7 Consideration and management of other issues

Chapter 7 provides an assessment of the project's potential impacts that were not identified as key issues by either the Director-General's requirements or the subsequent environmental risk analysis (see Chapter 8).

The issues discussed in this chapter have either been directly identified by the project team or have emerged through the consultation process (see Chapter 5). The level of assessment reflects the fact that these are issues commonly associated with road projects and are appropriately addressed through the design process or by implementing best practice management and mitigation measures.

7.1 Air quality

7.1.1 The existing environment

An air quality assessment was undertaken for the project (Holmes Air Sciences, 2008). Air quality in the vicinity of the study area is largely influenced by emissions from motor vehicles travelling on Victoria Road and other local roads. Other sources of air pollution that are typical of urban areas include domestic and commercial solvents and aerosols and motor vehicle refinishing.

Air pollutants from vehicles that are potentially harmful to human health include carbon monoxide (CO), nitrogen oxides (NO_x) and particulate matter (less than 10 micrometres in diameter (PM_{10})).

Air quality data recorded for these pollutants at Rozelle Hospital, about 1.2 kilometres south of the project site, is considered to be indicative of air quality within the study area. A summary of the monitoring data for 2000 to 2006 is shown in Table 7-1. The results are all below the Department of Environment and Climate Change (DECC) air quality goals except for the PM_{10} maximum 24-hour value of 51 micrograms per cubic metre (µg/m^3) recorded in 2004, which was 1 µg/m^3 above the goal, and the PM_{10} maximum 24-hour value of 52 µg/m^3 recorded in 2006, which was 2 µg/m^3 above the DECC goal. This data demonstrates that air quality is generally good.

Table 7–1 **Summary of monitoring data for CO, NO_2 and PM_{10} (2000–2006)**

	CO (ppm)		NO_2 (µg/m³*)		PM_{10} (µg/m³)	
Year	**Maximum 1-hour value**	**Maximum 8-hour value**	**Maximum 1-hour value**	**Annual average**	**Maximum 24-hour value**	**Annual average**
DECC goal	25	8	246	62	50	30
2000	5.0	-	143.5	29.5	-	-
2001	3.2	-	135.3	29.9	-	-
2002	2.8	2.3	176.3	30.8	-	-
2003	2.7	1.9	106.6	28.7	-	-
2004	3.0	1.9	131.2	26.7	51.0	20.1
2005	2.7	1.8	106.6	26.7	47.0	20.2
2006	2.4	1.7	118.9	26.7	52.0	20.5

* Micrograms per cubic metre

Background levels for the study area were estimated by averaging the yearly values shown in Table 7-1. The results are presented in Table 7-2. Importantly, as Victoria Road is not a new roadway, the estimates are already influenced by emissions from it. Therefore, adding these values to model predictions results in a very conservative estimate of impacts. In addition, the values in Table 7-1 are maximum averages for the year, and adding a model to these values is likely to result in an overestimation.

Table 7–2 **Estimated background levels of CO, NO_2 and PM_{10}**

Pollutant	Averaging period	Estimated background concentration
CO	1 hour, 8 hour	3.1 ppm, 1.9 ppm*
NO_2	1 hour	131.2 µg/m³
	Annual average	28.4 µg/m³
PM_{10}	24 hour	50 µg/m³
	Annual average	20.3 µg/m³

* Parts per million

7.1.2 Assessment of potential impacts

Construction impacts

Dust generation would be the primary potential impact on air quality resulting from construction of the project. The amount of dust would depend on the silt and moisture content of the soils and the type of activities being carried out.

The major causes of dust would be excavation, sawing, sweeping, blasting, and wind erosion of exposed surfaces. The main activities which may result in dust generation would include:

- Excavations for bridge abutment and pier locations.
- Removal of medians and other items.
- Milling and re-sheeting of the road pavement.

- Trenching for the installation of structures (such as overhead signage and conduits).
- General use of construction and compound sites.

Dust mobilisation has the potential to create a visual impact, settle on property and residences and cause general discomfort for the community in the immediate area, as well as project personnel. However, these impacts are likely to be temporary and localised, and best practice management and mitigation measures can adequately address relevant DECC goals for dust deposition and control potential impacts.

Exhaust from construction vehicles, plant and equipment would result in the emission of air pollutants. However, given the high traffic flow in the study area, the relative contribution from construction-based emissions would be minor and would disperse quickly.

Operational impacts

To assess the potential impacts on air quality associated with the operation of the project, modelling was based on existing conditions and conditions expected during operation of the upgrade project. No modelling for future years was carried out as this is primarily a comparison between existing and upgraded scenarios, and traffic modelling has shown that there is not expected to be a significant growth in peak-hour traffic as a result of the project. Inputs for the model included meteorological conditions, traffic volumes, vehicle emission rates and receptor locations.

Using the model, predictions were made at the following locations:

- Distances of 0 (kerbside), 10, 20, 30 and 50 metres from the kerb.
- Sensitive receptors near the bridge abutment locations on the Drummoyne and Rozelle foreshores, including Drummoyne Swim Centre and residences closest to the existing and proposed bridges.

Predictions were then considered in the context of estimated background concentrations and comparisons were made with the applicable DECC air quality goals.

Using the modelling results, it is predicted that there would be only slight differences between the highest pollution concentrations with and without the project. The main differences between the existing and upgrade scenarios would occur along the Iron Cove Bridge, largely because the proposed bridge crossing would move traffic closer to western receptors. There would also be reductions at some locations along this section due to the spread of traffic across a larger area, which would increase the opportunity for dispersion. Overall, however, there would not be significant differences between the existing conditions, and following the upgrade, at any section along the route.

More specifically, it is predicted that:

- Concentrations of CO, NO_2 and PM_{10} would all be within the relevant DECC assessment criteria. Even when added to estimated background levels (to produce a conservative estimation of impact), goals would be only marginally exceeded for particulates. (These goals are exceeded occasionally in all parts of Sydney due to widespread events such as bushfires and dust storms.) It is unlikely that the contribution from the roadway would cause additional exceedances of the 24-hour goal.
- The highest concentrations of CO for the existing and upgrade scenarios would be within DECC air quality goals for both the 1-hour and 8-hour averages. Concentrations of CO are predicted to be slightly higher with the upgrade than without. The maximum predicted values are 1.7 and 1.0 parts per million for the 1-hour and 8-hour averaging times, respectively, for both the existing and upgraded scenarios. Even when added to estimated background concentrations of 3.1 (1-hour) and 1.9 parts per million (8-hour), values remain within the relevant goals. It is also predicted that concentrations at specific receivers adjacent to the proposed bridge would be below relevant goals.
- The highest 1-hour and annual average concentrations of NO_2 would be within the DECC air quality goals. The highest 1-hour average predictions are 62.6 (existing) and 62.2 $\mu g/m^3$ (upgrade) and, even

when added to a background level of 131.2 µg/m^3, these levels are less than the DECC goal of 246 µg/m^3. For sensitive receptors, some increases and some reductions are expected. The largest increases are predicted to occur at Drummoyne Swim Centre, and Formosa Street and Byrnes Street residences. However, these increases are predicted to be relatively minor and levels are again predicted to be well within relevant goals.

- The 24-hour and annual average levels of particulate matter would be well below the DECC assessment criteria. Although the 24-hour predictions exceed the goal of 50 µg/m^3 when added to estimated background levels, the 24-hour predictions are exceeded on occasion due to widespread events such as bushfires and dust storms and it is considered unlikely that any contribution from the roadway would cause additional exceedences.
- The highest 24-hour PM_{10} concentration during operation of the project along sections of the roadway between Darling Street and Robert Street would be 5.8 µg/m^3. This would be similar to levels already experienced between Park Avenue and Terry Street. It is also predicted that the highest annual PM_{10} concentration during operation of the project would be 1.7 µg/m^3. When added to the existing background of 20.3 µg/m^3, the DECC goals would be met. For the sensitive receptors, the PM_{10} predictions for the upgraded scenario are estimated to be very similar to those for the existing configuration. There would be some increases at Drummoyne Swim Centre and the Formosa Street residences, but predictions still remain well below the air quality goals. It is also predicted that there would be some decreases in concentrations at the Victoria Road and Byrne Street residences.

In general, air quality is not predicted to decline noticeably as a result of the project, and would continue to meet DECC air quality goals.

7.1.3 Mitigation and management measures

Mitigation and management measures are presented in Table 7-3. These measures are incorporated in a draft statement of commitments in Chapter 9.

Table 7–3 **Air quality mitigation and management measures**

Potential impact	Mitigation and management measures
Construction	
Airborne dust particulates	Hardstands or similar will be provided in compound areas and work sites. Where possible, existing ground cover will be retained.
	Disturbed areas, stockpiles and handling areas will be maintained in a condition that minimises windblown, traffic-generated or equipment-generated dust. This will be done through activities including (but not limited to) watering, road sweeping and removal of accumulated material from environmental controls.
	Disturbed areas will be restored progressively, where possible, or at the completion of works.
	Where wind speeds reach a velocity that visually mobilises dust particulates, dust generating activities will cease and appropriate measures will be implemented to control dispersion.
Reduction in local air quality from vehicle emissions	Construction equipment and plant will be maintained in good working order, and maintenance will be carried out where emissions are unacceptable. Equipment, plant and construction vehicles will be turned off when not in use.

7.2 Geology and soils

7.2.1 The existing environment

The geology of the area is Hawkesbury sandstone (Sydney 1:100,000 Geological Sheet, Geological Survey of NSW). Soils found through Drummoyne, Rozelle and the foreshores of Iron Cove contain highly disturbed soils of the Hawkesbury and Lambert soil landscape units. Soils are generally shallow to moderately deep with further depth in drainage lines. Some shale lenses can be observed. The Hawkesbury and Lambert soil landscape units are prone to an extreme and high level of soil erosion hazard, respectively. These soil types are typically found on rocky outcrops and at shallow depths. Other characteristics include high permeability and low soil fertility. Colluvial Hawkesbury soil is evident along a thin band on the eastern shore of Iron Cove.

Generally, the soils in the study area have been heavily modified by a long history of extensive industrial, commercial and residential development. Areas on the foreshore of Iron Cove have been reclaimed and contain imported materials. The soil conditions can be described as various grades of fill, overlying alluvial gravelly sands, overlying sandstone bedrock.

The site is located within a mapped acid sulfate soil risk area. Section 6.2 contains a description of ASS in relation to the project, as well as a discussion of the groundwater characteristics and potential impacts.

7.2.2 Assessment of potential impacts

Construction impacts

The soils in the study area are considered to be highly erodible and therefore susceptible to erosion when exposed during excavation and vegetation removal. During construction, erosion attributable to the project has the potential to affect Iron Cove by increasing sediment loads during rain, which would, in turn, increase turbidity within the cove. Other pollutants could potentially be introduced into Iron Cove during construction through runoff, or incidents on-site. These may include chemicals, oils and various other construction by-products or materials.

The erosion and sedimentation risk of the project was assessed in accordance with the RTA's *Erosion and Sedimentation Risk Assessment Procedure* (RTA, 2004). Through the risk assessment, the overall project was identified as a high risk activity because:

- It includes construction within a permanent waterway.
- It has the potential to disturb acid sulfate and/or contaminated soil.

The potential for erosion and sedimentation impact from road works throughout Rozelle and Drummoyne is considered low. The project in these areas would include activities such as excavation to remove medians; installation of gantries, traffic signals and communications conduits; and milling and re-sheeting of road pavements. These activities would expose only small areas of unconsolidated material at any one time and any erosion potential would be managed through the implementation of appropriate controls and practices (see Section 7.3).

Adjacent to the foreshore of Iron Cove, vegetation would be cleared and minor earthworks would occur to enable construction of the bridge structures and suitable compound areas. In addition, a small area of Iron Cove would be temporarily reclaimed on the Rozelle side. These activities would allow for the construction of the bridge piers and abutments, works associated with pedestrian and cyclist facilities, and temporary construction compounds. While these activities would present a higher risk of erosion than the road work aspects of the project, the implementation of standard/best practice mitigation measures would be appropriate to manage this risk.

The project also has the potential to disturb and expose ASS during construction of the proposed bridge and approaches. This is discussed in detail in Section 6.2.

Operational impacts

During operation, the risk of impacts associated with erosion and sedimentation would be manageable. Suitable replacement landscaping would be provided in areas around the bridge abutments disturbed during construction activity. No long-term risk is anticipated from erosion and sedimentation.

7.2.3 Mitigation and management measures

Mitigation and management measures would be implemented in accordance with the RTA's *Water Policy and Code of Practice for Water Management (1999)* and *Managing Urban Stormwater: Soils and Construction (Landcom, 2004).* These measures are presented in Table 7-4 and in a draft statement of commitments in Chapter 9.

Table 7–4 **Geology and soils mitigation and management measures**

Potential impacts	Mitigation and management principles
Construction	
Degradation of land	A specialist soil conservation consultant will be engaged for the project to help manage erosion and sedimentation. The specialist will, among other things, help develop plans of management to minimise the risk of activities which may intercept potential ASS and contaminated material, and also develop an appropriate audit and inspection program for high-risk elements of the project.
	Erosion and sedimentation control measures will be implemented prior to the commencement of site preparation and construction activities to stabilise and contain exposed or unconsolidated surfaces. Controls will be maintained and inspected regularly to ensure their ongoing effectiveness.
	Stockpiles will be designed, established, operated and decommissioned to ensure all materials are adequately contained and not mobilised through wind or water.
	The area of soil exposed during construction will be minimised wherever reasonable and feasible. Areas disturbed during construction will be restored progressively, where possible, as construction activities are completed. Restoration will be monitored until sites are stable.

7.3 Water

7.3.1 The existing environment

Iron Cove is the main water body within the study area. It is tidal and opens to the north-east to form part of Sydney Harbour. The width of Iron Cove at Iron Cove Bridge is about 350 metres. Water depth (below the average high water mark) ranges from about 4.1 metres near the northern side of Iron Cove, and 3-3.9 metres on the southern side. The depth increases closer to the entrance to Iron Cove and is about 5.5 metres near Birkenhead Point.

Hydrology

Surface water received by Iron Cove is via a network of stormwater drains from the surrounding suburbs of Summer Hill, Lewisham, Petersham, Leichhardt, Haberfield, Dobroyd Point, the northern areas of Rozelle and southern areas of Drummoyne. (The southern areas of Rozelle drain to Rozelle Bay/White Bay and the north-west areas of Drummoyne, drain to Parramatta River.)

Most watercourses in the project corridor are built urban drains, with the exception of Iron Cove. There is minimal natural drainage remaining, primarily confined to park areas and other public open spaces. Hawthorne Canal and Iron Cove Creek are two large stormwater canals that flow into Iron Cove upstream of the study area at Dobroyd Point.

A discussion of the groundwater characteristics and potential impacts is contained in Section 6.2.

Water quality

Industrial sites on the Rozelle and Drummoyne foreshores, including the former Dunlop Rubber Factory at Birkenhead Point, former Balmain Power Station, and former Monsanto Chemical Factory, have influenced the water quality of Iron Cove.

Today, diffuse sources of contamination that affect water quality include road infrastructure, residential and commercial buildings, and railway lines. Point sources of contamination include operational sites such as Rozelle Hospital and Birkenhead Point Marina.

It is generally accepted that the water quality in Iron Cove is predominantly influenced by stormwater runoff from the surrounding land (Leichhardt Council, 2007). During wet weather, water quality would be expected to be poor, with point and diffuse sources within the catchment directly influencing both chemical water quality parameters (pH, nutrients, dissolved oxygen, and inorganic and organic matter) and physical water quality parameters (light penetration, salinity and temperature).

Regular monthly water quality monitoring undertaken by Sydney Water in the Iron Cove region indicates that:

- Water pH varies between 6.1 to 8.5, with pH slightly more alkaline during wet weather than during dry weather, although still within the ANZECC (2000) range for estuarine waters.
- All nutrient parameters tend to be elevated during wet weather compared to dry weather and all mean values exceed the ANZECC (2000) guidelines for estuarine waters, indicating elevated nutrient levels in Iron Cove for much of the time.
- Median bacteria levels within Iron Cove are generally not high, but tend to be elevated during wet weather.
- Median levels of faecal coliforms range from three colony-forming units per 100 millilitres (cfu/100 mL) in dry weather to 108 cfu/100 mL in wet weather, while levels of enterococci vary from 4 cfu/100 mL in dry weather to 95 cfu/100 mL in wet weather (Marine Pollution Research, 2008).

The Harbourwatch program also monitors faecal coliforms and enterococci, as indicators of water quality. The closest monitoring site to Iron Cove is Dawn Fraser Pool, where stormwater drains discharge alongside the swimming enclosure, and pollution from upper Parramatta River, Lane Cove River and Iron Cove Bay can affect water quality. Runoff at this location is typical of Iron Cove and contains pollutants such as:

- Fine organic and inorganic suspended particulates.
- Sewage from overflows and leaks in the system.
- Animal faecal waste.
- Oils, greases and surface chemicals from roads, and industrial and domestic sites.
- Plant fertilizers, pesticides and chemicals from building sites and gardens.
- Litter, including rubbish, leaf litter and grass clippings.

Sewage overflows during wet weather contribute to fluctuations in water quality within Iron Cove. It is estimated that 20–50 overflow events per year occur in the Sydney Harbour catchment/Parramatta

River with overflow impacts for the next 5–10 days (Marine Pollution Research, 2008). However, this is not considered to be a major source of water quality deterioration in Iron Cove.

Overall, water quality of Iron Cove appears to be good with regard to physical water quality parameters, slightly eutrophic with regard to nutrient levels, and at least mildly polluted with regard to metal pollutants derived from urban activities. The water quality of Iron Cove would appear to be aided by both good local wind mixing and good tidal flushing.

7.3.2 Assessment of potential impacts

Construction impacts

During construction, there is potential for impacts on the water quality of Iron Cove and other receiving water bodies in the study area. Road work activities have the potential to expose unconsolidated subsurface materials. In the event of rain, such material would have the potential to move from the site, discharge into the local stormwater system and eventually travel downstream into water bodies such as Iron Cove, Rozelle/White Bay and the Parramatta River. While the likelihood and resultant impacts of these surface water discharges from the road works would be considered low, they may contribute to already poor levels of turbidity and a short-term decline in other water parameters in Iron Cove during rain.

Road works would also include high-pressure water blasting to remove redundant line markings, and the application of paint to provide new line markings and delineate the bus lane. Both activities have the potential to affect local water quality downstream through the introduction of chemical pollutants. However, it is considered unlikely that these activities, performed with appropriate and best practice work procedures, would contribute to any deterioration in water quality within Iron Cove or other surrounding water bodies.

Construction of a new bridge and associated approaches would present a higher level of risk to the water quality in Iron Cove than works associated with the road through Drummoyne and Rozelle. Works on the foreshore and in Iron Cove would be expected to continue for about two years. During this time, water quality in Iron Cove would be exposed to various levels of risk. During the land-based construction works, unconsolidated material would be exposed through vegetation clearing, excavation and piling, and minor reclamation on the foreshore. This would present a moderate risk to water quality. The potential impact of contamination and ASS on water quality is discussed in Section 6.2.

Above-water work, involving the in-situ casting of bridge components and grouting, would present a moderate risk of material falling into Iron Cove, but only a minor risk to water quality.

Across the full length of the project during construction (and operation), there is a risk of accidental spills, which may include fuels, oils, grease, chemicals, hydraulic fluids and other liquids. During construction, heavy construction plant would be in use on roadways and on the water within Iron Cove. There is a low to moderate risk that liquids may enter Iron Cove either through the local stormwater system or directly from over-water equipment. While there would be a degree of risk throughout construction, this risk would be minimised through the implementation of standard/best practice work and emergency response procedures (see Section 7.3.3).

Operational impacts

The operational impacts of the project on water quality within the study area would be limited, due to improved traffic conditions and decreased risk of accidents. The quantity of pollutants deposited at the road surface is expected to remain unchanged, as the project would not facilitate an increase in traffic along Victoria Road.

However, there would be an increase in impervious surfaces contributing additional stormwater to Iron Cove. Potential pollution sources from road surfaces include heavy metals and organics (such as hydrocarbons) arising from tyre wear, vehicle wear (such as brake linings), pavement wear, emissions, and accidental spills, all of which could reduce water quality in receiving waters. Other materials that could deposit in Iron Cove from the roadside environment include litter and larger waste materials.

Taking into consideration the characteristics of the catchment in terms of both size and land use, any impact from an increase in bridge deck runoff from the new pavement surface would be considered negligible.

In addition, there would be some improvement in the condition of the waterway in the vicinity of the project through the implementation of gross pollutant traps (GPT) to capture litter washed from the roadway and new bridge during rainfall events.

7.3.3 Mitigation and management measures

Mitigation and management measures would be implemented in accordance with the RTA's *Water Policy and Code of Practice for Water Management* (1999) and *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).

Mitigation and management measures are presented in Table 7-5. These measures are incorporated in a draft statement of commitments in Chapter 9.

Table 7–5 **Water mitigation and management measures**

Potential impacts	Mitigation and management measures
Construction	
Sedimentation of waterways	Construction planning will seek to maintain water quality in Iron Cove throughout the construction phase. Ground surfaces will be protected from disturbance where possible. Where this is not possible, suitable management controls, which may include installation of sediment control devices, dust suppression and temporary ground stabilisation measures (eg hardstands, mulching) will be implemented to protect unconsolidated surfaces.
Reduction in water quality due to accidental spills	Activities with the potential to reduce or contaminate local water quality (including refuelling, concrete washout, storage of fuels and hazardous materials, and washing of plant) will be undertaken within appropriately bunded areas.
	Procedures to respond to spills and incidents will be prepared and implemented to protect water quality in Iron Cove. The procedures will detail measures to contain, clean up and dispose of materials that may have a detrimental effect on water quality. All construction personnel will be trained in their obligations with respect to any legal requirements and site procedures.
Operation	
Reduction in water quality	Gross pollutant traps will be installed, and maintained, on any additional stormwater outlets.
	An operational incident response plan will be prepared and implemented.

7.4 Biodiversity

7.4.1 The existing environment

Terrestrial environment

The study area is located in a highly modified urban environment. There is scattered vegetation along and surrounding Victoria Road that consists largely of planted street trees, grassed recreation parks, grassed verges and ornamental gardens. There is limited fauna habitat and there are no bushland reserves. The biodiversity values are considered to be low and are extant largely beyond the road reservation within private and public lands.

A flora inventory and fauna habitat assessment was undertaken on the Rozelle and Drummoyne foreshores of Iron Cove in areas that may be directly or indirectly affected by the project (Ecological, 2008). The study found that introduced and non-indigenous species account for 51 per cent of recorded plant species, and five of the species recorded are weeds listed under the *Noxious Weeds Act 1993*. Locally native plant species were found at both sites, consisting of established and mature plantings. There was no evident remnant vegetation at either site, with all native plants encountered, excluding some groundcover, likely to have been planted.

No occurrences of threatened or regionally significant flora species listed on the *Threatened Species Act 1995* (TSC Act) or EPBC Act were observed on either Drummoyne or Rozelle foreshores. However, needle-leaf mistletoe, *Amyema cambagei,* which has been identified as regionally significant in western Sydney, was observed on several swamp oaks in the north-eastern section of King George Park. It is considered unlikely that the area of Drummoyne affected by the project contains habitat for any flora with significant conservation values.

Both sites subject to the flora inventory and fauna habitat assessment represent a highly modified urban environment, disturbed by noise and vibration from nearby roads, weeds, and feral animals. The sites are only likely to provide habitat for common native flora and fauna, and for highly mobile species such as birds and possums. Three vulnerable species listed in the TSC Act, the pied oystercatcher (*Haematopus longirostris*), grey-headed flying-fox (*Pteropus poliocephalus*) and eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), have been recorded in the vicinity of the study area.

While there are very few vegetated areas within the study area that would provide suitable habitats for these species, habitat is provided by other elements within the environment. For example, the pied oystercatcher nests mostly on coastal or estuarine beaches, but occasionally on saltmarsh or grassy areas, and forages at low tide on exposed sand, mud and rock for molluscs, worms, crabs and small fish. The eastern bentwing-bat uses caves, derelict mines, stormwater tunnels, buildings and other structures as habitat, so the existing bridge may provide some habitat for this species.

Patches of vegetation on the sites contain dense canopy and understorey and may provide shelter and nest sites for common birds such as the Australian magpie, and potential roosting habitat for nocturnal birds such as owls.

Dense flowering species such as coast banksia and paperbark may provide foraging resources for a number of nectivorous birds. These species, along with a number of Port Jackson figs, may also provide food for the grey-headed flying-fox.

Scratch marks observed on several redgums in King George Park suggests use by arboreal mammals, most likely the common brush-tailed possum. The dense swamp oak canopy in some areas may also provide habitat for this species.

There are no hollow-bearing trees or large woody debris in the study area, and rocks are rare. The absence of these features suggests there is little available habitat for ground-dwelling mammals or reptiles, though leaf litter may provide some habitat for common reptiles such as gardens skinks.

Within the central median strip on Victoria Road between Evans Street and Darling Street at Rozelle, there are 23 Washington palms (*Washingtonia robusta*). These palms range in height from two to three metres and are estimated to be 10-15 years old. They are in good condition.

One Moreton Bay fig tree (*Ficus Macrophylla*) stands adjacent to The Cove at Drummoyne café at the western end of the existing bridge. The fig tree is around 70-80 years old, and is in good condition with a canopy spread of about 20 metres.

Aquatic and riparian environment

Aquatic ecological assessments were conducted in mid-2007 and early 2008 to inform preliminary investigations into the project, the latter as part of this environmental assessment.

The 2007 study found that the riparian slopes along the constructed foreshores of Iron Cove support a variety of native and introduced terrestrial plants. No intertidal saltmarsh plants or stands, mangrove stands, sea grasses or rock reefs were identified within, or in the vicinity of, the study area. The 2008 study found that the mangrove stands and saltmarsh patches nearest to the project area are in Sisters Bay, Drummoyne. There are no mangroves or saltmarsh patches on the Rozelle side of the cove.

The rocky shores were observed to have limited flora and fauna species diversity and abundance. There is a thin band of *Sargassum* algae in the shallow intertidal zone along the rocky shore under and on either side of the existing bridge, and several frondose algae species on the shallow wetted surfaces of concrete and wooden structures.

The 2008 study found that the nearest sub-tidal seagrass beds are upstream from the project, along the northern side of Sisters Bay and along the western and northern side of Callan Point. The seagrass beds comprise *Zostera capricorni* and *Halophilia sp* (paddle weed), with *Zostera capricorni* dominant. No seagrass beds were present in the area directly affected by the project.

The noxious marine vegetation *Caulerpra taxifolia* was not found during surveys for the project. The study concluded that this species is not present in the immediate project area or between the project area and Sisters Bay on the Drummoyne side of Iron Cove, or Callan Point on the Rozelle side.

There are three main types of intertidal and shallow sub-tidal aquatic habitat in and adjacent to the area directly affected by project:

- Basement rock or rock rubble habitat.
- Constructed hard substratum habitat.
- Unvegetated soft sediments.

There is no rocky reef in the study area, with the closest extending from Callan Point.

Aquatic biota known to occur in the area includes algae, fish, encrusting fauna and burrowing fauna. All species are common to the Sydney estuary. There are known habitats for the native water rat (*Hydromys chrysogaster*) upstream of Iron Cove Bridge and the riparian zone of the study area may provide a link to other habitats for this species. The taxa found in sediment samples taken from the cove are also common in mid-estuarine habitats in the Sydney estuary.

No species listed as vulnerable under Schedule 5 of the *Fisheries Management Act 1994* or declared as a noxious species under the same Act were identified in either study. No suitable habitats to support species listed under the *Fisheries Management Act 1994* or EPBC Act was observed.

The Sydney Regional Environment Plan (Sydney Harbour Catchment) 2005 identifies an environmental protection zone corresponding to a wetland protection area in Iron Cove. The environmental protection zone is more than 100 metres from the site of the proposed bridge, to the west along the Drummoyne foreshore. (Wetland protection areas comprise wetland habitats, including mangroves, seagrasses, saltmarshes, sedgelands, wet meadows and mudflats, and a 40-metre buffer zone to address movement, growth and seasonal variation.)

7.4.2 Assessment of potential impacts

Construction impacts — terrestrial ecology

Road works, including removal of the median, pavement milling and re-sheeting, installation of traffic signals, and other discrete activities, would be confined to the existing Victoria Road footprint. These areas have minimal planted vegetation. The replacement of the existing median would require the removal of the 23 Washington palms in Rozelle. The trees would be relocated to an appropriate location in consultation with an arboriculture specialist and council representative. Minor removal of other kerbside or median vegetation may also be required.

Compound sites discussed in Section 4.4.6 would not require any vegetation to be cleared. Minor pruning may be required to allow access and placement of equipment or staff facilities within the site.

Construction works associated with the bridge approaches, including the establishment of the construction sites, piling, erection of piers and tying-in of the proposed bridge to Victoria Road, would require some vegetation clearing. Clearing in Drummoyne would be minor as the construction footprint is located largely in existing car parks and previously disturbed areas. Additional clearing would be required on the Rozelle foreshore to accommodate the proposed bridge, pedestrian facilities and a temporary construction compound. Grass, landscaped gardens and trees would be removed or relocated. The impact on biodiversity would be negligible and no threatened species or ecological communities would be affected by this clearing.

An arboriculture impact assessment was carried out for the fig tree located near Drummoyne Swim Centre. About 15 per cent of the tree's canopy would need to be pruned along the alignment of the proposed new bridge, altering the appearance of the canopy slightly along the side closest to the bridge. This is unlikely to affect the life of the tree.

Construction impacts — aquatic ecology

During construction, largely associated with the proposed bridge, there would be potential for direct and indirect impacts on the aquatic ecology of Iron Cove. Potential direct effects would include:

- The loss or temporary alienation of riparian, intertidal and shallow subtidal rock rubble foreshore habitats, due totemporary reclamation on the Rozelle foreshore and bridge works.
- The direct loss of benthic organisms, due to sediments within and immediately adjacent to piling areas.
- The introduction of additional hard surface habitat available for colonisation by epibiota.

Potential indirect effects would include:

- Smothering of rocky reef habitats by uncontrolled spills, placed materials, or by uncontrolled sediment-laden stormwater runoff.
- Release of contaminants from sediments to the water column during piling activities.
- Smothering of adjacent aquatic habitats by the displacement and settlement of fine sediments.
- Accumulation of materials (such as concrete and formwork) on the seabed, which could be unintentionally discarded during construction of the bridge.
- Disturbance of sediment from the use of vessels in shallow waters.

Temporary reclamation along the foreshore of Iron Cove in Rozelle would impact the riparian biota. The area of riparian biota affected would be minor given the limited habitat value and limited extent of vegetation in these areas.

In addition, in-water construction activities, including piling and pier construction, may temporarily impact aquatic habitats and species in Iron Cove, including algae, molluscs, crustaceans and other encrusting and burrowing fauna. While site preparation and piling works on the bed of the cove may result in the direct loss of benthic organisms, the impact would be minor and short-term. This aquatic community is considered to be well represented within the estuary and it is anticipated that the biota would readily colonise the disturbed areas following construction. At no time during construction would fish passage below Iron Cove Bridge be blocked.

Given that the sediments of Iron Cove are known to contain contaminants, the disturbance of these contaminants during piling activities may affect aquatic organisms. Contamination impacts are addressed in detail in Section 6.2.

Operational impacts

Impacts during the operation of the proposed bridge would include a potential overall loss of marine algae due to shading by the proposed bridge. This loss is not considered to be a threat to the viability of any known aquatic species or communities given the common occurrence of the algae present. It may also be offset to some degree by the provision of additional hard substratum habitat on the support structures of the proposed bridge.

7.4.3 Mitigation and management measures

Mitigation and management measures are presented in Table 7-6. These measures are incorporated in a draft statement of commitments in Chapter 9.

Table 7–6 **Biodiversity mitigation and management measures**

Potential impacts	Mitigation and management measures
Construction	
Clearing, removal and relocation of vegetation	Revegetation and landscape planting will be undertaken on the foreshore of Iron Cove to integrate new infrastructure and to maintain and enhance habitat availability/connectivity. Preference will be for the use of locally indigenous species in plantings. Revegetation and landscaping activities will be undertaken progressively where possible.
	Vegetation to be retained immediately adjacent to construction works (including but not limited to work sites, access roads and compounds) will be protected from damage through the use of barriers or other forms of suitable delineation. Areas to be protected will be documented on construction plans.
	The Washington palm trees in the Rozelle median, and any other suitable vegetation, will be relocated in consultation with relevant landowners and stakeholders.
Spread of noxious weeds	Weeds will be removed or treated in areas to be disturbed by the project prior to the commencement of works. Weeds will then be managed throughout construction to prevent further spread or re-establishment.
Loss of aquatic biota and habitat	Opportunities for rehabilitation and enhancement of the in-water areas directly affected by the project will be investigated during detailed design (and in consultation with NSW Maritime Authority to ensure no navigation hazard is created).
Increased shading over Iron Cove	Surface treatments of the bridge piers will be considered during detailed design to encourage algae and encrusting biota, subject to applicable design durability and maintenance requirements.

Potential impacts	Mitigation and management measures
Impact on fig tree near Drummoyne Swim Centre	A project arborist will be engaged prior to and for the duration of the project to document, advise and monitor the management of the fig tree. The arborist's involvement will include, but not be limited to: • Preparing a tree management plan. • Establishing a tree protection zone (TPZ). • Undertaking approved canopy pruning. • Monitoring and providing advice regarding works within the TPZ. • Establishing a monitoring and management program following construction.
Operation	
Landscaping and revegetation	Landscaping will be monitored and maintained until it is established and self-supporting.
	The fig tree near Drummoyne Swim Centre will be monitored and maintained in accordance with an established program to encourage ongoing good health and to minimise interference with the new bridge.

7.5 Aboriginal heritage

7.5.1 The existing environment

The traditional owners of the area are the Cadigal (or Gadigal) whose land stretches from South Head to Petersham south of Parramatta River. Typical physical evidence of Aboriginal occupation in the Sydney region includes stone tools, rock engravings, midden deposits, scarred trees and sharpening/grinding grooves. The study area has been heavily affected by urban development including industry, roads, residential and other urban infrastructure. This has severely impacted Aboriginal sites that would have previously been located in this area.

A search of the DECC Aboriginal Heritage Information Management System (AHIMS) for the local area with a one kilometre buffer was requested by the RTA for the environmental assessment. The results identified 11 Aboriginal objects/sites as occurring in or near the search area, but no known declared Aboriginal places in the study area. The objects/sites in the search area include middens, shelters and rock engravings. None of these are located within or immediately adjacent to the study area.

A search of the National Native Title Tribunal database was also undertaken as part of the environmental assessment to identify any claims that may be active in or adjacent to the study area. The search revealed that there is one currently active native title claim which has been lodged by the Darug Tribal Aboriginal Corporation (DTAC) and relates to a number of localities across the Sydney region. The claim does not specifically identify any items or locations within the project corridor or within a 500 metre buffer of the corridor.

During January 2008, an Aboriginal site survey of the study area was carried out by a representative of the Metropolitan Local Aboriginal Land Council (Metropolitan LALC) and the RTA's Aboriginal Cultural and Heritage Advisor (ACHA) in order to identify any Aboriginal heritage constraints to the project. The survey was carried out by foot. No Aboriginal objects or places were found within the study area. The Metropolitan LALC has indicated that they have no objections to the project and confirmed that no Aboriginal cultural heritage constraints exist.

7.5.2 Assessment of potential impacts

No known Aboriginal objects or places would be directly or indirectly affected by the project or the ancillary construction activities. The project through Drummoyne and Rozelle would be limited to the existing road footprint. These areas have been heavily modified on the surface and at depth through successive construction and reconstruction activities associated with the development of Victoria Road.

Similarly, Iron Cove and the adjacent foreshores have been substantially altered through road construction and industrial development. The area to the west of the existing bridge was the route of a previous crossing of Iron Cove. The area has been subject to intrusive construction activities associated with this crossing undertaken during the early 1880s.

Supported by the results of the AHIMS search and the survey conducted by the Metropolitan LALC, it is considered that the likelihood of finding any unknown sites or objects within the study area is low. Notwithstanding this best practice measures would be adopted in the event of unexpected discovery during the construction activity (see Section 7.5.3).

There would be no operational impacts on items or artefacts of Aboriginal significance.

7.5.3 Mitigation and management measures

Mitigation and management measures are identified in Table 7-7. These measures are incorporated in a draft statement of commitments in Chapter 9.

Table 7–7 **Aboriginal heritage mitigation and management measures**

Potential impacts	Mitigation and management measures
Construction	
Potential discovery of items of Aboriginal cultural significance	All personnel working on site will be made aware of their legal obligations to protect Aboriginal cultural materials.
	In the event that any unknown Aboriginal objects or items are located during construction work, all work will cease in the vicinity of the find until specialist Aboriginal heritage advice is received.

7.6 Waste minimisation and management

Construction and maintenance of new and existing road infrastructure involve a range of activities. These include establishment of work sites, operation of site amenities, demolition and reconstruction of road surfaces and medians, bridge works, and decommissioning of work sites. These activities can produce a number of waste types such as:

- Concrete, asphalt and scrap metal from demolition works and surplus materials during construction.
- Excess spoil such as soil, rock and sediment, which can include acid sulfate soils (ASS) and other contaminated material.
- Temporary formwork.
- Green waste from clearing activities during site establishment.
- Waste fuels, oils, liquids and chemicals from machinery operation and maintenance.
- Miscellaneous packaging waste brought on site during deliveries or by workers, such as cardboard, paper, plastic and glass.
- General garbage and sewage from compound sites.

Waste generated during operation of a project is likely to be minimal and would be typical of that produced during routine maintenance activities. It is likely to include materials similar to those listed above for construction activities.

7.6.1 Mitigation and management measures

Waste management in NSW is regulated by a number of acts, including the *Protection of the Environment Operations Act 1997* and the *Waste Avoidance and Resource Recovery Act 2001*. The generation and management of waste during construction and operation of the project would be subject to the requirements of these acts, and other policy measures that encourage the efficient use of resources, avoid environmental harm, and provide for continual reduction in waste generation.

Waste minimisation measures are identified in Table 7-8. These measures are incorporated in a draft statement of commitments in Chapter 9.

Table 7–8 **Waste minimisation management measures**

Potential impacts	Mitigation and management measures
Construction	
Generation of waste	The waste hierarchy (avoidance, resource recovery, disposal) will be applied during construction. The way in which the waste hierarchy will be maximised will be documented and, where relevant to work activities, will be incorporated into work programs and site inductions.
	A quarterly record of all waste avoidance, resource recovery and disposal will be prepared and assessed to identify achievements and opportunities for improvement.
	Detailed design and product purchasing strategies will maximise the use of locally supplied products, where feasible, to minimise material transportation needs. Material requirements and suppliers will be identified during detailed design.
	There will be 100% recovery for re-use of waste classified as Virgin Excavated Natural Material (VENM).
	Where immediate re-use is not possible, spoil suitable for stockpiling will be stored, and the location, quality and quantity of spoil will be documented. Any additional environmental assessment or approval requirements for the stockpile will be undertaken as necessary.
	Secondary waste materials will be re-used on-site where reasonable and feasible.
	Where disposal is required, waste will be classified, handled, stored and disposed of in accordance with relevant guidelines.

7.7 Climate change and greenhouse gas emissions

7.7.1 Climate change

The term 'climate change' refers to change in the Earth's climate in modern times. According to the Intergovernmental Panel on Climate Change (IPCC), observational evidence shows that the warming of the Earth's climate system is unequivocal, with recorded increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global sea levels (IPCC, 2007).

Potential climate change impacts in Australia include:

- Increased frequency of extreme climate events such as heavy rains, droughts and floods.
- Decreases in rainfall in south-western Australia, south-eastern Australia and Queensland. Wetter conditions are possible in northern and eastern Australia in summer and inland Australia in autumn.
- More intense and sporadic rainfall (including from tropical cyclones). This would increase flooding and associated loss of life, property and productivity, and affect soil erosion and pollution of rivers and oceans.
- Likely increase in vulnerability to invasion by exotic species by increasing stress on established vegetation.

The Commonwealth and State Governments are establishing a number of mechanisms to reduce, control and monitor Australia's contribution to climate change. The RTA's response to greenhouse emissions will be guided by the following:

- Corporate greenhouse gas objectives — a corporate greenhouse gas reduction plan is being formulated to identify opportunities to reduce the RTA's energy use (electricity and fuel) and the use of high energy-intensity materials, including those used in road construction.
- NSW Government Energy Management Policy (GEMP) — this aims to reduce greenhouse gas emissions and provide significant energy cost savings for NSW Government agencies. The GEMP covers all energy use in NSW public sector agencies, including buildings, infrastructure, transport and motor vehicles, plant, equipment, goods and services.
- NSW Government Sustainability Policy — in May 2008, the NSW Government announced its plan for NSW government agencies to become 'carbon neutral' by 2020 as part of the NSW Sustainability Policy. 'Carbon neutrality' will likely include all RTA operations which were covered under the GEMP, including maintenance, street lighting and traffic signals operated by the RTA along the length of the proposed upgrade.

7.7.2 Potential impacts of climate change on the project

A number of predicted effects of climate change have been identified by the scientific community. Those relevant to the project are:

- Extreme temperature events, which could cause damage to transport infrastructure such as road pavements.
- Increased maintenance costs of infrastructure, as materials need to be replaced more often (possibly with more resilient products).
- Increased rainfall, which may exceed the capacity of the existing stormwater system, leading to flooding and associated damage to infrastructure and property.
- More intense rainfall, which may increase damage to infrastructure in areas vulnerable to severe erosion (such as the foreshore of Iron Cove).
- Rising sea level, which would increase the chance of coastal infrastructure inundation, and increase the risk of high salinity in some coastal areas, resulting in damage to infrastructure.

It is expected, however, that the project is unlikely to be severely affected by the effects of climate change. The bridge design is expected to be appropriate in the context of predicted environmental variations as a result of climate change. The bridge has been designed with regard to the temperature, water level and wind durability requirements of *AS5100.2 2004, Bridge Design: Part 2 Design Loads*. The height of the proposed bridge has been designed to maintain the existing bridge clearances.

7.7.3 Potential impacts of the project on climate change

A greenhouse gas (GHG) emission assessment was carried out to identify the emissions created by the construction and operation of the project, and thereby to determine the potential contribution of the project to climate change (Arup, 2008).

Emission boundaries

The separation of emissions into categories that are direct and indirect is fundamental to accepted GHG accounting standards. To distinguish between direct and indirect emission sources, the World Business Council for Sustainable Development and the World Resources Institute developed the categories for reporting GHG emissions from sources owned or controlled by an organisation. These categories are:

- Scope 1 — Direct GHG emissions.
- Scope 2 — Indirect GHG emissions associated with the production of electricity, steam or heat.
- Scope 3 — All other upstream and downstream GHG emissions.

Emissions that would be produced by the project are presented below.

Construction emissions

Scope 1 emissions produced by the project would result from fuel used by construction plant and equipment (such as a large crawler crane, piling rig, concrete pump, generators, air compressors, excavators and concrete trucks).

Scope 2 emissions would result from electricity used by lighting and appliances within site offices. The assessment assumed two main site offices equipped with computers, air conditioning, refrigeration, kitchen appliances, fluorescent lighting and security lighting, and three satellite offices equipped with refrigeration, kitchen appliances and fluorescent lighting. They would operate over a 24-month construction period.

Scope 3 emissions would result from:

- Embodied energy in materials, such as concrete, steel, asphalt, fill and aggregate. These were calculated using emission factors provided by the RTA's Carbon Estimation Tool for Road Construction Projects or the VicRoads Framework to Calculate Greenhouse Gas Emissions from Road Construction (where not provided in the RTA guideline).
- Waste-related emissions, which occur when organic matter contained in waste decomposes in a landfill and produces methane at the landfill site.
- Fuel used for transport to and from the project site. This was estimated based on the construction quantity estimates, the likely trip length, the number of loads and rate of fuel combustion of trucks. The source locations of the materials are not yet determined and therefore a distance of 30 kilometres was assumed as representative of the average distance for all material to and from site.
- Upstream emissions from fuel and electricity supply. For all uses of energy, there are a number of sources of upstream emissions associated with supply. (For transport fuels, these include emissions associated with extraction, production and transport of the specified fuel. For electricity use, these include both the emissions from the extraction, production and transport of fuels used in the production of the purchased electricity; and also emissions associated with the electricity lost in transmission and distribution on the way to the consumer.)

Estimations of the amount of fuel, electricity, materials, waste and transport as a result of the project were used to calculate the expected GHG emissions for the major project activities. Emissions were determined using National Greenhouse Accounts Factors (Department of Climate Change, 2008). A summary of predicted construction GHG emissions is presented in Table 7-9.

Table 7–9 **Summary of construction GHG emissions**

Scope	Source	GHG emissions (tCO_2e-)*
Scope 1	Construction and plant equipment	886
Scope 2	Electricity use on site	50
Scope 3	Embodied energy	17,927
	Waste	10,983
	Transport to and from project site	164
	Upstream fuel and electricity supply	86
Total		**30,096**

* Tonne of carbon dioxide equivalent.

Operational emissions

Scope 1 emissions during operation would be produced by fuel used by road maintenance plant and equipment. While road maintenance activities that constitute Scope 1 emissions would be the responsibility of the RTA, these emissions are considered to be very minor compared to the high traffic volumes. Furthermore, as a result of the upgrade, ongoing maintenance is anticipated to decrease compared to 'business as usual'. These emissions have therefore been excluded from estimates.

Scope 2 and 3 emissions during operation would be produced by lighting and signage. It is estimated that:

- The lighting system would increase Scope 2 emissions by 22.2 kilowatt hours per year (kWh/year), and Scope 3 emissions by 4.2 kWh/year.
- Traffic signals would reduce Scope 2 emissions by five kWh/year, and Scope 3 emissions by one kWh/year.
- Variable message signs and overhead signage structures would increase Scope 2 emissions by 95.9 kWh/year, and Scope 3 emissions by 18.3 kWh/year.

The methodology adopted for the assessment of Scope 3 operational traffic emissions was to first consider the emissions generated over one year for a passenger travelling the length of the upgrade citybound in the AM peak and outbound during the PM peak.

The analysis shows that the emissions per car passenger are much greater than per bus passenger. There is a difference between the AM and PM emissions per passenger for buses due to the higher bus occupancy rates reported for the AM services.

The analysis was used to determine the annual GHG emissions per passenger for the predicted journey speeds along the 3.5-kilometre route of the proposed upgrade, for both the existing situation and the reduced travel times following implementation of the project.

The results show that the greatest emissions savings are for both cars and buses in the AM peak periods. The results also show that greater emissions savings would be made where there is a resulting modal shift from car to bus. However, the number of actual passengers predicted to shift from car to bus for this journey is dependent on a number of external factors and is difficult to predict with any accuracy.

To quantify these emissions savings, the 'business as usual' (no project) situation was compared with the operation of the project on a per-passenger basis for three scenarios, as shown in Table 7-10.

Table 7–10 **Scenario emissions savings**

Scenario	Details	Emissions savings per annum* ($kgCO_{2e-}$)
Scenario 1	Passengers who currently travel by car inbound during the AM peak and outbound during the PM peak and would continue to travel this journey by car after implementation of the project.	39.4
Scenario 2	Passengers who currently travel by bus inbound during the AM peak and outbound during the PM peak and would continue to travel this journey by bus after the implementation of the project.	25.1
Scenario 3	Passengers who currently travel by car inbound during the AM peak and outbound during the PM peak and would switch to travel this journey by bus after the upgrade.	733.0

*Emissions were determined using National Greenhouse Accounts Factors (Department of Climate Change, 2008).

It is estimated that about 5800 people make the typical AM citybound/PM outbound journey by car and a further 4700 by bus. This implies a potential emission saving of 345 tonne of carbon dioxide (tCO_2e-) per year without any modal shift. This saving would offset the increased lighting emissions with residual emission savings of 212 tCO_2e- per year. These residual emission savings would give a payback period for the construction emissions of about 140 years.

To reduce the payback period, a modal shift is required. If 350 people were to change their journey from car to bus, this would result in a potential emission saving of 589 tCO_2e- per year. This saving would offset the increased lighting emissions with residual emission savings of 454 tCO_2e- per year. The residual emission savings reduce the payback period by 55 per cent to about 65 years.

This is a conservative estimate, as any modal shift would also likely reduce emissions outside of the project boundaries, as those travelling by bus would continue their journey beyond the 3.5 kilometre length of the upgrade and continue to reduce emissions relative to their original car journey. Should there be a more significant modal shift (that is, more than 350 people), the payback period would be further reduced from the 65 years predicted.

7.7.4 Mitigation and management measures

Mitigation and management measures are presented in Table 7-11. These measures are incorporated in a draft statement of commitments described in Chapter 9.

Table 7–11 **Potential impacts and mitigation measures**

Potential impacts	Mitigation and management measure
Construction	
GHG emissions released during construction	An assessment to identify energy-efficient equipment (that use fuel and electrical energy) will be undertaken during project development. Where practicable, equipment with high energy efficiencies will be used.
	Prior to working on-site, all personnel will be trained in energy- and fuel-efficient measures and work practices.
	Equipment will be maintained to retain optimum levels of energy efficiency.
	Where feasible, natural gas or biofuels (biodiesel, ethanol, or blends such as e10 and b80), will be used to reduce GHG emissions from construction plant and equipment.
	Waste generated during construction and demolition will be re-used and recycled wherever possible.
	Material will be sourced locally, where possible, to reduce transport related emissions.
	Recycled materials (eg fly ash to replace cement, recycled aggregate and recycled content in steel) will be used, where possible, to minimise the lifespan impact of GHG emissions in production. (This will be undertaken where feasible and reasonable, having regard to specifications, particularly 'design, construct, maintain' requirements.)

7.8 Hazards and risks

7.8.1 Potential hazards and risks

In the absence of adequate environmental and safety controls, a number of hazards and risks have the potential to pose a danger to site personnel, members of the public and the environment. These are presented below.

Construction risks

Hazards and risks with the potential to affect the environment throughout construction may include:

- Release of dangerous and hazardous materials to the receiving environment.
- Generation of construction waste.
- Increased sedimentation of receiving waters.
- Disturbance of contaminated soils and sediments.
- Maintenance of construction equipment and plant.
- Disturbance of potential acid sulfate soils, resulting in production of sulfuric acid.

Details of the risk of impacting the receiving environment are contained in Chapter 6 and the earlier sections of this chapter. The hazards and risks would be addressed through the implementation of standard and best practice mitigation measures which would minimise the potential for adverse impacts on the environment during the construction process.

Operational risks

Operational hazards and risks as a result of the project would include those common to urban roads. There would be potential for contaminants from the road, such as engine oil and litter, to adversely affect the receiving environment through stormwater flows. To minimise impacts, the proposed bridge would include gross pollutant traps, and an operational emergency response procedure would be implemented to reduce risks to the local environment.

Changed traffic conditions along Victoria Road may cause confusion for some drivers, especially those who are not regular users of the road. To minimise confusion, the project would be designed with consideration of the relevant design guidelines, and road users would be informed of the changes to road operations through signage and traffic signals, including tidal flow controls.

Personnel undertaking maintenance activities and operating the tidal flow system in Drummoyne would adhere to all safety requirements, minimising any risk to their safety and the public.

7.9 Cumulative impacts

Cumulative impacts are changes to the environment that result when the impacts of a project combine with other past, present and future actions to create combined or synergistic effects. These may be adverse or beneficial in nature and are often best addressed strategically at a state or regional level rather than on a project-by-project basis.

7.9.1 Approach to assessment

In considering the potential cumulative impacts associated with the Victoria Road upgrade, the following process was generally followed:

- Understand the impacts of the project in detail with a focus on key issues.
- Consider those other projects and initiatives with which there may be an interaction and resulting cumulative effect.
- Confine the consideration of cumulative impacts within sensible limits so as to maximise the relevance of the enquiry.

The potential impacts of the project have been assessed in detail. The results are documented in Chapter 6 and in the earlier sections of this chapter. The key issues have been confirmed as transport, contamination, noise and vibration, visual amenity and urban design, social and economic effects and heritage.

A range of other proposals have the potential to interact with the Victoria Road upgrade. These include development proposals and other transport initiatives. They are identified in Section 7.9.2.

Spatially, the consideration of cumulative impacts has generally been confined to the Drummoyne peninsula and the Balmain peninsula (including Rozelle). Temporally, the focus has been on interactions with those developments likely to occur at or around the same time as the Victoria Road upgrade. Interaction between the project and already existing development has generally been considered as part of the environmental assessment already documented.

7.9.2 Other proposals and initiatives

A number of proposals in the Drummoyne and Rozelle area are at varying stages of development. These include:

- Birkenhead Point shopping centre refurbishment, Drummoyne.
- Balmain Leagues Club (Tigers) redevelopment.
- Former Carrier site (Multiplex), Rozelle.
- Callan Park redevelopment, Rozelle.
- White Bay Power Station site redevelopment, Rozelle.
- Rozelle Railway Yards redevelopment, Rozelle.
- Martin Bright Steel site redevelopment, Rozelle.

Some of the above proposals are in preliminary stages of investigation while others have progressed to masterplanning and rezoning. The Birkenhead Point shopping centre refurbishment is currently underway.

In addition, the proposed North West Metro, between Rouse Hill and St James station, is a major transport initiative that has potential to interact with the project. It is proposed to be fully operational in 2017.

These proposals are discussed below.

7.9.3 Assessment of potential cumulative impacts

Traffic effect

The objective of the Victoria Road upgrade is to improve bus efficiency and reliability. Improvements in these areas would benefit surrounding land uses, including those identified for redevelopment, through the provision of a better transport service. The traffic effect that major land use changes may have on the project has been considered and is discussed in Section 6.1.

Other cumulative effects

The footprint of Victoria Road would not markedly change as a result of the project. In this context, cumulative impacts would be minimal.

Information about the potential environmental impacts associated with many of the redevelopment proposals identified in Section 7.9.2 is limited due to the preliminary nature of the developments. Notwithstanding, serious cumulative effects are not expected. Avoiding, minimising and mitigating environmental impacts has been a priority in the development of the Victoria Road upgrade and, as a result, potential impacts are not of a nature or scale that suggest a risk of cumulative effects.

Of the projects listed in Section 7.9.2, the Birkenhead Point shopping centre refurbishment is likely to occur concurrently with the construction of the project. There would be issues relating to the need to maintain access to the shopping centre for customers, deliveries and construction traffic, and potential cumulative effects on amenity associated with concurrent construction works. Discussions with the operators of the centre have commenced and will continue with a view to appropriately addressing these issues.

Sydney Link - North West Metro

The upgrading of Victoria Road and the North West Metro are together part of a long-term integrated strategy to address the transport challenges facing the Victoria Road corridor into the CBD as well as the transport needs of Sydney's rapidly growing North West sector. The Victoria Road project responds to a more immediate need for public transport improvements in the corridor and would operate for a number of years to service this area before the North West Metro is fully operational in 2017. These initiatives are therefore complementary from a transport perspective.

The development of the North West Metro proposal is in its preliminary stages and, as a result, details regarding potential environmental impacts are limited. The scale and nature of impacts associated with the project are not such that serious cumulative effects are likely to result.

Sydney Link - M4 Extension

The M4 Extension is in the preliminary stages of project development with a number of options under consideration.

The specific configuration of any eastward extension to the M4 would determine the extent to which it could influence traffic volumes on Victoria Road and the nature of the broader relationship to the Victoria Road project. Any changes in traffic volumes on Victoria Road resulting from an M4 Extension are not likely to adversely affect operation of the bus priority measures that are the centrepiece of the Victoria Road project.

The Victoria Road project responds to a more immediate need for bus priority improvement. With substantial completion in 2010, it would deliver benefits for several years prior to an M4 Extension becoming operational. It would also continue to serve an import bus priority function after that time.