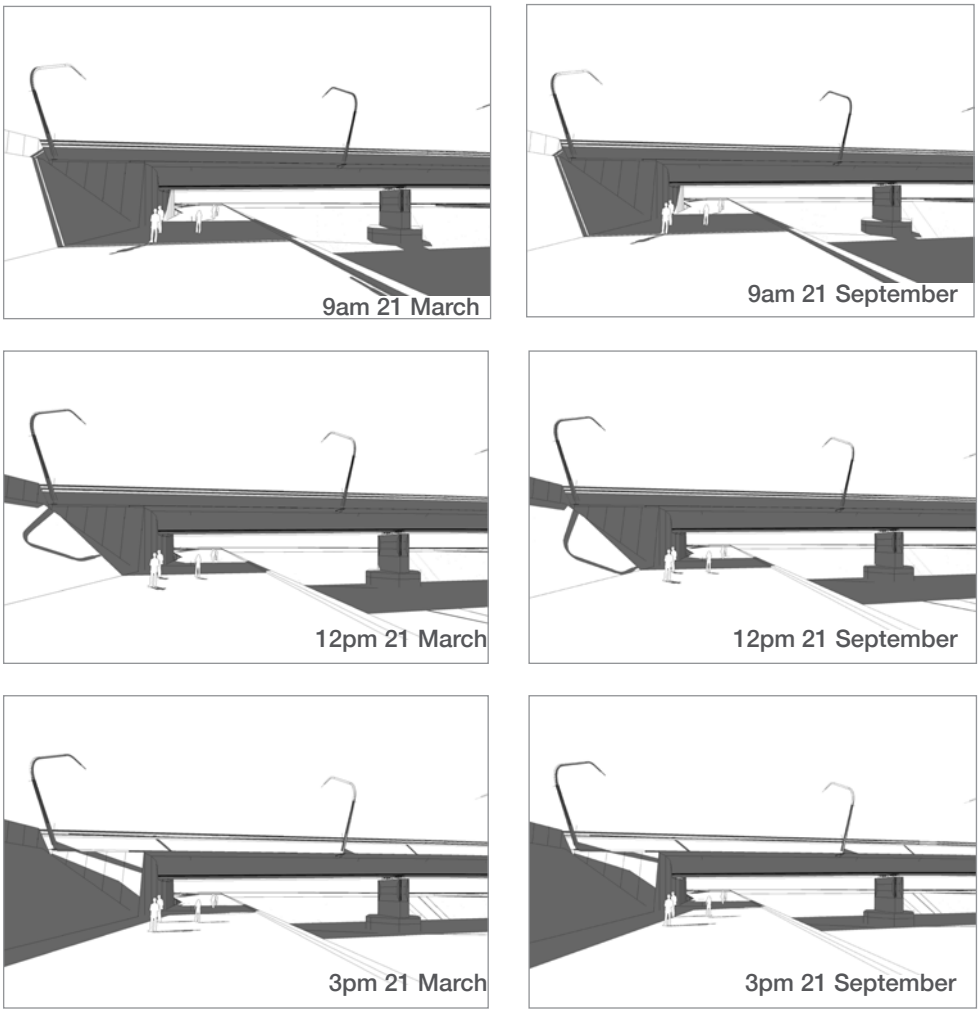


Figure 10.10 – Shadow diagrams for Wentworth Point abutment

10.3 Mitigation and management measures

No mitigation measures are proposed beyond the design measures described earlier.

11 Climate change

This Chapter responds to the Director General's requirement for:

/ An assessment of the effects of sea level rise as a result of climate change on the project.

11.1 Projections of sea level rise

There are a number of policy and strategy documents that provide different projections of mean global sea level rise by 2050 and 2100 including:

/ *Intergovernmental Panel on Climate Change* (Fourth Assessment Report, 2007).
/ *NSW Sea Level Rise Policy Statement* (NSW Government, 2009).
/ *NSW Coastal Planning Guideline: Adapting to Sea Level Rise* (NSW Government, 2010).
/ *Adapting to Climate Change in Australia, an Australian Government Position Paper* (Australian Government, 2010).
/ *Garnaut Climate Change Review – Update* (Australian Government, 2011).

Table 11.1 summarises the projected values for mean sea level rise as a result of climate change to be considered by 2050 and 2100 based on 1990 levels.

Table 11.1 - Projections of mean sea level rise (MSLR)

Projection		2050	2100
A	NSW planning benchmark	0.4 m	0.9 m
B	IPCC AR4 upper limit A1FI projections (adjusted time series)	0.28 m	0.82 m
C	Upper bound of sea level rise projected by statistical methods (as referenced by Australian Government publications above)	-	1.4 m
D	Suggested upper bound of global mean sea level rise only if all variables are quickly accelerated to extremely high limits (as referenced by Australian Government publications above)	-	2 m

The resulting impact on current sea levels at Homebush Bay (for projection scenarios A, C and D in Table 11.1) by 2100 is presented in Table 11.2. Scenario B is less than the planning benchmark required by the NSW Government and was therefore excluded.

Table 11.2 - Projections of mean sea level rise (MSLR) to 2100

Extreme water level	m Australian Height Datum (AHD)				
	Current level[1]	Assumed 1990 levels	0.9 m MSLR	1.4 m MSLR	2 m MSLR
Highest Astronomical Tide	1.17	1.107	2.007	2.507	3.107
1-in-20 year extreme sea level event	1.375	Assumed as per current	2.275	2.775	3.375
1-in-100 year extreme sea level event[1]	1.435	Assumed as per current	2.335	2.835	3.435
1-in-2000 year extreme sea level event[1]	1.62	Assumed as per current	2.52	3.02	3.62
Sydney Harbour Foreshores and Waterways DCP[2]	1.675	Assumed as per current	2.575	3.075	3.675

[1] Estimated on basis that increased frequency of storm surge events will not affect the 1 in 100 year event magnitude

[2] Assuming that the DCP adopts the 0.9m increase as per the NSW Sea Level Rise Policy

11.2 Assessment of the potential impacts

The following potential impacts on the proposal were identified as a result of sea level rise induced by climate change:

- Impacts on the structural integrity of the bridge.
- Coastal inundation at bridge landing points at Rhodes and Wentworth Point.
- Increased restrictions on maritime navigation due to reduced clearance beneath the bridge.

A qualitative risk assessment was undertaken to evaluate the risks associated with these potential impacts. A summary of this assessment is provided in the following sections.

11.2.1 Structural integrity of the bridge

Under AS 5100.2, the bridge should be designed to withstand flooding events up to and including the 2,000-year average recurrent interval event (also known as a 'one-in-2,000-year flood').

The full length of the superstructure soffit of the bridge would be designed to be above the 2,000-year average recurrent interval event (1.62 m AHD)) at a minimum height of 2.0m AHD at the eastern end.

However, adopting a 0.9 m allowance for sea level rise in 2100 (which would bring the 2,000-year average recurrent interval event to 2.52 m AHD) would mean that the water level would increase above the soffit along the lower sections of the bridge at its eastern end. If worst-case scenarios of climate change-induced sea level rise were to eventuate (refer Table 11.2), this would mean a much higher impact from flood waters.

Bridge collapse was found to be extremely unlikely as the majority of the superstructure would be well above the 2000-year average recurrent interval event. In addition, the relatively low currents experienced in Homebush Bay (less than 0.5 m per second) mean these potential additional loads would likely not be expected to govern the structural design.

The degradation of materials used in the bridge construction may accelerate through impacts caused by increased frequency of inundation events, particularly of the bridge piers. This accelerated degradation has the potential to reduce the life expectancy of the infrastructure, increase maintenance costs and possibly lead to failure earlier than without sea level rise.

11.2.2 Inundation at landing points

The eastern landing point of the bridge would be at Rhodes, just above the crest of the existing seawall between 2.8 and 3.5 m AHD. The final landing level would be determined during the detailed design stage and in consultation with City of Canada Bay Council. Under AS 5100.2, the bridge is to be designed to maintain serviceability during the 20-year average recurrent interval event (1.375 m AHD). Adopting a 900 mm allowance for sea level rise, the 20-year average recurrent interval event would be lower than the landing deck level.

The western landing point of the bridge would be at Wentworth Point, at an elevation of 8.25 m AHD. At this height, the landing point would not be vulnerable to inundation for any of the extreme sea levels and climate change sea level rise scenarios considered in the assessment.

11.2.3 Increased restrictions due to reduced bridge clearance

All sea level rise scenarios would effectively reduce the adopted bridge clearance height above Mean High Water Springs by a magnitude of the actual sea level increase (ignoring changes to tidal behaviour from increased water levels).

A reduction in clearance would potentially restrict some larger vessels that would currently be able to navigate the bridge, either preventing navigation completely, or restricting their access to low tide. Further discussion regarding maritime clearance is provided in Chapter 12 of this report.

11.3 Mitigation and management measures

The design of the Homebush Bay Bridge adopts necessary measures to protected against the adverse impacts of sea level rise under climate change projections to reduce the risk of:

- Bridge collapse.
- Coastal inundation at the Rhodes landing point.
- Increased restrictions on maritime navigation functionality due to reduced bridge clearance height.

There would be specific allowance for projected sea level rise scenarios, particularly with regards to ground-plane levels, clearance heights and critical design loads.

The landing points (particularly at Rhodes) would be designed in accordance with current forecast of sea level rise due to climate change. The minimum level adopted for landing points at the sea wall is 2.8 m AHD, which is well above the current development control plan requirement with an additional 900 mm to meet the projection set in *NSW Coastal Planning Guideline: Adapting to Sea Level Rise*.

12 Navigation and safety

This Chapter provides a detailed assessment of impacts on maritime navigation in Homebush Bay as a result of the proposed bridge. Specifically, it addresses the following matters of consideration outlined in the Director General's requirements:

- Details of the bridge clearance on the Wentworth Point side and the deep water navigation channel.
- Impacts of the project (construction and operational) on existing and future maritime and recreational use (particularly the proposed rowing course from the end of Homebush Bay to Burroway Road) of Homebush Bay.
- Safety of navigation in Homebush Bay for water-based traffic.

This assessment is based on a desktop study using publicly available information, relevant literature and a visual inspection of the bridge landing area and surroundings. As specific vessel usage data for Homebush Bay is not available, informed assumptions have been made in lieu of this information.

12.1 Existing environment

12.1.1 Berthing locations

A number of locations within Homebush Bay have been identified as current or historical formalised vessel berthing points (Figure 12.1). All are on the western side of the bay. There are no known offshore mooring points within the bay.

The formalised berthing locations are:

- A loading/unloading jetty north of the proposed bridge alignment. This is marked as 'A' on Figure 12.1.
- Fixed timber wharves/jetties ('B' and 'D' on Figure 12.1) and one floating pontoon wharf ('C' on Figure 12.1) south of the proposed bridge alignment. Only the floating pontoon wharf appears to be regularly used (it is used for launching small recreational craft such as small yachts, kayaks).
- A floating timber structure of an unknown historical use located at the southern end of the bay near Bennelong Avenue ('E' on Figure 12.1). This structure is in disrepair and unlikely to be functional.

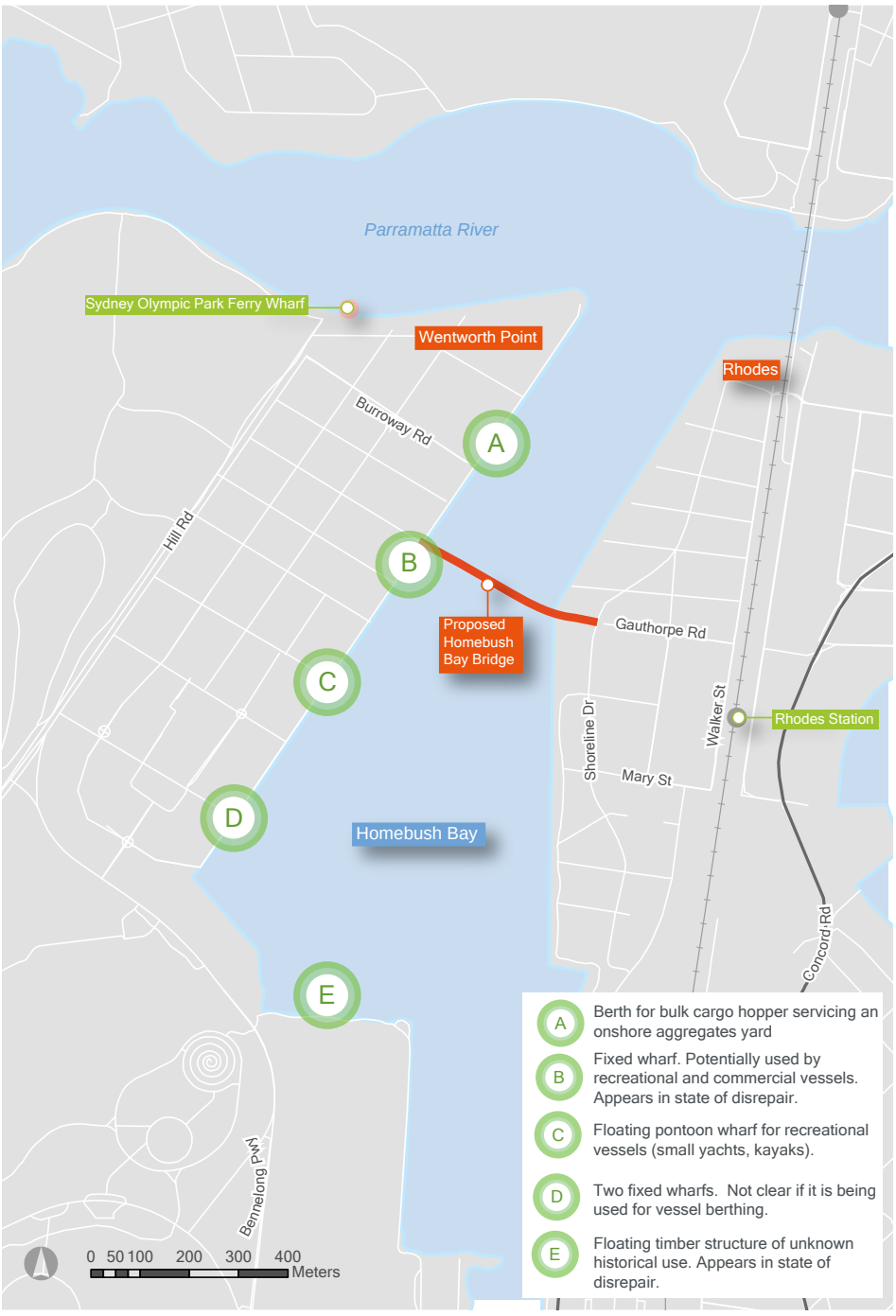


Figure 12.1 – Berthing locations in the Homebush Bay area

12.2 Existing vessel usage

Specific vessel usage data within Homebush Bay is not available. However, existing water depths within the bay, the existing berth facilities and general observations provide an indication to the types of vessel use in the bay.

Except for a narrow section of deeper water along its western boundary, Homebush Bay is relatively shallow, with much of the bay less than one m deep at low tide. The southern half of the bay is particularly shallow, with some areas exposed at low tide. This shallowness restricts the type and size of vessels that can physically navigate the bay.

Vessels navigating the bay are mainly:

- Recreational craft such as kayaks, canoes, and small sailing yachts and powerboats up to 15–20 m long.
- Bulk cargo hoppers (these are roughly 50 ms long and 10 ms wide), which use the northernmost jetty (berth A in Figure 12.1).

The bay is also used – though infrequently – by construction barges and work boats, particularly in recent times for the decontamination and foreshore works associated with developments on the eastern side of the bay.

There is no data on the average numbers of vessels navigating Homebush Bay per day. However, observations suggest that vessel traffic is low in Homebush Bay compared to other nearby waterways including the Parramatta River.

12.3 Bridge clearance height

The vertical span clearance heights above mean high water spring (the highest level that spring tides reach) at other bridges in the region was reviewed for this assessment. Minimum clearances for nearby bridges are:

- Ryde road and rail bridges to the east of Homebush Bay – clearance of 11.8 and 11.5 ms, respectively.
- Silverwater Bridge to the west of Homebush Bay – clearance of 12.2 ms.

These bridges span the Parramatta River, which is a primary navigation channel and subject to a variety of recreational and commercial vessel traffic, including relatively large yachts and powerboats.

In addition, Tom Uglys Bridge on the Georges River (flowing into Botany Bay to the south of Sydney) has a height clearance at mean high water spring of 5.7 ms, and is a good upper precedent for the maximum height clearance to be provided for vessels navigating under the proposed Homebush Bay Bridge. The extent of waterways west of Tom Uglys Bridge and the recreational and commercial use are greater than that which would apply to Homebush Bay south of the proposed bridge (Sylvania Marina and Tom Uglys Marina are located immediately west of Tom Uglys Bridge. Vessels navigating west of Tom Uglys Bridge include various ferries and cruise boats as well as a large number of recreational vessels accessing the marinas and waterways leading to the upper reaches of the Georges River).

12.4 Proposed Rowing NSW rowing course

It is understood Rowing NSW is proposing to establish a new rowing course between the northern end of Homebush Bay and Burroway Road. The requirements for the proposed rowing course have been discussed with Rowing NSW as part of consultation for the proposed bridge (refer to Chapter 6). In summary, the proposed course would:

- Be used only for sprint competitions over a length of 1000–1,500 ms.
- Run parallel to the Wentworth Point foreshore where the deep-water navigation channel is located.
- Ideally have six lanes marked by buoys, with each lane at least 12.5 to 13 ms wide.
- Be used on about 20 weekends per year, with races run in the morning until about 1pm.
- Have the finish line at the northern side of Wentworth Point where Rowing NSW has allocated some land for its rowing facilities.

12.5 Assessment of potential impacts

12.5.1 Construction stage

Maritime traffic generated during construction would be limited to piling barges and the boat used for installing and decommissioning the sediment control devices. No maritime traffic would be generated from delivery of construction materials as these deliveries would be land based only.

Impacts on maritime traffic may potentially occur during placement of the new bridge piles and piers, limiting their transit route options within the bridge alignment and presenting a physical safety hazard. Construction barges used during piling would also obstruct vessels while in use.

However, considering the low numbers of vessels currently navigating this section of the bay, and the finite construction timeframe for maritime-based construction activities (about 12 months), the specific overall impacts during the bridge construction stage could be considered relatively low if managed appropriately.

12.5.2 Operational stage

The potential impacts on vessels navigating Homebush Bay once the bridge is constructed would include:

- Restriction of vessels with an air draft larger than can be permitted by the clearance height beneath the bridge (air draft is the height of the vessel above the water line).
- The physical presence of the bridge, which presents a new vessel impact hazard.

As shown in the engineering drawings in Appendix C, the proposed bridge design makes provision for a 20 m-wide deep-water navigation channel near the western end of the alignment to allow larger vessels to pass under the bridge. This does not preclude smaller craft passing under the bridge at other points along the alignment. Larger vessels currently transit the line of the proposed navigation channel as this is where water depths are at a maximum.

The proposed bridge design makes provision for a minimum clearance height of 5.7 ms above mean high water spring within the designated deep-water navigation channel. This height is based on an assessment of likely air draft requirements against the practicality and cost implications to the bridge design, and discussions with NSW Maritime (now RMS). There is no established guidance in Australia on the typical distribution of air draft for vessels navigating inland waterways. However, international guidance (*Standards for the use of inland waterways by recreational craft* PIANC 2000) suggests that a 5.7 m height clearance would be sufficient for most sizes of recreational craft up to about 20 ms long. The clearance is also sufficient for the passing of small construction barges and accompanying tug boats.

The impact of this height restriction on existing and potential future waterborne activities is considered in Table 12.1.

Table 12.1 - Impacts of Homebush Bay Bridge on waterborne activities

Activity within Homebush Bay (existing and future)	Impact of bridge clearance restriction at 5.7 m above mean high water spring[1]
Navigation of recreational craft within the bay	No restrictions on small craft (e.g. rowing boats, kayaks, small sailing boats). Some potential restrictions on larger craft with excessive air draft requirements (e.g. vessels with tall masts and aerials).
Construction over water and waterborne transportation of materials	Small dumb barges with a small tug or self-propelled work boat should be able to navigate the bridge. Floating in of jack-up barge restricted, but could be utilised if transported by road and assembled on land from southern end of bay. Self-propelled hopper barges may be restricted.
Dredging of the bay	Use of dredgers for major dredging campaigns may be restricted. Small-scale dredging could be possible with excavator on barge, supported with dumb hopper barge with small tug.
Access for waterborne emergency services vessels	Smaller vessels in fleet should be able to navigate bridge. Larger vessels in fleet may be restricted.

[1] this is the minimum clearance height above MHWS. Up to about 1.2 m would be added to the clearance height at lower tides.

The likelihood of vessels physically impacting the proposed bridge over its design life is considered to be low. However, the consequences of such an impact could potentially be severe in terms of vessel damage and human safety. The locations of the bridge piers have been chosen to minimise these physical obstructions. In particular, the deep-water navigation channel has been chosen to match the existing transit routes into the bay. The risk of vessels impacting the bridge would be further reduced with the implementation of management measures described in Chapter 12.

The proposed bridge design layout has taken into consideration NSW requirements for the proposed rowing course. As shown in Appendix C, the design allows two

sets of three rowing lanes accommodated under spans 2 and 3. This proposed arrangement was presented to Rowing NSW on 15 June 2011. Rowing NSW gave positive feedback on the proposal (refer meeting minutes, Appendix D).

12.6 Mitigation and management measures

12.6.1 Construction stage

Mitigation and management measures are proposed that would reduce the impacts on navigation within Homebush Bay during bridge construction. These measures would involve:

- Marking exclusion zones around critical areas of construction activities and floating construction plant.
- A proclaimed Marine Notice would be issued via RMS alerting maritime operators of ongoing construction activities.
- Provision for temporary aids to navigation would be made where reasonable and feasible (e.g. lighted buoys to mark exclusion zones).
- Preparing and implementing a construction environmental management plan to set out maritime procedures and impact reduction measures to be adopted during the construction stage.

12.6.2 Operational stage

The following mitigation measures are incorporated into the bridge design:

- Navigation – The design for the bridge aims to address the potential impacts on navigation within Homebush Bay through the provision of a main navigation channel, and the setting of an appropriate clearance height.
- Vessel impact – The ability of the bridge to resist potential vessel impact scenarios has been assessed, and it is considered unlikely at this stage that specific boat impact mitigation measures would be required. However, this issue will be considered in more detail during later stages of the project.
- Rowing course – The bridge layout allows adequate space for the six lanes required for the proposed Rowing NSW course to pass under the western bridge spans, as well as sufficient height clearance. In consultation with RMS, the provision of appropriate safety measures would be considered during rowing races to avoid rowing boats clashing with other vessels in the bay and with the bridge piers. This may involve setting up temporary exclusion zones around the course and specific marking of the pier extents during the events.
- Aids to Navigation – A particular mitigation measure that would be considered at further design stages is the provision of permanent Aids to Navigation on the bridge structure. The International Association of Marine Aids to Navigation and Lighting Authorities provides recommendations for the specification of Aids to Navigation of bridges within inland waterways. It is proposed that green and red navigation lights marking the deep-water navigation channel extents, and a cardinal white light in the centre of the span at deck level, be provided on the bridge to aid boat operators at night. Complementary day markings may also be provided. The final arrangement of the Aids to Navigation, including lighting flashing sequences, would need to be agreed with RMS during future design stages.