

# Appendix F

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Traffic and transport assessment

# SYDNEY HARBOUR BRIDGE SOUTHERN CYCLEWAY

## TRAFFIC AND TRANSPORT IMPACT ASSESSMENT

FOR  
ROADS AND MARITIME SERVICES



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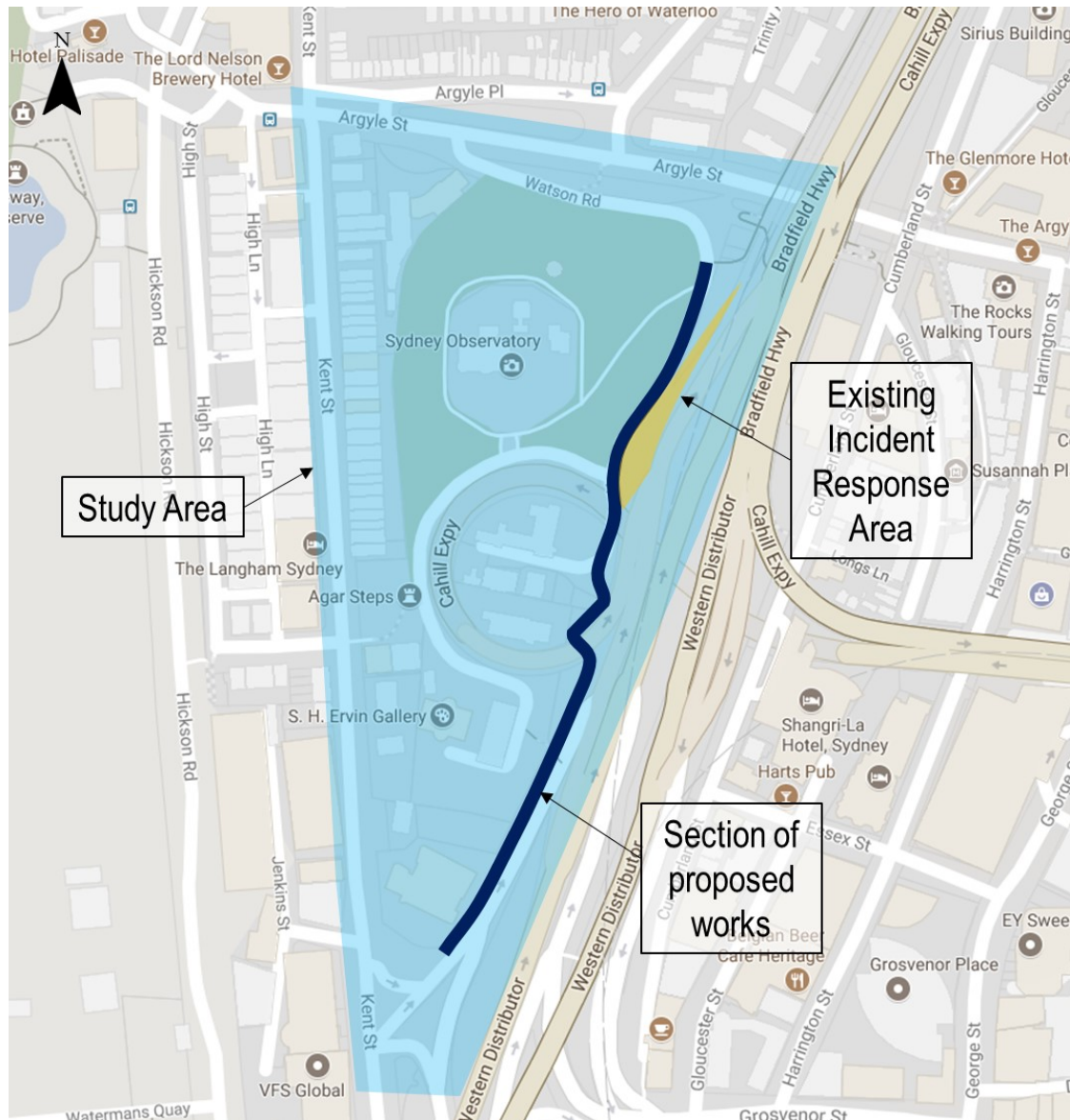
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## 1. INTRODUCTION

Bitzios Consulting was commissioned by Roads and Maritime Services to conduct a Traffic and Transport Impact Assessment (TIA) to input into the Review of Environmental Factors (REF) for this project. The proposed work are located from the Sydney Harbour Bridge Cycleway portal on Upper Fort Street to the Kent Street cycleway on the Bradfield Highway on ramp. To assess the potential traffic impact of the proposed design to vehicle drivers, pedestrians and cyclists, the surrounding road network was considered in the study area. The study area is indicated below in Figure 1.1:



**Figure 1.1: Study area**

The project is currently a concept design and proposes the following:

- A wider bridge for pedestrians and cyclists across the Cahill Expressway with separated paths for pedestrians and cyclists along the length of the route
- Widening of the existing shared path along the Bradfield Highway on ramp from Kent Street Cycleway to National Trust
- Replacement of the existing footbridge and approach ramp from the Bradfield Highway on ramp to Upper Fort Street. The new bridge and approach ramp will be wider with smoother gradients and improved sight lines
- Installation of a dedicated cycleway from Fort Street Public School to Sydney Harbour Bridge Cycleway portal.

- Widening of the existing footpath from Kent Street Cycleway to the National Trust
- Replacement of the existing footbridge and approach ramp to be replaced with a new footbridge and approach ramp with smoother gradients and improved sight lines
- new dedicated cycleway extending from Fort Street Public school to the Sydney Harbour Bridge Cycleway portal, a portion of which will be located within the existing Incident Response Area (IRA), adjacent to the Bradfield Highway. The proposed cycleway will be on grade; however, excavation within the IRA is required to achieve gradients from the IRA to the Sydney Harbour Bridge Portal.

The construction for this proposed work are divided into four precincts along the proposed section of work. These precincts include:

- Precinct 1: Harbour Bridge Link and Incident Response Area (IRA)
- Precinct 2: Incident Response Area and Fort Street Public School
- Precinct 3: Bridge crossing and S.H Ervin Gallery Frontage
- Precinct 4: S.H Ervin Gallery to Kent Street.

Stages of construction begin north of the Cahill Expressway, in Precinct 1 and continue south towards Kent Street completing with Precinct 4. As the proposed cycleway is to run immediately west of the Bradfield Highway, a section of the proposed cycleway will be located within the existing IRA, as shown in Figure 1.1. The proposed cycleway will remain at grade and there are no proposed structures within the section; however, construction of the cycleway and approach ramp is required within the IRA. For this reason, this TTIA during construction is required. This TTIA also assesses the potential impact of the proposed design in its operational stage.

## 1.1 SCOPE

This Traffic and Transport Impact Assessment (TTIA) includes:

- A review of the existing conditions to all road users including vehicle drivers, public transport users, cyclists and pedestrians
- An assessment of the potential construction impact during all stages of construction
- An assessment of the potential operational impact
- Recommendations and management measures.

## 2. EXISTING CONDITIONS

### 2.1 OVERVIEW

This chapter presents the existing conditions of the road, public transport, cycle and pedestrian networks within the study area. It provides an in-depth view of the study area and the characteristics of the links within the network. The chapter also identifies common movements within the study area for vehicle drivers, public transport users, cyclists and pedestrians. In addition, this chapter identifies bus services and routes that travel within the study area and may be affected by construction of the proposed work. Furthermore, this chapter analyses traffic and pedestrian surveys to determine key movements within the study area.

### 2.2 CYCLEWAYS

There are two existing established cycleways in the study area including the Sydney Harbour Bridge cycleway and the Kent Street cycleway. In addition to these cycleways, the Kent Street underpass is an underground connection of the Kent Street cycleway to the Clarence Street cycleway. Figure 2.1 illustrates the existing cycle routes in the study area.

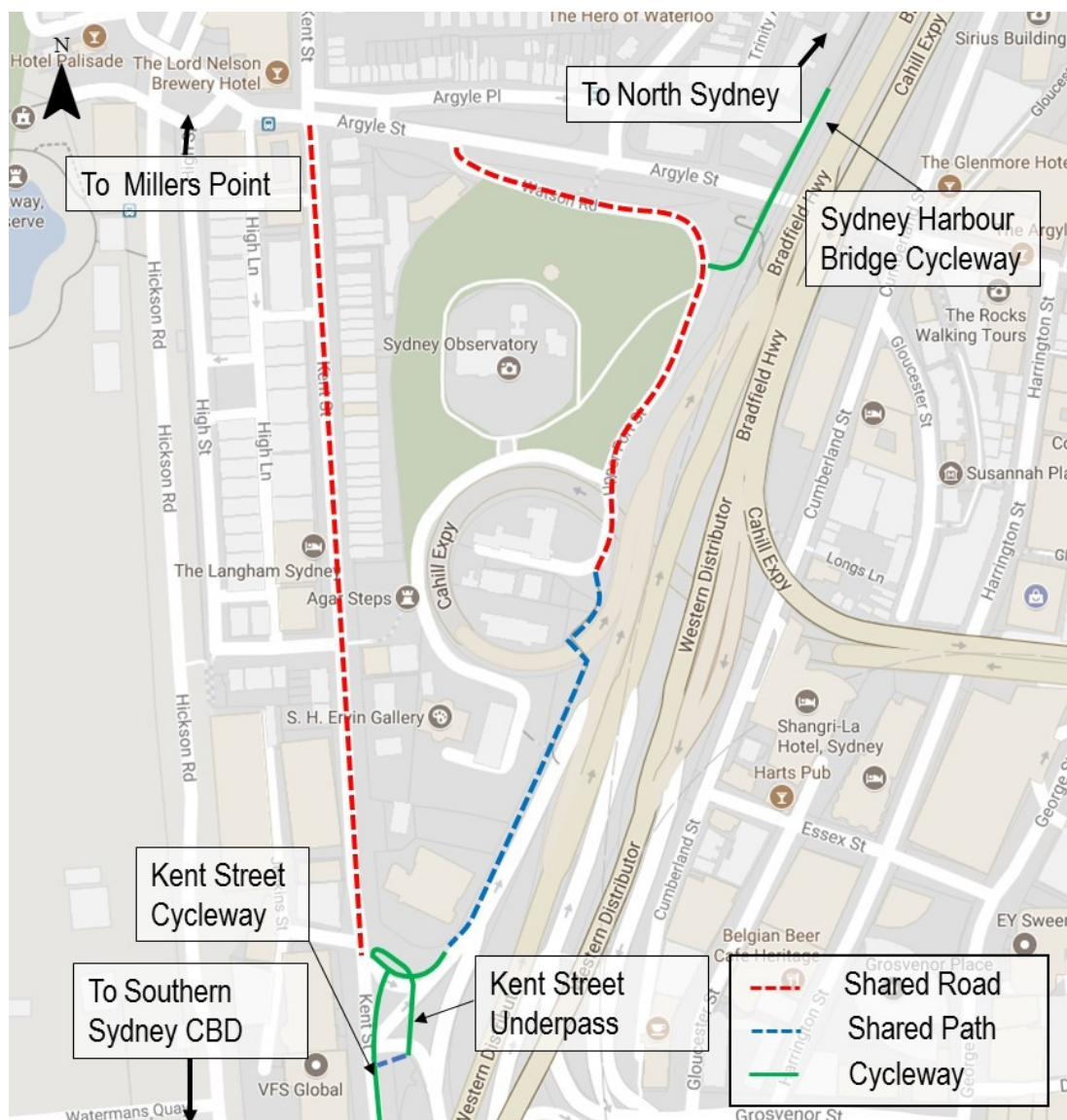


Figure 2.1: Existing cycle routes within study area



## 2.2.1 Sydney Harbour Bridge cycleway

The Sydney Harbour Bridge cycleway is a two way, dedicated cycleway, providing cyclists with northbound and southbound travel from the Sydney CBD to North Sydney and beyond. In the northbound direction, the cycleway begins at the Upper Fort Street portal, extends across the Sydney Harbour Bridge and exits onto Burton Street in Milsons Point. To gain access to the CBD, cyclists connect to the Kent Street cycleway via the shared road on Upper Fort Street and the shared path along the Bradfield Highway on ramp. Figure 2.2 shows the on/off ramp onto the Sydney Harbour Bridge cycleway from the Upper Fort Street portal.



**Figure 2.2: On/off ramp from Sydney Harbour Bridge cycleway from Upper Fort Street**

## 2.2.2 Kent Street cycleway

The Kent Street cycleway is a two way, two lane cycleway. In the northbound direction, the cycleway begins from Liverpool Street in Southern Sydney CBD and continues along Kent Street, through the Kent Street underpass and connects to the Bradfield Highway on ramp shared path. The cycleway is a prime connection for cyclists travelling to, from and within the Sydney CBD to North Sydney and beyond. Figure 2.3 shows the cycleway southbound from the Bradfield Highway on ramp.



**Figure 2.3: Kent Street cycleway southbound from the Bradfield Highway on ramp**

### 2.2.3 Kent Street underpass

The Kent Street underpass connects cyclists travelling to and from the Sydney Harbour Bridge cycleway with the cycleways on Kent Street and Clarence Street. The underpass has separated cyclists and pedestrian paths where the two-way cycle lanes connecting from Kent Street intersect with the two-way cycle lanes towards Clarence Street. The cycle lanes travelling along Clarence Street continue to York Street and provide an alternative route towards the Southern Sydney CBD. The underpass provides a safer and faster route for cyclists travelling on the Kent Street Cycleway rather than cycling at grade via the traffic lights. Figure 2.4 shows the northbound entrance into the underpass from Kent Street.



**Figure 2.4:** Northbound entrance into the Kent Street underpass from Kent Street



## 2.3 ROAD NETWORK

### 2.3.1 Bradfield Highway

The Bradfield Highway is an eight lane state highway with two permanent northbound lanes, one southbound lane and four interchangeable lanes. The direction of these lanes changes according to the necessities of the peak hour. There is also a single bus lane where a range of bus routes utilise the highway. These routes are discussed in Section 2.4. The highway has a variable speed limit with a posted limit of 70km/h in the event of a blacked-out sign. The Bradfield Highway connects the Sydney CBD with North Sydney, across the Sydney Harbour Bridge. Figure 2.5 shows the highway next to the Incident Response Area in the northbound direction.



**Figure 2.5: Bradfield Highway facing northbound**

### 2.3.2 Bradfield Highway on ramp

The Bradfield Highway on ramp merges from Clarence Street and Kent Street and connects to the Bradfield Highway. It is a state owned on ramp and is composed of a single lane from Kent Street and two lanes from Clarence Street with a median where one lane is a dedicated bus lane. The ramp provides access to the highway in the northbound direction. It is located within a variable speed limit zone with a posted limit of 70km/h in the event the sign is blacked out. The ramp has no parking availabilities or bus zones. Figure 2.6 shows the merge of Kent Street with Clarence Street on the ramp in the northbound direction.



**Figure 2.6: Access to Bradfield Highway via Kent Street and Clarence Street facing northbound**

### 2.3.3 Cahill Expressway

The Cahill Expressway is state owned and serves as a connection between the Eastern Distributor, Macquarie Street, the Sydney CBD and the Bradfield Highway. Northbound traffic travels along the loop and merges onto the Bradfield Highway. This merge is adjacent to the proposed site. There are two lanes in the northbound direction on the expressway which merge into a single lane to connect to the Bradfield Highway. The expressway has a posted speed limit of 70 km/h with a recommended limit of 35km/h within the loop. Northbound, the Cahill Expressway is used for a single bus route, the bus route 200 travelling from Bondi Junction towards Chatswood. There is no on-street parking. The connection between the Cahill Expressway and the Bradfield Highway is shown below in Figure 2.7.



**Figure 2.7: Cahill Expressway merging onto Bradfield Highway facing northbound**

### 2.3.4 Kent Street

Kent Street is a two-way, two-lane road that extends from Liverpool Street in Southern Sydney CBD to Windmill Street in Millers Point. It intersects with Argyle Street and Clarence Street in the study area. There is a posted speed limit of 40 km/h along the length of the road due to the high level of pedestrian activity, with plenty of pedestrian crossing opportunities throughout the road. North of the Bradfield Highway on ramp, Kent Street has parking available on both sides with the following parking restrictions:

- Two-hour parking from 8am to 6pm Monday to Friday
- Four-hour parking from 6pm to 10pm Monday to Friday
- Four-hour parking from 8am to 8pm Saturday and Sunday

There are no bus zones or buses operating through north of the Bradfield Highway on ramp from Kent Street. Buses use the Bradfield Highway on ramp to travel north from the city. South of the Bradfield Highway ramp, the Kent Street cycleway is positioned on the east of Kent Street and continues to Liverpool Street. The Kent Street Cycleway is discussed in depth in Section 2.2.2. A cross section of Kent Street in the northbound direction in the study area is shown in Figure 2.8.



**Figure 2.8: Kent Street facing northbound**

The following roads are under the care of the City of Sydney:

- Argyle Street
- Watson Road
- Upper Fort Street
- The National Trust driveway

These roads are further discussed below.

### 2.3.5 Argyle Street

Argyle Street is a two-lane, two-way road that travels from the northern end of Kent Street, through the tunnel under the Bradfield Highway and connects to Harrington Street in the east. It has a posted speed limit of 40 km/h with a high level of pedestrian activity in the area. The road provides access to the Sydney Observatory via Watson Road. A bus zone is located next to Watson Road. Opposite the bus zone there is on-street parallel parking with a two-hour restriction from 8am to 6pm every day and four-hour parking from 6pm to 10pm and continues west of Lower Fort Street. East of Lower Fort Street, on-street parking is provided on both sides of the street with the same parking restrictions. Parking on this street is all metered with no residential permits. Figure 2.9 shows the cross section of Argyle Street.





**Figure 2.9: Argyle Street facing eastbound**

### 2.3.6 Watson Road

Watson Road connects from Argyle Street to Upper Fort Street as a two-way, two lane road. The road has a steep grade and a posted speed limit of 40 km/h. Given the grade of the road, buses should not operate on the road and the nearest bus stop is on Argyle Street. In the eastbound direction, there is no on-street parking. In the westbound direction, there is on-street, metered parking with a two-hour restriction from 8am to 6pm every day. Watson Road provides access to the Sydney Observatory and Fort Street Public School and direct cyclist access to the Sydney Harbour Bridge Cycleway. A typical cross section of the road can be seen in Figure 2.10.



**Figure 2.10: Watson Road facing eastbound**



### 2.3.7 Upper Fort Street

Upper Fort Street is a two-lane, two-way road that connects from Watson Road and provides direct access to Fort Street Public School. The road has a posted speed limit of 40 km/h and is located within a school zone. It provides cyclists with a connection from the Sydney Harbour Bridge Cycleway to the city cycle routes. Upper Fort Street also provides access to the Sydney Observatory and connects to the National Trust Centre/S.H. Ervin Gallery driveway. In the northbound direction, sections east of the road have two-hour on-street metered parking available every day from 8am to 6pm. Buses should not operate on Upper Fort Street given the grade on Watson Road. Figure 2.11 shows a cross-section of the street facing northbound.



Figure 2.11: Upper Fort Street facing northbound

### 2.3.8 National Trust Centre/S.H. Ervin Gallery carpark driveway

The National Trust Centre/S.H. Ervin Gallery carpark driveway branches from Upper Fort Street and provides direct access to the National Trust Centre and the S.H. Ervin Gallery. The driveway is narrow but operates in both directions. Buses should not operate on the driveway and no on-street parking is available on the driveway. The driveway is shown in Figure 2.12.

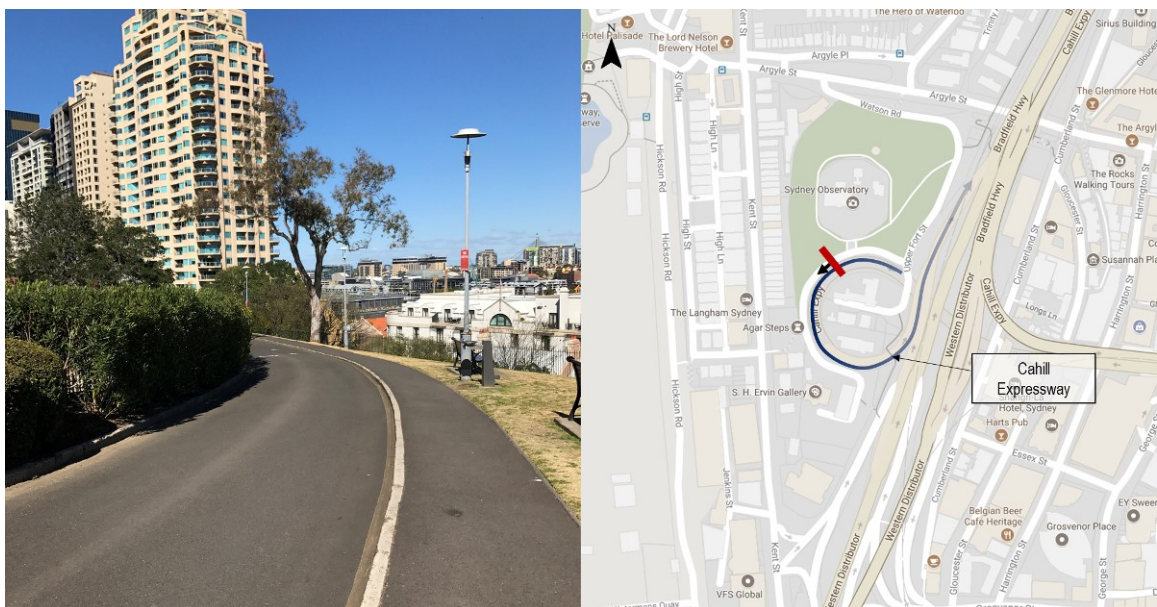
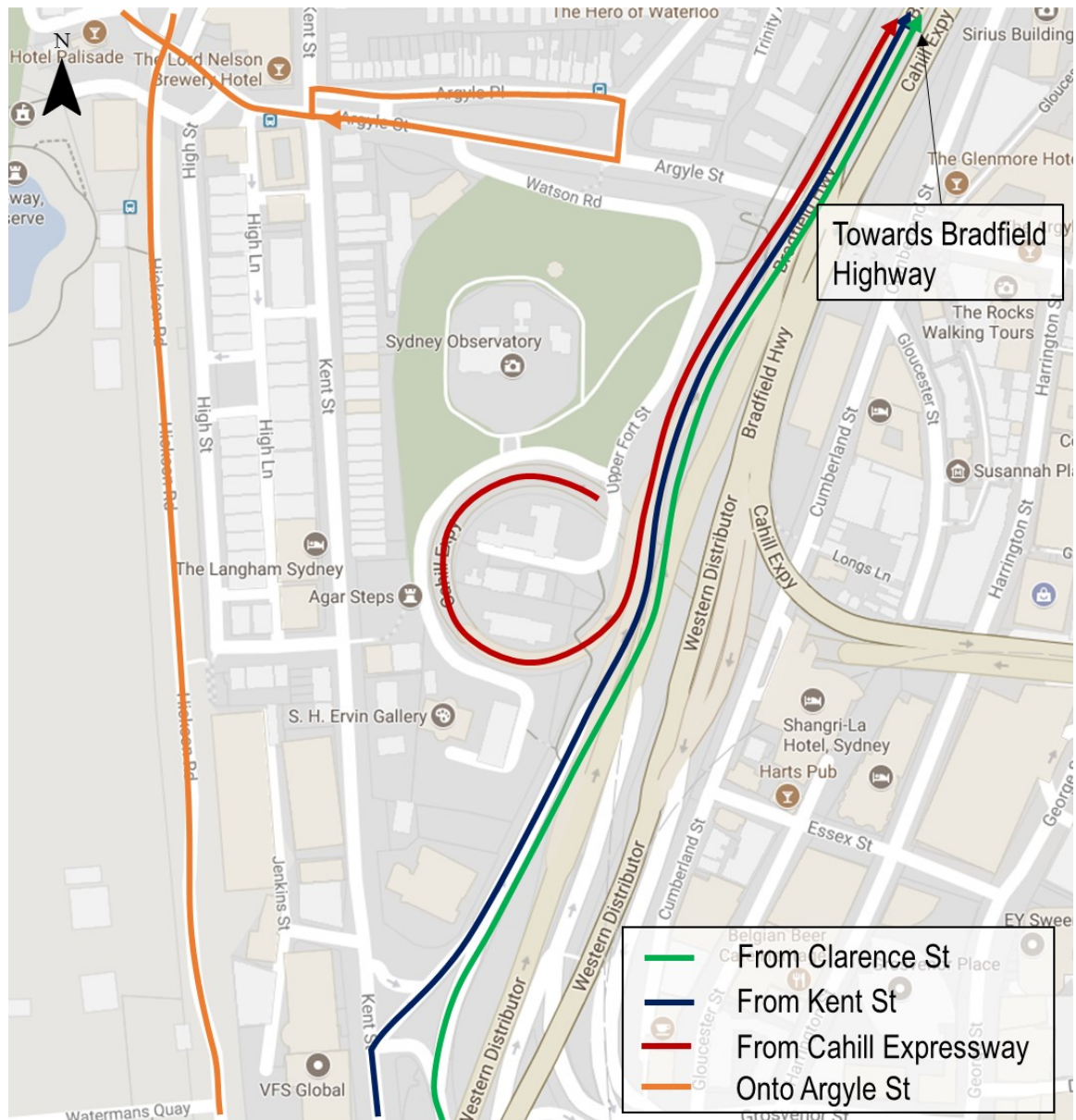


Figure 2.12: National Trust Centre/S.H. Ervin Gallery Car Park Driveway facing southbound

## 2.4 BUS ROUTES AND STOPS

While there are no bus stops located within the study area, a number of bus routes travel through it. Most services travel northbound from Clarence Street onto the Bradfield Highway and some enter the highway from Kent Street. All bus services operating in and around the study area are listed in Table 2.1 and Figure 2.13 illustrates the routes of all bus services operating in the study area.

It should be noted that a single service operates onto Argyle Street, which is the 311 travelling from Millers Point to Central Railway Square via Darlinghurst and Potts Point. A single service also enters the Bradfield Highway from the Cahill Expressway. This is the 200 service travelling from Bondi Junction to Chatswood.



**Figure 2.13: Routes of bus services operating within the study area**

**Table 2.1 Bus services operating within the study area**

Bus Service	Bus Route
<b>Bradfield Highway on ramp from Clarence Street</b>	
169	City Wynyard to Manly via Narrabeena
171	City Wynyard to Manly
178	City Wynyard to Cromer Heights
179	City Wynyard to Wheeler Heights
180	City Wynyard to Collaroy Plateau
183	City Wynyard & Milsons Point to Narrabeen
184	City Wynyard & Milsons Point to Mona Vale
185	City Wynyard to Mona Vale via Warriewood
201	City Bridge Street to Cremorne
204	PrePay Only - City Bridge Street to Northbridge (Freeway)
205	PrePay Only - City Bridge Street to East Willoughby (Freeway)
206	City Gresham Street to East Lindfield via Freeway
243	City Wynyard to Spit Junction
244	City Wynyard to Chowder Bay Mosman
245	City Wynyard to Balmoral
246	City Wynyard to Balmoral Heights
247	City Wynyard to Taronga Zoo via Mosman Junction
249	City Wynyard to Beauty Point
251	City Wynyard to Lane Cove West via Freeway
252	City King Street Wharf to Gladesville via North Sydney
253	City Wynyard to Riverview via Freeway
261	Lane Cove to City King Street Wharf via Longueville
272	PrePay Only - City Wynyard to North Willoughby
285	City Wynyard to Lane Cove West via Freeway
288	City Erskine Street to Epping
289	City Wynyard to Lane Cove West via Freeway
290	City Erskine Street to Epping via North Sydney & Macquarie University
292	City Erskine Street to Marsfield via Macquarie Park
293	PrePay Only - City Wynyard to Marsfield
294	City Wynyard to Macquarie University
297	PrePay Only - Denistone East to City Wynyard via Lane Cove Tunnel
E65	PrePay Only - City Wynyard to South Curl Curl (Express Service)
E66	City Wynyard to Allambie (Express Service)
E68	City Wynyard to Brookvale via North Balgowlah (Express Service)
E69	City Wynyard to Manly via Narrabeena (Express Service)
E70	PrePay Only - City Wynyard to Manly (Express Service)
E71	City Wynyard to Manly via Clontarf (Express Service)
E76	City Wynyard to Dee Why via North Curl Curl (Express Service)
E77	City Wynyard to Dee Why via Wingala (Express Service)
E78	City Wynyard to Cromer Heights (Express Service)
E79	City Wynyard to Wheeler Heights (Express Service)
E83	PrePay Only - City Wynyard to North Narrabeen (Express Service)
E84	City Wynyard to Mona Vale (Express Service)

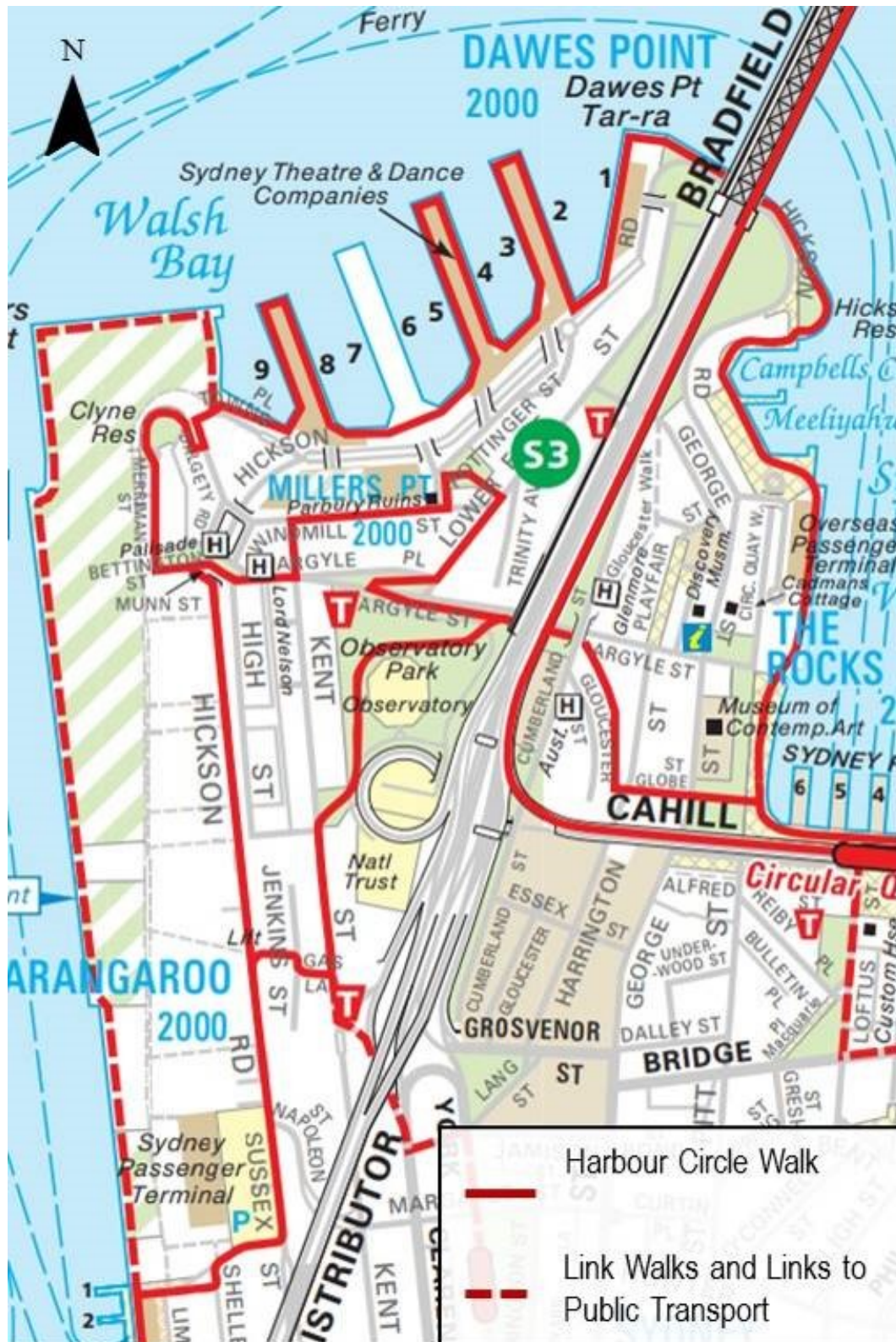


Bus Service	Bus Route
E85	City Wynyard to Mona Vale via Warriewood (Express Service)
E86	PrePay Only - City Wynyard to McCarrs Creek (Express Service)
E87	PrePay Only - City Wynyard to Newport (Express Service)
E88	PrePay Only - City Wynyard to North Avalon (Express Service)
E89	PrePay Only - City Wynyard to Avalon (Express Service)
L80	City Wynyard to Collaroy Plateau (Limited Stops)
L85	City Wynyard to Mona Vale via Warriewood (Limited Stops)
L88	City Wynyard to Avalon (Limited Stops)
L90	City Wynyard to Palm Beach (Limited Stops)
m20	PrePay Only - Botany to Gore Hill
M30	PrePay Only - Sydenham to Spit Junction via City
M40	PrePay Only - Bondi Junction to Chatswood
<b>Bradfield Highway on ramp from Kent Street</b>	
620N	City Wynyard to Dural via New Line Road
620X	City Wynyard to Dural via Cherrybrook
621	City Wynyard to Castle Hill via Cherrybrook
642	City Wynyard to Round Corner Dural
642X	City Wynyard to Round Corner Dural via Lane Cove Tunnel
650	City Wynyard to West Pennant Hills
650X	City Wynyard to West Pennant Hills via Lane Cove Tunnel
651	City Wynyard to Castle Hill
652X	City Wynyard to Knightsbridge
<b>Cahill Expressway onto Bradfield Highway</b>	
200	Bondi Junction to Chatswood
<b>Argyle Street</b>	
311	Central Railway Square to Millers Point via Darlinghurst & Potts Point



## 2.5 WALKING ROUTES

There is an official walking route, 'A Harbour Circle Walk 2011' that passes through the study area. It is presented by Walking Coastal Sydney, a collaboration of all coastal councils within Sydney. Figure 2.14 presents an excerpt of the A Harbour Circle Walk 2011 Map, where the route passes through the study area. The map presents the Harbour Circle Walk route as well as links to public transport.



Adapted from 'A Harbour Circle Walk 2011' from Walking Coastal Sydney

**Figure 2.14: Official walking routes within the study area**

In addition to these official routes there are ample pedestrian facilities within the study area, such as Argyle Street and Kent Street, which have high pedestrian activity. Both streets have footpaths on both sides of the street and ample crossing opportunities. In addition to Argyle Street and Kent Street, footpaths are located on all streets in the study area except for the Bradfield Highway and the portion of Clarence Street connecting to the Bradfield Highway on ramp.

Footpaths connect all major sites such as Observatory Hill Park to the Sydney CBD via Upper Fort Street and the shared path next to the Bradfield Highway on ramp. Furthermore, Observatory Hill Park is accessible by foot from Kent Street and Argyle Street via stairs on the western side of the hill and via Watson Road, respectively.

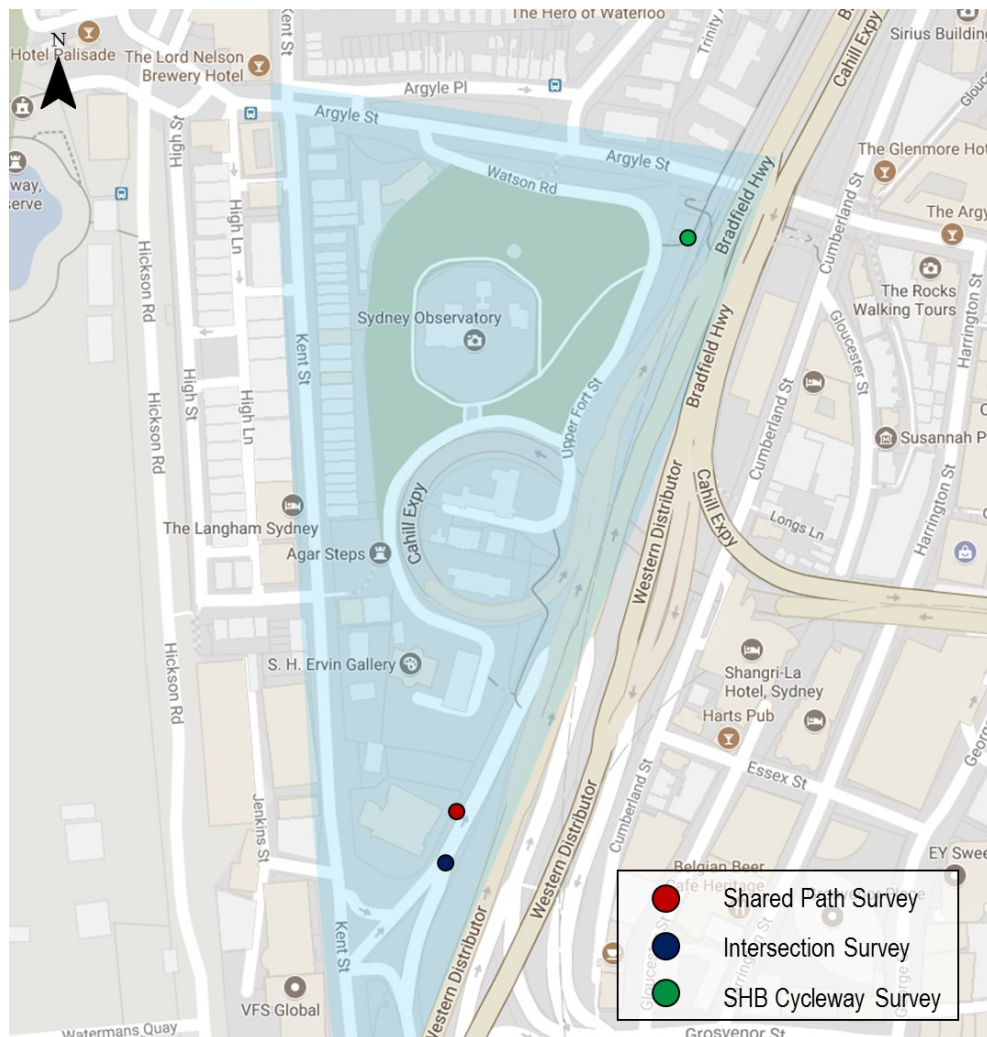
## 2.6 TRAFFIC COUNT DATA

### 2.6.1 Traffic count locations

Three types of data were provided by Roads and Maritime to quantify the movements of vehicles, cyclists and pedestrians. The types of survey data were:

- An intersection survey at the merge of Kent Street and Clarence Street before the Bradfield Highway on ramp
- A shared path survey of pedestrians and cyclists between Upper Fort Street to the Kent Street Cycleway
- Sydney Harbour Bridge Cycleway Survey Data at the Upper Fort Street portal.

The locations of these surveys are presented in Figure 2.15.



**Figure 2.15: Location of traffic surveys**

## 2.6.2 Traffic count data summary

### *Intersection survey*

Traffic counts were recorded from the Kent Street and Clarence Street merge before the Bradfield Highway on ramp. The counts were conducted on 28 March 2017 and were recorded for a week. Table 2.2 summarises the traffic counts at this intersection.

**Table 2.2 Summary of intersection survey**

Average	Peak Period	Total
Weekday Daily Average	-	4333 vehicles per day
Weekday Peak Average	AM Peak	247 vehicles per hour
	PM Peak	351 vehicles per hour
7 Day Daily Average	-	4112 vehicles per day
7 Day Peak Average	AM Peak	228 vehicles per hour
	PM Peak	314 vehicles per hour

Around 14 per cent of the daily traffic flow uses the on ramp during the weekday peak periods. The data indicated a larger portion of vehicles using the ramp in the evening peak period, where eight per cent of the daily average occurs during the PM peak as opposed to six per cent in the AM Peak. It should be noted that moveable medians are implemented on the Clarence Street on ramp onto the Bradfield Highway during the weekday AM peak periods.

### *Shared path survey*

Pedestrian and cyclist counts were conducted on the shared path next to the Bradfield Highway on ramp. These counts were taken on Wednesday 30 March 2016 from 6am to 7pm and recorded in 15-minute intervals. The counts monitored pedestrian and cyclists' movements in the northbound and southbound direction as well as cyclist movements travelling on-road from Clarence Street. Table 2.3 summarises the results of this survey throughout the day and Table 2.4 summarises the data during the peak periods.

**Table 2.3 Summary of shared path pedestrian and cyclist daily survey data**

Peak	Direction	Pedestrian Counts	Cyclist Count	
			Shared Path	Clarence Street
AM Count 6am – 12pm	Northbound	183	208	58
	Southbound	104	473	
	Total	287	681	58
PM Count 12pm – 7pm	Northbound	171	359	128
	Southbound	301	285	
	Total	472	644	128
Total		759	1511	



**Table 2.4 Summary of shared path pedestrian and cyclist peak periods survey data**

Peak	Direction	Pedestrian Counts	Cyclist Count	
			Shared Path	Clarence Street
AM Peak		8.15am – 9.15am	7.45am – 8.45am	7.30am – 8.30am
	Northbound	117	90	34
	Southbound	61	220	
	Total	178	310	34
PM Peak		2.45pm – 3.45pm	5.30pm – 6.30pm	5.30pm – 6.30pm
	Northbound	43	170	68
	Southbound	103	108	
	Total	146	278	68

It should be noted that the peak hours provided in the table indicate the period when the path was most utilised by users. As such each path user has a different AM and PM peak time.

From the pedestrian counts, a total of 759 pedestrians were recorded travelling northbound and southbound along the shared path throughout the day. The data indicated around 20 per cent of pedestrians used the shared path during the peak periods where 178 were observed to be travelling in the morning peak and 146 travelling in the afternoon peak.

The cyclists count recorded 1511 cyclists using the shared path and travelling on-road from Clarence Street. Similar to the pedestrian counts, around 20 per cent of the daily cyclists count occurred in the peak periods where 344 cyclists were recorded in the morning peak and 346 cyclists in the evening peak.

Table 2.3 also indicates the proportion of users travelling along the shared path. In the morning peak 64 per cent of pedestrians travelled northbound, which was reciprocated in the evening peak. Of cyclists, 64 per cent were recorded in the survey to travel southbound in the morning period and 63 per cent travelled northbound in the evening period. Furthermore, the data indicated that along the shared path adjacent to the Bradfield Highway a greater percentage of users cycled into the Sydney CBD than walked, while a greater portion of pedestrians were observed to travelling northbound than to cycle. Site observations indicate that pedestrians in this area make short trips, for example, between Kent Street and Fort Street Public School, whereas cyclists are travelling longer distances, for example, between Sydney CBD and North Sydney.

### **Sydney Harbour Bridge cycleway survey**

Data was obtained from the past ten years to evaluate the trend of cyclists travelling along the Sydney Harbour Bridge cycleway. The survey data was obtained from the Roads and Maritime Services permanent bicycle counter (#90902) near Upper Fort Street, Millers Point. The number of cyclists travelling northbound and southbound via the cycleway were recorded daily and the averages are provided in Table 2.5. The cyclist counts for the separated northbound and southbound directions for 2016 were not provided in the data; however, the combined counts for both directions were provided and are included in Table 2.5.

**Table 2.5 Summary of Sydney Harbour Bridge cycleway survey data from 2007-2016**

Year	Northbound		Southbound		Both Directions	
	Weekday Average	Weekend Average	Weekday Average	Weekend Average	Weekday Average	Weekend Average
2007	403	234	397	233	801	467
2008	628	278	637	285	1264	562
2009	808	313	826	327	1634	640
2010	825	326	842	336	1667	662
2011	919	420	969	415	1888	835
2012	978	519	1036	517	2014	1037
2013	1111	484	1194	483	2305	966
2014	1068	475	1144	479	2212	953
2015	946	464	1027	461	1973	925
2016 (mid-year)	-	-	-	-	2098	955

Table 2.5 indicates a steady increase in cyclists using the cycleway throughout the ten-year period. The data indicates balanced portions of cyclists travelling northbound and southbound throughout the decade, with a slight increase in cyclists travelling southbound towards the end of the ten-year period. As of 2015, around 52 per cent of the daily average of cyclists were travelling southbound towards the Sydney CBD.



### 3. CONSTRUCTION PERIOD IMPACT ASSESSMENT

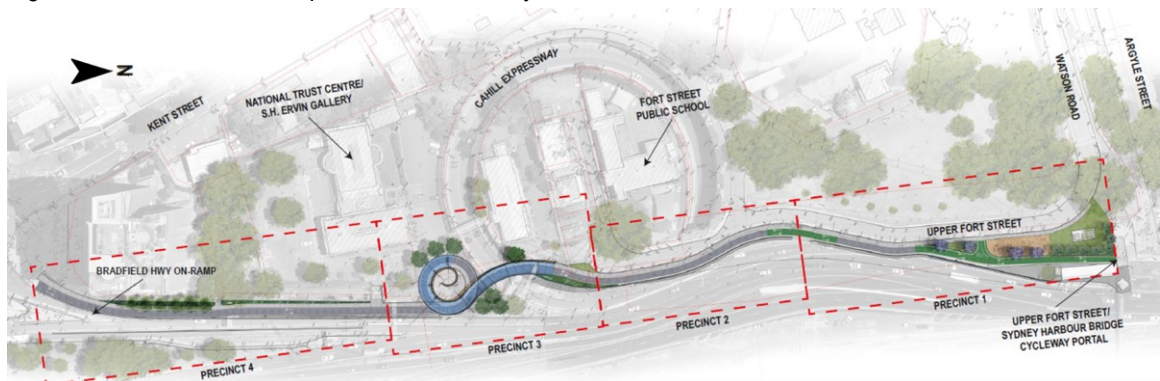
#### 3.1 OVERVIEW

Proposed construction work for the proposal will occur in four precincts. The construction work through the four precincts are programmed to occur simultaneously and are estimated to require ten months (weather permitting). This will include three weeks for site set ups and four weeks for completion work. This section describes each precinct and identifies any traffic impact generated by each precinct. Traffic impact include footpath, road and cycleway closures and the effect on road users; methods to mitigate any identified impact are included. This section also discusses any other impact associated with each precinct.

The four construction precincts proposed include:

- Precinct 1: Harbour Bridge Link and Incident Response Area (IRA)
- Precinct 2: Incident Response Area and Fort Street Public School
- Precinct 3: Bridge crossing and S.H Ervin Gallery Frontage
- Precinct 4: S.H Ervin Gallery to Kent Street.

Figure 3.1 illustrates all four precincts in the study area.

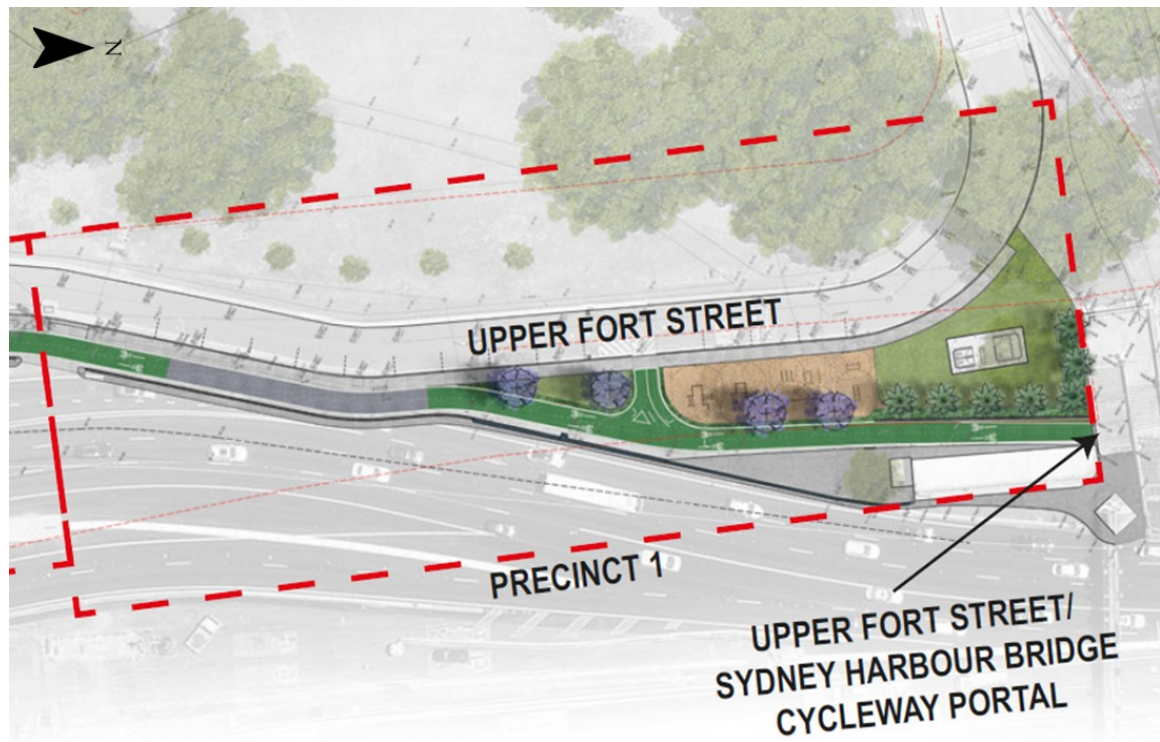


**Figure 3.1: Precincts in the study area**

## 3.2 PRECINCT 1: HARBOUR BRIDGE LINK AND INCIDENT RESPONSE AREA

### 3.2.1 Description of work

Precinct 1 is located north of the Cahill Expressway within the (IRA) and along Upper Fort Street, as shown below in Figure 3.2.



**Figure 3.2: Precinct 1 – Harbour Bridge link and IRA**

The work in this precinct is estimated to take four to five months to complete and includes the following tasks:

- Establish the northern side site compound which involves the removal of large trees and exercise equipment from the Observatory Hill outdoor gym and the installation of site sheds and facilities
- Construct a temporary cycle detour through the Sydney Harbour Bridge portal stairs
- Construct the cycleway along the Roads and Maritime IRA will include the following work:
  - Install new drainage pipes, pits and grates along eastern alignment of new retaining wall
  - Install new safety barrier along western side of northbound Bradfield Highway lanes
  - Install continuous piles for new retaining wall
  - Excavate for new cycleway and install wall lining, storm water and floor slab
  - Demolish existing retaining wall and parapet
  - Modify remaining retaining wall and parapet wall to ensure stability and suitable finish
- Construct an on-grade cycleway, including placing the new concrete and finish, including handrails, lighting, and line marking.

Construction in this precinct will require temporary cycle path and road closures, further discussed below. No permanent closures will be required in this precinct.

### 3.2.2 Cycle path closures

The existing cyclist provision from Kent Street cycleway to the Sydney Harbour Bridge Cycleway will be closed during the period of construction. However, a temporary cycleway detour is proposed to be constructed at the beginning of work in Precinct 1.

The detour will maintain cycle access from North Sydney towards Sydney CBD. It will begin from the Sydney Harbour Bridge stairs and continue via Watson Road, Argyle Street, and Kent Street and continue on the Kent Street cycleway. This detour will add about 250 metres to the existing cyclist route from the Upper Fort Street portal towards the Kent Street cycleway via the shared path. Furthermore, there is no dedicated cycleway along this detour and there is a steep grade on Watson Road. This may present safety risks to cyclists as they are required to mix with vehicles and manage their speeds travelling downhill on Watson Road. This temporary cycle detour will remain until the completion of work in all precincts.

### 3.2.3 Footpath closures

The west footpath on Upper Fort Street will remain available for pedestrians travelling from Watson Road towards Fort Street Public School or the Sydney Observatory. A Construction Traffic Management Plan (CTMP), approved by Roads and Maritime, will be developed to manage the pedestrian traffic near the site.

### 3.2.4 Road closures

During the construction of the proposed cycleway in the IRA, the site will be accessed via the boom gate on the Bradfield Highway to Upper Fort Street. The western northbound lanes of the Bradfield Highway may be closed for some deliveries and work. Where possible, large deliveries and work will occur at night or during off peak hours to mitigate the impact to traffic along Bradfield Highway and along Upper Fort Street.

The construction of the on-grade cycleway will also require the temporary removal of approximately 10 on street parking spaces on the east side of Upper Fort Street for large deliveries, including plant and equipment. Currently there are 13 available spaces, with the temporary closures three spaces will remain operational during work. To mitigate the impact on traffic, deliveries should be planned beforehand to allow for the necessary precautions. Deliveries should avoid peak school drop off and pick up times to minimise the impact on school traffic and, where possible, deliveries should be made in off-peak hours.

### 3.2.5 Other impacts

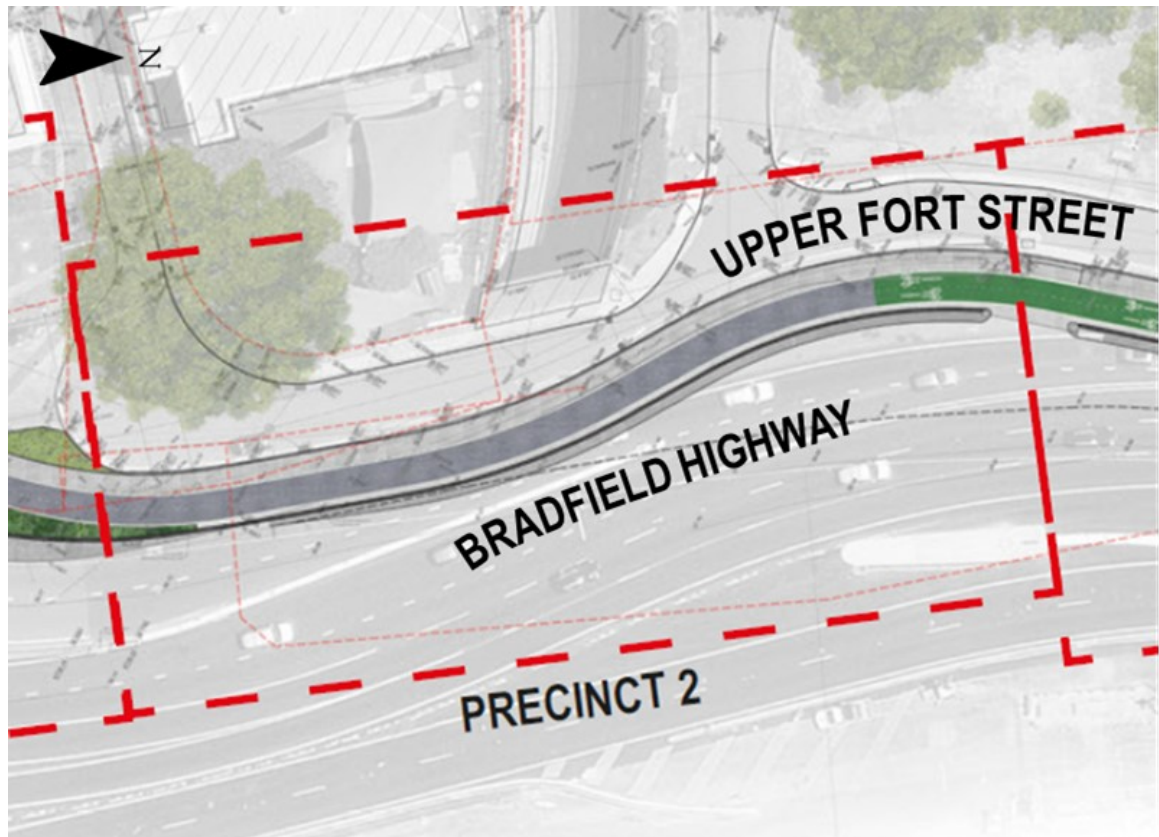
Other impacts to consider in Precinct 1 include:

- It is located in a school zone. This will require a CTMP addressing the management of pedestrians travelling next to the site. Being a school zone, additional measures should be established to protect pedestrians near the site. Deliveries must be scheduled outside of peak school drop off and pick up hours in order to minimise the impact on school traffic
- The Roads and Maritime IRA and Upper Fort Street boom gate will remain operational at all times and can be used for short term deliveries during off-peak hours. A CTMP will be required for trucks and plant, entering and exiting the site
- A portion of the cycleway is next to a door marked "Rail Tunnel Emergency Exit Door – Keep Clear at all times". The door will need to be kept clear during construction, including a clear path from the door through the worksite.

### 3.3 PRECINCT 2: INCIDENT RESPONSE AREA AND FORT STREET PUBLIC SCHOOL

#### 3.3.1 Description of work

Precinct 2 is located north of the Cahill Expressway within the IRA, in close proximity to Fort Street Public School, south of Precinct 1. Precinct 2 is presented below in Figure 3.3.



**Figure 3.3: Precinct 2 – IRA and Fort Street Public School**

Precinct 2 is estimated to require five to six months of construction work. The work proposed in this precinct includes:

- The relocation and protection of existing Cahill Expressway utilities including:
  - The electrical and fire fighting water supply conduits and cables along the existing retaining wall will need to be protected before being incorporated into the backfill behind the new retaining wall
  - There may be a requirement to relocate the existing pit in the Roads and Maritime IRA
- Construction of new kerb and retaining wall along Roads and Maritime IRA to support widening for cycleway:
  - Cut existing pavement
  - Construct foundation for new kerb and retaining wall
  - Install new kerb
  - Install new retaining wall most likely to be precast L-shaped wall
  - Backfill against new retaining wall and modify existing Upper Fort Street drainage
- Construction of new cycleway alignment:
  - Install new handrail along retaining wall
  - Demolish existing kerb and handrail
  - Construct new shared path
  - Finish cycleway, handrails, lighting, landscaping.

Work in this precinct will require temporary cycle path, pedestrian footpath, and road closures, which are further discussed in this section. The work will not require any permanent closures to the travel networks.



### **3.3.2 Cycle path closures**

The existing cyclist provision between the Sydney Harbour Bridge cycleway and the Kent Street cycleway will be closed during the completion of work in this Precinct. A cycle detour is proposed around the site via the temporary ramp on the Sydney Harbour Bridge stairs and will continue onto Watson Road, Argyle Street and Kent Street, connecting to the Kent Street cycleway. This temporary cycle detour will remain until the completion of work in all precincts.

### **3.3.3 Footpath closures**

Pedestrian access along Upper Fort Street will be maintained for access to the school. However, the access may be closed for short periods for deliveries and work. Several on street parking spaces along Upper Fort Street will be closed during the construction of the new cycleway alignment. A CTMP should be prepared before the start of work to determine adequate management of pedestrians near this precinct. Where possible, these deliveries and work should be scheduled outside of peak school drop off and pick up hours.

### **3.3.4 Road closures**

During the relocation of existing utilities on the Cahill Expressway retaining wall and the construction of the new kerb and retaining wall along the RMS IRA, closure of the western lane of the Cahill Expressway will be required. To minimise the impact to traffic, these work and deliveries will be conducted at night.

During the construction of the new cycleway alignment, the Upper Fort Street parking lane will also be closed for the duration of work, which is about one month. However, the work and deliveries are proposed at night to minimise the impact on day time traffic.

### **3.3.5 Other impacts**

Deliveries and work during the relocation of the Cahill Expressway utilities occur next to live traffic on the expressway. A CTMP should be prepared before the start of work to adequately manage traffic within proximity to the site.

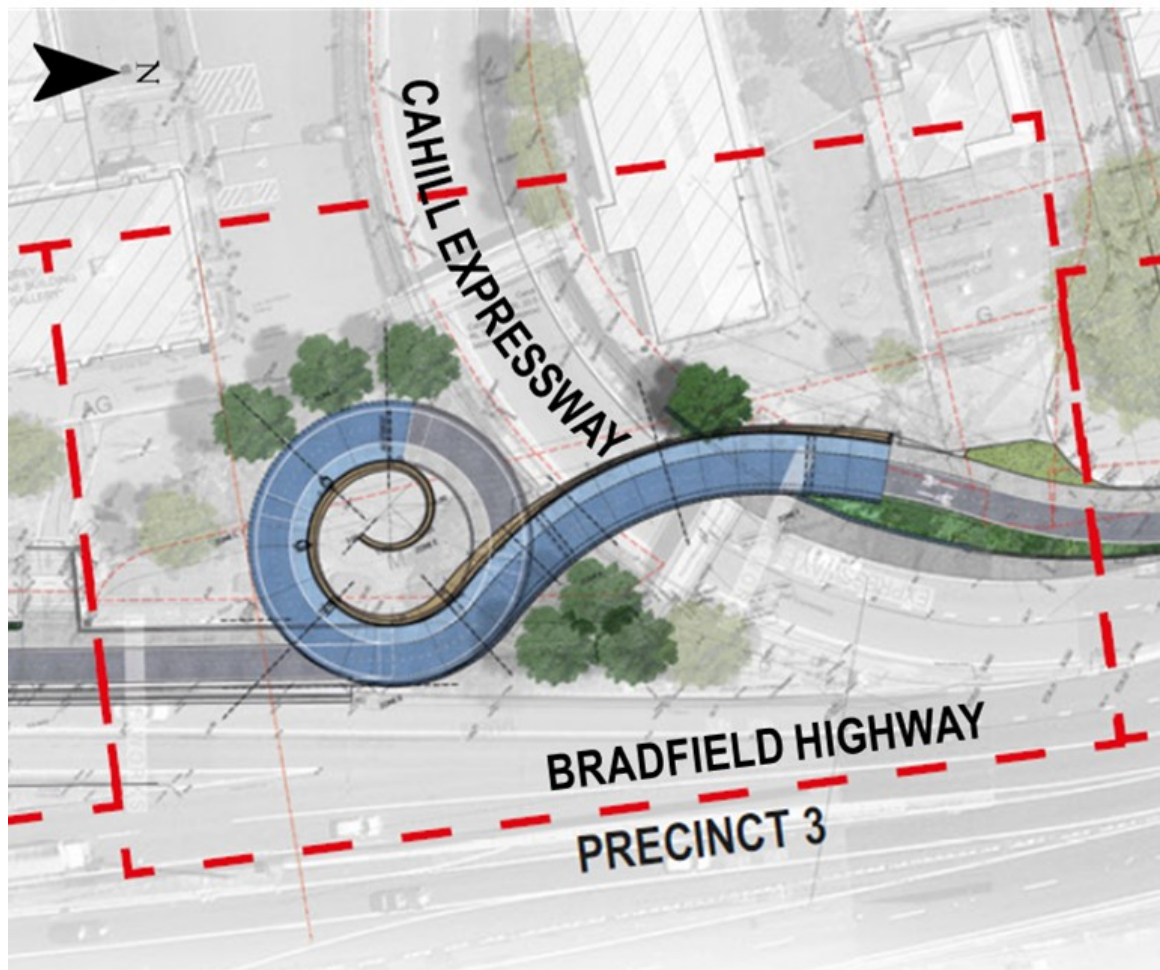
Another impact to consider in this precinct is the work that will occur in the Roads and Maritime IRA. During construction of the proposed cycleway, the IRA will remain operational.



### 3.4 PRECINCT 3: BRIDGE CROSSING AND S.H. ERVIN GALLERY FRONTAGE

#### 3.4.1 Description of work

Precinct 3 is located next to the S.H. Ervin Gallery carpark and contains the bridge crossing. The location of the precinct is shown below in Figure 3.4



**Figure 3.4: Precinct 3 – Bridge crossing and S.H. Ervin Gallery frontage**

The work of Precinct 3 will be conducted in three stages. Overall these stages are proposed to be completed in seven to eight months. These stages include:

- Demolition of the existing footbridge
- Construction of the new cyclist and pedestrian bridge
- Construction of the elevated spiral structure.

Each stage within this precinct comprises of the following work.

#### ***Demolition of existing cycleway bridge***

This stage is estimated to take three months to complete and includes the following work:

- Establish the southern site compound located in the S.H. Ervin Gallery carpark and frontage
- Preparatory work which will involve:
  - Relocating the gas main penetrating the southern approach
  - Install physical protection over firefighting and electrical supply services attached to the Cahill Expressway corkscrew retaining wall.
  - Install lifting frame under existing span to ensure the crossing bridge remains intact when lifted.
  - Remove existing handrails.
  - Chip concrete until steel I-beams are exposed on both ends.

- Demolition of the span:
  - Position a large 200 tonne crane on the median triangle east of the span, next to the Cahill Expressway exit and the Bradfield Highway
  - Cut fixed end on the southern side of the bridge and remove expansion joint in footway on the northern end. Ends should be able to be cut with Oxy Acetylene torches when concrete is removed
  - Lift span onto waiting loading truck, which will then relocate the span to a site where it can be safely demolished.
- Reinstall the existing Cahill Expressway retaining wall below the northern abutment
- Demolish the southern bridge approach including pathways and walls with an excavator mounted hammer and remove existing handrails. Materials will be removed by a small truck via National Trust Centre/S.H. Ervin Gallery carpark driveway.

### ***Construction of new cycleway bridge***

This stage is expected to be completed in four months. This work includes:

- Construct new abutments on the northern and southern sides.
- Install the new span which will require positioning a truck with structural steel components and a large mobile crane in the Cahill Expressway cutting
- Pour the concrete deck slab and finalise the cycleway including handrails and lighting.

### ***Construction of elevated spiral structure***

The final stage of Precinct 3 is proposed to be completed in five months. Construction work includes the following:

- Remove trees and clear the area
- Install small piles for pier foundations with a small piling rig of about 20 tonnes capacity. A small piling rig is required due to the access limitation along the Gallery carpark driveway
- Construct the on-ground ramp section next to the Cahill Expressway
- Construct concrete pile caps and piers on the western side to allow access for a crane to the centre of the structure to minimise crane size
- Install structural steel span sections on western side using a small crane that can access the site via the S.H. Gallery carpark driveway
- Construct the remaining concrete pile caps and piers
- Install the remaining structural steel span sections using a similar crane
- Pour concrete deck slab and finalise the cycleway including handrails and lighting.

The work in Precinct 3 will require temporary cycle path, pedestrian footpath, and road closures. These closures are further discussed below. No permanent closures to the travel network will be required in this precinct.

## **3.4.2 Cycle path closures**

The existing cycle path between the Sydney Harbour Bridge cycleway and the Kent Street cycleway will be closed during the completion of work in this Precinct. A cycle detour is proposed around the site via the temporary ramp on the Sydney Harbour Bridge stairs, which will continue onto Watson Road, Argyle Street and Kent Street, connecting to the Kent Street cycleway. This temporary cycle detour will remain until the completion of work in all precincts.

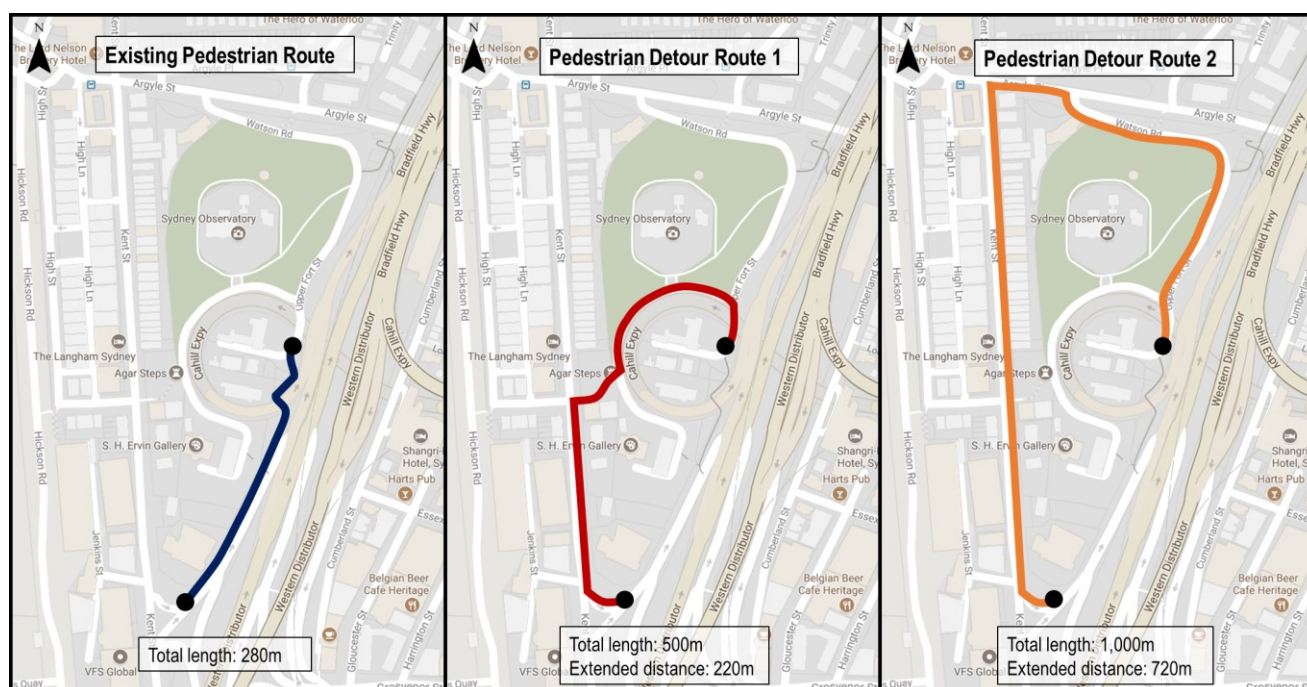
## **3.4.3 Footpath closures**

The existing pedestrian route from the southern end of the shared path adjacent to the Bradfield Highway to Fort Street Public School is 280 metres via the Cahill Expressway Footbridge. During the construction work for Precinct 3 where the Footbridge will be closed, two alternative detour routes will be available for pedestrians to travel between Upper Fort Street and the surrounding road network. One route is accessible

from Kent Street via the Agar Steps to the footpath adjacent to the S.H. Ervin Gallery carpark driveway. However, as this route features steps it is not suitable for pedestrians with prams or trolleys and for Persons With a Disability. This route from the southern end of the shared path adjacent to the Bradfield Highway on ramp to Fort Street Public School is approximately 220 metres longer than the current pedestrian route via the Cahill Expressway Footbridge.

Alternatively, another detour route will be available connecting the shared path to Fort Street Public School via Kent Street and Argyle Street to Upper Fort Street via Watson Road. This route will be approximately 720 metres longer than the existing pedestrian route via the Cahill Expressway footbridge. While this route is longer, it is free of steps and is accessible by pedestrians with prams or trolleys and by Persons With a Disability.

Figure 3.5 compares the existing pedestrian route with the two alternative routes proposed.



**Figure 3.5: Comparison of existing and proposed detour pedestrian routes**

### 3.4.4 Road closures

The work during the demolition of the existing footbridge and the construction of the new cyclist and pedestrian bridge are located above and within the Cahill Expressway. Work of particular note include the demolition and installation of the existing and proposed spans, the construction of the northern and southern abutments and pouring the concrete slab in both stages. Given the proximity to the road, the closure of the expressway will be required. For purposes of assessment, during demolition of the existing bridge, about 10 full road closures of the Cahill Expressway may be required. During construction of the new bridge, about 12 full closures of the Cahill Expressway may be required. This will be further assessed and evaluated by the Construction Contractor in consultation with Transport for NSW's Transport Management Centre.

The closure will minimise the risk to surrounding traffic and particularly eliminate the risk of materials falling onto live traffic during the demolition of the southern approach and the construction of the northern and southern abutments.

During the demolition of the existing span, a 200 tonne crane will be required for the work. This crane is proposed to be positioned on the triangle median between the Cahill Expressway exit and the Bradfield Highway. Given the scale of the crane and the proximity to the two roads, closure of the Cahill Expressway and multiple northbound lanes on the west side of the Bradfield Highway will be necessary for the



installation of the crane and manoeuvring the load trucks. As the work in this precinct requires road and lane closures, to minimise the impact on peak traffic, work is proposed to be conducted at night.

The construction of the elevated spiral structure will also require road closures on the Cahill Expressway during the construction of the on-ground ramp section adjacent to the expressway. This work will also occur at night.

Detours and Construction Traffic Management Plans (CTMP) are required to be prepared before the start of work to warn and divert traffic during road closures and construction.

Traffic re-routed due to the closure of the Cahill Expressway will mainly use the following four routes:

- Route 1 – detour at Cahill Expressway on ramp at Domain Tunnel via Sydney Harbour Tunnel then Falcon Street and Miller Street to North Sydney/Kirribilli
- Route 2 – detour at Cahill Expressway on ramp at Conservatorium Road via Bridge Street and Grosvenor Street to Sydney Harbour Bridge
- Route 3 – detour at Eastern Distributor northbound City exit to Shakespeare Place then via Macquarie Street, Bridge Street and Grosvenor Street to Sydney Harbour Bridge
- Route 4 – detour at Sir John Young Crescent northbound City exit to Shakespeare Place then via Macquarie Street, Bridge Street and Grosvenor Street to Sydney Harbour Bridge.

Routes 2 to 4 via the city have been confirmed as feasible using the Sydney Light Rail website and the Livetraffic website.

It is assumed that diverted traffic will be distributed to the alternative routes in the following proportions:

- 50% on Route 1
- 50% distributed evenly across Routes 2 to 4.

Traffic volumes are so low overnight that, even if 100% of traffic is distributed across any one route, the impact will be negligible.

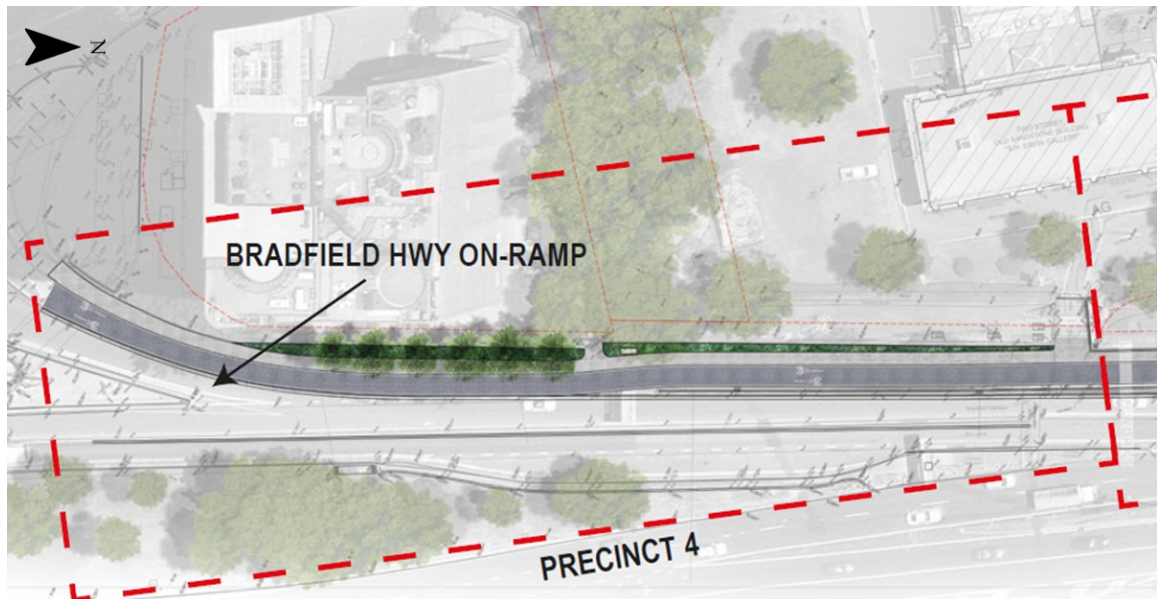
### **3.4.5 Other impacts**

Access to the southern site is via the S.H. Ervin Gallery carpark driveway, which is a very narrow access road from Upper Fort Street. The proposed work assumes that small rigid body trucks, including small concrete agitators, flat beds, and small concrete pumps, can manoeuvre through the driveway and access the site. An alternative access should be considered in the event the car park driveway cannot accommodate the vehicles needing access.

### 3.5 PRECINCT 4 – S.H. ERVIN GALLERY TO KENT STREET

#### 3.5.1 Description of work

Precinct 4 is located south of S.H. Ervin Gallery and continues to Kent Street, next to the Bradfield Highway on ramp. Precinct 4 is presented in Figure 3.6.



**Figure 3.6: Precinct 4 – S.H. Ervin Gallery to Kent Street**

Construction work in Precinct 4 is proposed to require seven to eight months to complete the following work:

- Relocate utilities within the Precinct
- Adjust the kerb line on east side of Kent Street on ramp to widen the footpath
- Demolish the existing central median between Kent Street and Clarence Street merge on the Bradfield Highway on ramp and install a temporary pavement
- Install temporary traffic barriers along edge of work on the Bradfield Highway on ramp
- Adjust storm water to suit the new kerb alignment
- Adjust existing retaining wall, ramp and stairs north of the existing National Trust Centre stairs
- Construct new kerb and pavement
- Reconstruct the central median on Bradfield Highway on ramp
- Finishing work comprised of asphalt, line marking and sign posts.

Work in Precinct 4 will require temporary cycle path and road closures throughout the duration of construction. The closures are further discussed in this section. No permanent closures to the travel network will be required.

#### 3.5.2 Cycle path closures

Precinct 4 will have the same cyclist detour proposed for all other precincts, where cyclists will be diverted from the Sydney Harbour Bridge stairs via Watson Road, Argyle Street to Kent Street and connect to the Kent Street cycleway. This temporary cyclist detour will remain until the completion of work in all precincts.

#### 3.5.3 Footpath closures

Pedestrian access to the S.H Ervin Gallery will be maintained from the Bradfield Highway on ramp, where pedestrians will be guided through the work and detoured through the Gallery carpark. This will involve a temporary stair access to the Gallery while the existing stairs are modified. Managing the pedestrians through the work will require a CTMP with appropriate Traffic Control Plans (TCP).

#### **3.5.4 Road closures**

The majority of work in this precinct will require road closures on the Bradfield Highway on ramp given the work are either on or next to the on ramp. For the purposes of assessment, about 42 full road closures of the northbound on ramp to the Bradfield Highway may be required. This will be further assessed and evaluated by the Construction Contractor in consultation with Transport for NSW's Transport Management Centre. To minimise the impact on traffic during the day, the work are proposed at night. In addition, the western Cahill Expressway lane may be required to be closed during demolition work in this precinct. Given the number of the full road closures required in this precinct, where possible, work and deliveries should be scheduled before work and occur simultaneously to minimise the need for additional full road closures.

#### **3.5.5 Other impacts**

Precinct 4 shares the same site compound as Precinct 3, where access to the site compound is via the S.H. Ervin Gallery carpark driveway, which is a very narrow access road from Upper Fort Street. The proposed works assume that small rigid body trucks, including small concrete agitators, flat beds, and small concrete pumps can manoeuvre through the driveway and access the site. An alternative access from Kent Street on ramp may be considered. However, this limits deliveries to night time only.



## 4. OPERATIONAL PERIOD IMPACT ASSESSMENT

### 4.1 OVERVIEW

Key changes to existing conditions from the proposed design and other proposed work within the study area include:

- Adjustment of the Bradfield Highway on ramp
- Realignment of the IRA
- The impact of the Sydney Harbour Bridge Southern Toll Plaza Precinct upgrade
- Extension of the retaining wall to the Bradfield Highway on ramp
- Operation of the Upper Fort Street boom gate
- Implementation of the spiral ramp
- Separated pedestrian footpath and cycleway from Kent Street on ramp to Upper Fort Street
- Cycleway conflict with the rail tunnel emergency exit
- Separated pedestrian footpath and cycleway on Upper Fort Street

### 4.2 ADJUSTMENT OF THE BRADFIELD HIGHWAY ON RAMP

The proposed work includes an increase in width of the shared path adjacent to the Bradfield Highway on ramp. This expansion will result in the reduction in road width on the ramp which will alter the approach and merge taper lengths.

Approach and merge taper lengths are also affected by the speed limit along the road. The existing speed on the ramp changes from 40km/h to 70km/h, which requires an acceleration lane length of 150 metres and a taper length of 62 metres according to the Austroads Guide to Road Design. This is not met by the existing layout and will further be reduced with the extension of the shared path. Moving the variable speed limit north along the Bradfield Highway on ramp will maintain a 40 km/h speed limit along the Clarence Street and Kent Street merge which is more suitable for the ramp as this requires an acceleration lane length of 105 metres and a taper length of 36 metres. These are more adequate approach and merge taper lengths for the Kent Street and Clarence Street merge.

A speed survey was conducted between Tuesday 28 March and Monday 3 April 2017, located on the Kent Street lane and the Clarence Street lane of the on ramp. The survey indicated the average speed on both roads remained between 40km/h to 50km/h, and the 85<sup>th</sup> percentile speed between 51km/h and 55km/h throughout the survey period. This further supports maintaining a limit of 40km/h between the Kent Street and Clarence Street merge.

The Kent Street and Clarence Street merge is also proposed to be modified from a lane change to a zip merge. A lane change is distinguished by a C1 line marking between a major road and a minor road, where vehicles on the minor road are required to give way to those on the major road. On the ramp, vehicles on Kent Street are required to give way to those travelling from Clarence Street. A zip merge eliminates the C1 line marking, where any vehicle behind another vehicle in the adjacent lane is required to give way to that vehicle during the merge.

A zip merge is appropriate where the speed of vehicles in each lane is similar, typically less than a 20% difference in speed according to Roads and Maritime Supplement to Australian Standard 2016. From the speed survey both roads indicated similar average weekly speeds where Kent Street recorded an average speed of 43 km/h with an 85<sup>th</sup> percentile speed of 51km/h and Clarence Street observed an average of 45 km/h with an 85<sup>th</sup> percentile speed of 55km/h. This falls below the 20% difference and is deemed acceptable for the zip merge.

Implementation of a zip merge on the on ramp will promote equal priority to vehicles on Kent Street and on Clarence Street. This will decrease the risk of blockage on the Kent Street/ Clarence Street intersection and

traffic build up along Kent Street towards the CBD in the northbound direction, particularly in the evening peak.

#### **4.3 REALIGNMENT OF THE IRA**

The proposed cycleway will be constructed within the existing IRA. The IRA is utilised by emergency vehicles including NSW Ambulance, NSW Fire and Rescue, NSW Police and Roads and Maritime Driver Aid Services, where vehicles park in the IRA in the event of an emergency on the Sydney Harbour Bridge.

The IRA is proposed to be realigned with the Bradfield Highway, as part of the Sydney Harbour Bridge Southern Toll Plaza Precinct upgrade. The project will modify lane widths and medians and alter the alignment of the Highway and the IRA. This project is further discussed in Section 4.4. Emergency vehicles in the IRA park parallel to the Bradfield Highway and as such, the length of the IRA is prioritised over the width of the area. The proposed cycleway is to be constructed on the residual space of the response area, while the length of the area will be maintained and the overall impact to the IRA will be minimal.

#### **4.4 IMPACT OF THE SYDNEY HARBOUR BRIDGE SOUTHERN TOLL PLAZA PRECINCT UPGRADE**

The Sydney Harbour Bridge Southern Toll Plaza Precinct upgrade is currently being undertaken on the Bradfield Highway and is expected to be completed early 2018. The project involves the removal of the southern toll booths and the realignment of travel lanes to optimise the operational requirements of the Bradfield Highway for all users, predominately in the southbound direction. Initially, the number of lanes at the toll booths increased from eight lanes to a total of 15 lanes. The project will reduce to 14 lanes, incorporating two dedicated bus lanes. While the project has minimal impact on northbound travel onto the highway, the realignment of travel lanes will involve a reduction of lane widths which will particularly impact the alignment of the IRA.

#### **4.5 EXTENSION OF THE RETAINING WALL TO THE BRADFIELD HIGHWAY ON RAMP**

The proposed cycleway incorporates a retaining wall adjacent to the Bradfield Highway from the Sydney Harbour Bridge to the Bradfield Highway on ramp with an opening provided at the Upper Fort Street boom gate. Currently, a number of cyclists travel northbound towards the Sydney Harbour Bridge Cycleway via the Clarence Street on ramp to the Bradfield Highway, in order to avoid the Kent Street underpass. With the proposed design, cyclists travelling from Clarence Street will only be able to enter the Sydney Harbour Bridge cycleway by using the Kent Street underpass otherwise they will be restricted to continuing along the Bradfield Highway.

Cyclists travelling on the Bradfield Highway are at high risk of collision where they are travelling amongst high volumes of traffic at high speeds. To protect cyclists from entering the highway, signs should be placed prior to the Clarence Street ramp warning them of the lack of access to the Sydney Harbour Bridge Cycleway and wayfinding signs towards the Kent Street underpass. This will be beneficial particularly, to amateur cyclists.

With the proposed cycleway, cyclists travelling northbound from Clarence Street will be required to use the Kent Street underpass. While this route is longer than travelling via the Clarence Street on ramp, it is dedicated to protecting cyclists and will reduce the risk of collisions.

#### **4.6 OPERATION OF THE UPPER FORT STREET BOOM GATE**

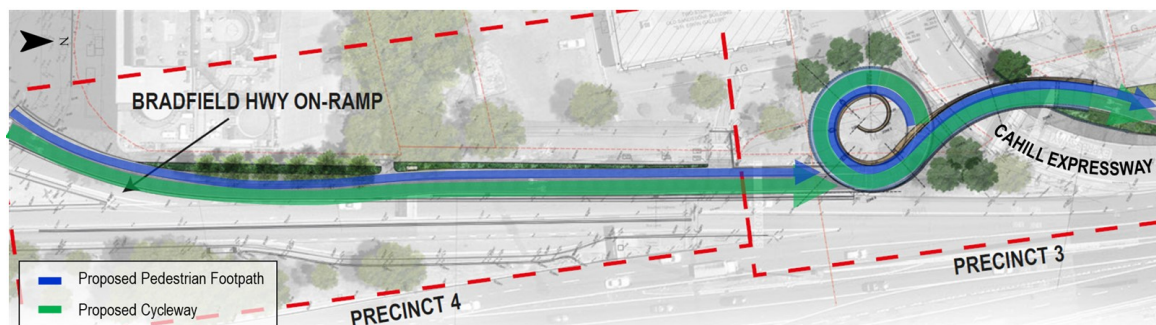
The existing Upper Fort Street boom gate will be operational during construction and after completion of the work. The proposed cycleway will intersect with the boom gate where the cycleway intersection will be marked green to indicate a conflict zone. In the operation phase vehicles using the boom gate will be required to give way to cyclists on the cycleway, unless the flashing lights of emergency vehicles are on. Signs warning cyclists of vehicles entering via the boom gate would be installed in both directions.

#### 4.7 IMPLEMENTATION OF A SPIRAL RAMP

The existing bridge connecting Upper Fort Street to the footpath adjacent to the Bradfield Highway on ramp is too steep for cyclists and poses potential risks of injury and collisions with pedestrians. The proposed spiral ramp was designed to accommodate the height requirements of vehicles using the Cahill Expressway below while providing a safe gradient for cyclists travelling via this route. The spiral ramp will have separated pedestrian and cycle paths and decrease the risk of collision between both users. However, the travel distance for both users will increase compared to using the existing bridge, though the increase in travel distance is marginal. The increase will be about 56 metres measured from the National Trust Centre stairs to the southern abutment of the existing and proposed bridge. Furthermore, cyclists travelling around the loop may slow down and cause a build up of cyclists on the bridge, particularly in peak periods.

#### 4.8 SEPARATED PEDESTRIAN FOOTPATH AND CYCLEWAY FROM KENT STREET ON RAMP TO UPPER FORT STREET

A separated pedestrian footpath will run parallel to the proposed cycleway from the Bradfield Highway on ramp and connect to Upper Fort Street via the spiral ramp. The pedestrian footpath is proposed west of the cycleway and will follow the inner circle of the spiral ramp, as shown in Figure 4.1.



**Figure 4.1: Proposed pedestrian footpath and cycleway in the northbound direction**

The separated pathways will reduce likelihood of collisions between pedestrians and cyclists. It should be noted that the sections of the cycleway with downhill gradients would have cyclists travelling at higher speeds. These sections include the path beside the Bradfield Highway on ramp in the southbound direction; however, the proposed cycleway will improve these gradients from the existing conditions. In particular, the Cahill Expressway Bridge southern approach ramp which has an existing gradient of 1:6 which will be improved to 1:20, providing smoother transition from the spiral ramp to the path beside the Bradfield Highway on ramp. A smoother gradient will improve speed management for cyclists travelling downhill. Furthermore, it will improve ease of uphill travel.

Within sections of downhill gradient where cyclists travel at faster speeds, the cycle lane will be located away from the pedestrian footpath and will minimise the likelihood of collision between the two users. However, on the southern portion of the proposed cycleway adjacent to the Bradfield Highway on ramp, the faster lane is positioned adjacent to the traffic lane where the proposed retaining wall will end and will not protect cyclists from oncoming traffic. Therefore, it is important to avoid locating hazards such as street furniture and sign posts in these sections as cyclists may hit them or swerve to avoid them and lose control.

#### 4.9 CYCLEWAY CONFLICT WITH THE RAIL TUNNEL EMERGENCY EXIT

A portion of the cycleway is proposed adjacent to the Rail Tunnel Emergency Exit door located in Precinct 1. The door is currently marked with "Rail Tunnel Emergency Exit Door – Keep Clear at all times" sign and is proposed to be operational after completion of work. The portion of the cycleway that conflicts with the door will be designed to provide adequate distance from the door and the cycleway, in accordance with the Australian Standards. To further prevent collisions between cyclists on the cycleway and individuals using the emergency exit, warning signs will be implemented to alert cyclists of the door opening on both sides of



the exit. The section of the cycleway that will conflict with the exit will be painted green to highlight the conflict point to pedestrians and cyclists.

#### **4.10 SEPARATED PEDESTRIAN FOOTPATH AND CYCLEWAY ON UPPER FORT STREET**

Where the proposed cycleway will run parallel to the eastern side of Upper Fort Street, the road geometry and on-street parking will not be affected. The pedestrian footpath will be adjacent to the cycleway from the spiral ramp and continue onto Upper Fort Street. There is a potential conflict point between the proposed cycleway and pedestrian footpath at the intersection on Upper Fort Street near Watson Road. This will be similar to the existing conditions of the conflict area; however, there is currently no formal pedestrian footpath extending onto the eastern side of Upper Fort Street. To avoid collisions between pedestrians and cyclists at this intersection, cyclists must give way to pedestrians crossing the cycle path where appropriate signage and line marking must be implemented adjacent to the cycleway, in accordance with the NSW Bicycle Guidelines.

## 5. SAFEGUARDS AND MITIGATION/MANAGEMENT MEASURES

Where the proposed cycleway will provide a dedicated route from the Sydney Harbour Bridge Cycleway to the Sydney CBD, it will also result in modification of the on ramp to the Bradfield Highway and the realignment of the IRA and will restrict cyclists travelling northbound from Clarence Street to travel via the Kent Street underpass. However, these changes will have an overall positive impact to the traffic network in terms of traffic flow and pedestrian and cyclists access.

To mitigate any potential risk prior to, during and after construction, Table 5.1 provides a summary of the traffic, access and community consultation safeguards and mitigation measures that are recommended to be implemented throughout the development of the proposal.

**Table 5.1: Traffic, access and community consultation safeguards and mitigation measures**

Impact	Environmental safeguards	Responsibility	Timing
Traffic Management	<ul style="list-style-type: none"> <li>Construction Traffic Management Plans for each stage of construction would be developed and approved by Roads and Maritime prior to the start of work.</li> <li>Traffic control measures are to be undertaken in accordance with the Roads and Maritime Traffic Control at Work Sites Manual 2010 and approved by Roads and Maritime prior to implementation.</li> <li>Appropriate traffic management measures would be implemented and maintained, such as warning signs, illuminated warning devices, manual and electronic traffic control and provision of temporary barriers and markers to control the proposed work areas.</li> <li>Traffic would be appropriately warned of any road closures and night work prior to the work.</li> </ul>	Roads and Maritime and construction contractor	Pre-construction and construction
Access	<ul style="list-style-type: none"> <li>During construction, arrangements would be made to ensure pedestrian, cyclist and vehicular access to The National Trust Centre/S.H. Ervin Gallery and Fort Street Public School are maintained at all times.</li> <li>Appropriate measures would be made to ensure cyclists are redirected to the Kent Street underpass from Clarence Street when travelling northbound towards the Sydney Harbour Bridge Cycleway.</li> </ul>	Roads and Maritime	Pre-construction, construction and operation

Impact	Environmental safeguards	Responsibility	Timing
Traffic management around special events	<ul style="list-style-type: none"> <li>▪ Road occupancy license would be obtained from Transport for NSW Transport Management Centre for all construction activities. Major CBD and city wide events would be considered when applying for road occupancy licences and when scheduling construction activities.</li> <li>▪ Consultation with Transport for NSW Transport Management Centre would ensure that no significant conflicts between construction activities and major events in the city occur.</li> </ul>	Transport for NSW Transport Management Centre	Pre-construction and Construction
Cyclists movements	<ul style="list-style-type: none"> <li>▪ A cyclist communication strategy would be implemented that would include establishing information signs and maps to inform cyclists of changes to cycle route and the detour from Kent Street to the Sydney Harbour Bridge Cycleway portal.</li> <li>▪ As part of the strategy, information signs and material would be strategically located along major cyclist travel routes to clearly communicate proposed and ongoing changes.</li> <li>▪ Appropriate warning signs would be implemented to warn cyclists of vehicles entering the cycleway in accordance with Roads and Maritime practice.</li> <li>▪ Appropriate signage would be implemented in sections where cyclists must give way to pedestrians.</li> </ul>	Roads and Maritime	Pre-construction, construction and operation
Communication with stakeholders	<ul style="list-style-type: none"> <li>▪ Consultation with relevant stakeholders including employees, visitors, students and parents of the National Trust Centre, Sydney Observatory and Fort Street Public School, as well as vehicle drivers along the Cahill Expressway and Bradfield Highway via Kent Street and Clarence Street. Stakeholders would be adequately notified of construction prior to the start of work.</li> <li>▪ Stakeholders would have access to information of construction work including construction impacts to vehicle, pedestrian and cycle routes and notifications of road closures via the City of Sydney and Roads and Maritime websites.</li> </ul>	City of Sydney, Roads and Maritime	Pre-construction and construction

Impact	Environmental safeguards	Responsibility	Timing
Location of street furniture or sign posts on the cycleway	<ul style="list-style-type: none"> <li>▪ Street furniture and signs post should not be located such that they obstruct the cycleway and become a hazard.</li> <li>▪ No street furniture or sign posts can be positioned on the cycleway on the spiral ramp and the Bradfield Highway on ramp, where cyclists can potentially lose control and collide with other cyclists or pedestrians.</li> </ul>	City of Sydney, Roads and Maritime	Pre-construction, construction