13 Soils and contamination

This chapter addresses the likely impacts of the proposal that relate to soils and contamination, and acid sulfate soils. It specifically addresses the requirements of the Director General that the environmental assessment must include:

/ A detailed assessment of the potential impacts of the construction of the bridge piers on the disturbance of contaminated marine sediments in Homebush Bay and the connecting ramps on contaminated land in Rhodes and Wentworth Point. The assessment must take into account information from any previous investigations as well as any additional investigations as necessary and will need to include a thorough description of the methodology used in the assessment, and justification for the methodology used and predictions made.

/ Details of construction mitigation measures and any proposed remediation works required as a result of the project and justification for why the proposed remediation measures would succeed.

/ A site audit statement and a site audit report by an auditor accredited under the *Contaminated Land Management Act 1997*. Details of the assessment and recommendations of the investigations must be included.

/ Details of compliance with any order issued under the *Contaminated Land Management Act 1997*.

/ An assessment of acid sulfate soils, including management measures and disposal strategies in accordance with the *Acid Sulfate Soils Manual* (ASSMAC, 1998).

Golder Associates was commissioned by the proponent to investigate the chemical contamination of the existing environment within the bridge alignment, assess the potential impacts associated with the construction of the bridge and its approaches, and identify environmental management measures that would enable construction of the bridge in an environmentally responsible manner. This work involved desktop research and is documented in the report found in Appendix I. The Golder Associates report has been independently audited by Rod Harwood from Environmental Strategies. Rod Harwood is an auditor accredited under the *Contaminated Land Management Act 1997*. The audit statement and report are presented in Appendix J.

13.1 Existing environment

13.1.1 Appreciation of the level of contamination in Homebush Bay

The levels of dioxin and chlorinated compound contamination in Homebush Bay are amongst the highest identified in studies from around the world. The high level of contamination is the result of past industrial activities that commenced in the 1920's which included manufacturing of timber preservatives, paints, herbicides and pesticides.

Homebush Bay has been subject to numerous contamination investigations over the past 20 years.

Elevated dioxin concentrations (reported in units of picograms per gram, pg/g) have been reported in sediments at levels of up to 154,000 pg/g in sediments collected from 0-0.1 m depth, 380,000 pg/g in sediments collected from 0.4-0.5 m depth and 238,000 pg/g in sediments collected from 0.9-1.0 m depth. These concentrations exceed the US EPA Region 5 ecological screening level of 11.0 pg/g for polychlorinated dibenzo-p-dioxins and the Canadian Interim Sediment Quality Guidelines of 0.85 pg/g Toxic Equivalent and the Probable Effect Level (an indicator of contamination) of 21.5 pg/g Toxic Equivalent.

Surface sediment concentrations contours of dioxins (2,3,7,8-TCDD) are presented in Figure 13.1. The contours are based on sampling undertaken by URS in 2002 and EVS in 1998. Note that since the preparation of this contour map, the sediments along the eastern foreshore of the Bay adjacent to the former Union Carbide and Allied Feeds properties have been remediated (Refer to Section 13.1.3).

Organic contaminant analysis of the bay sediments have reported levels of dichlorodiphenyldichloroethylene (an organochlorine pesticide), exceeding the Interim Sediment Quality Guidelines 'high-guidelines' (Australian & New Zealand Environment & Conservation Council, 2000). Levels of naphthalene, phenanthrene and anthracene exceeded the Interim Sediment Quality Guidelines 'low-guidelines'. Elevated concentrations of furans (Polychlorinated dibenzofurans), heavy metals particularly copper, zinc and lead and polycyclic aromatic hydrocarbons (PAH) have been also reported.

Concentration of contaminants relevant to the bridge route alignment is discussed in Section 13.1.3.

A total ban on fishing has been in place in Homebush Bay since 1989 due to unacceptable risks posed by sediment contamination and subsequent bioaccumulation in edible species. A ban was also placed by the Department of Primary Industries on commercial fishing in Sydney Harbour in 2006 as a precautionary measure following the identification of elevated levels of dioxin in a number of species of fish and crustaceans.

The proposal acknowledges the highly contaminated conditions of Homebush Bay. A conservative methodology and environmental monitoring approach is proposed for the construction stage of the project. Specifically:

/ Maximum concentrations of contaminants identified during characterisation of the Bay sediment have been taken into account for the preparation of the bridge design and construction methodology.

/ The proposed construction methodology would minimise the disturbance of contaminated soils and sediments. The proposed methodology also avoids the production of contaminated material or hazardous waste from the Bay or foreshore areas.

/ The placement of piles in Homebush Bay (both remediated and unremediated sections of the Bay) would use driven piles as the preferred construction method for the foundations of the bridge. The driven piles construction method would minimise the disturbance of surficial sediments and prevent the generation of contaminated or hazardous waste material. The proposed construction methodology excludes dredging and bored piles, which have the potential to generate contaminated or hazardous waste.

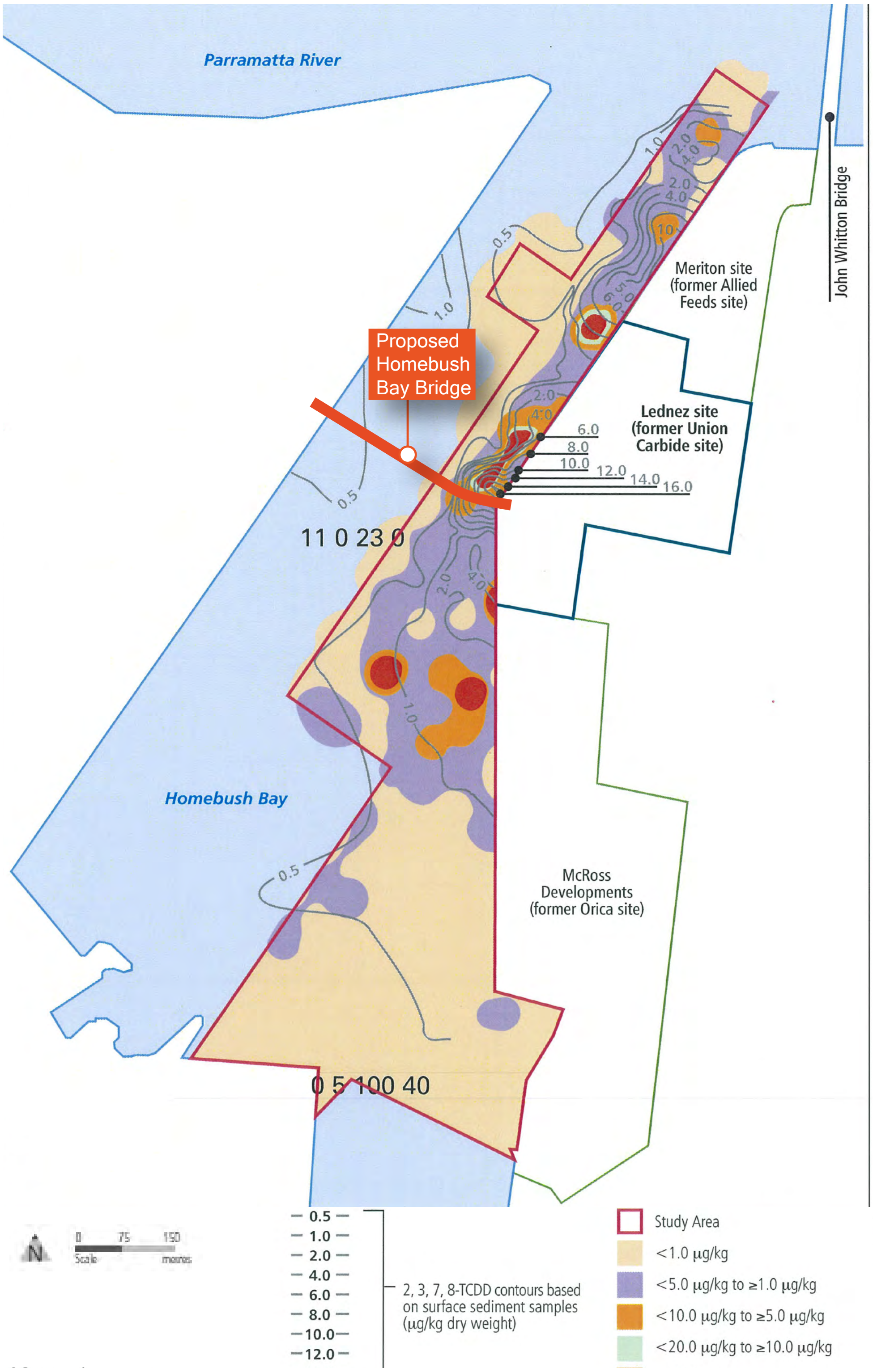

Figure 13.1 – Surface sediment concentration contours for dioxins in Homebush Bay reported by PB in 2002 (Source: Environmental Impact Statement Remediation of Lednez Site, Rhodes and Homebush Bay: Technical Paper 3 (PB, 2002))

- The placement of piles and other construction activities in the remediated area of Homebush Bay would maintain the integrity of the geotextile marker and capping layer.
- Turbidity containment devices (i.e. sediment curtains) would be placed around piling areas to minimise mobilisation of sediments and minimise the transportation of associated contaminants throughout the bay and Sydney Harbour.
- Land based construction activities would required shallow excavation to depth levels above the remediated capping layer. This would prevent the disturbance of contaminated soil located beneath the remediated capping layer.
- A construction environmental management plan which includes a monitoring and reporting system for contamination would be developed in consultation with OEH (EPA) and independently audited by an auditor accredited under the *Contaminated Land Management Act 1997*.

13.1.2 Existing conditions at Rhodes

Land Contamination Status

The remediation of the land occupied by the proposed bridge approach road at Rhodes was completed in 2011(former Lednez / Union Carbide site. Refer to Figure 13.2). Land remediation involved the removal and treatment of contaminated fill, soil and sediments from the land-based areas, and their replacement with non-contaminated fill material to provide isolation of the deeper contaminated soils.

Key steps of the remediation work involved:

- Reinstating the area within 3 m of Homebush Bay with imported virgin excavated natural material.
- Reinstating the area between 3 and 40 m of Homebush Bay with fill complying with the adopted reuse criteria, and capping with a 1 m layer of imported virgin excavated natural material.
- Reinstating the open space area further than 40 m from Homebush Bay with fill complying with the adopted reuse criteria for open space (conservative reuse criteria for less than 1 m deep and a less conservative criteria for 1-5 m deep).

The site audit statement prepared by Aecom (2011) for the remediation works indicates that:

- The land that would be occupied by the bridge approach road at Rhodes has been remediated to a standard suitable for use as open space foreshore.
- The land surrounding the proposed bridge approach has been remediated to a standard suitable for use as open space foreshore and parkland.

Acid sulfate soils

For the Rhodes landing area, the *1:25,000 Acid Sulfate Soil Risk Map*, Parramatta Sheet prepared by the NSW Department of Land and Water Conservation, indicates that there is a high probability that acid sulfate soils occur within 1 m of the ground surface at Rhodes.

However, the land occupied by the proposed bridge approach road at Rhodes has been excavated, assessed and/or treated prior to replacement as fill and covered with a 1 m layer of virgin excavated natural material as part of the Rhodes land remediation works. Therefore the probability of occurrence of acid sulfate soil material in the land occupied by the proposed bridge approach road at Rhodes is very low.

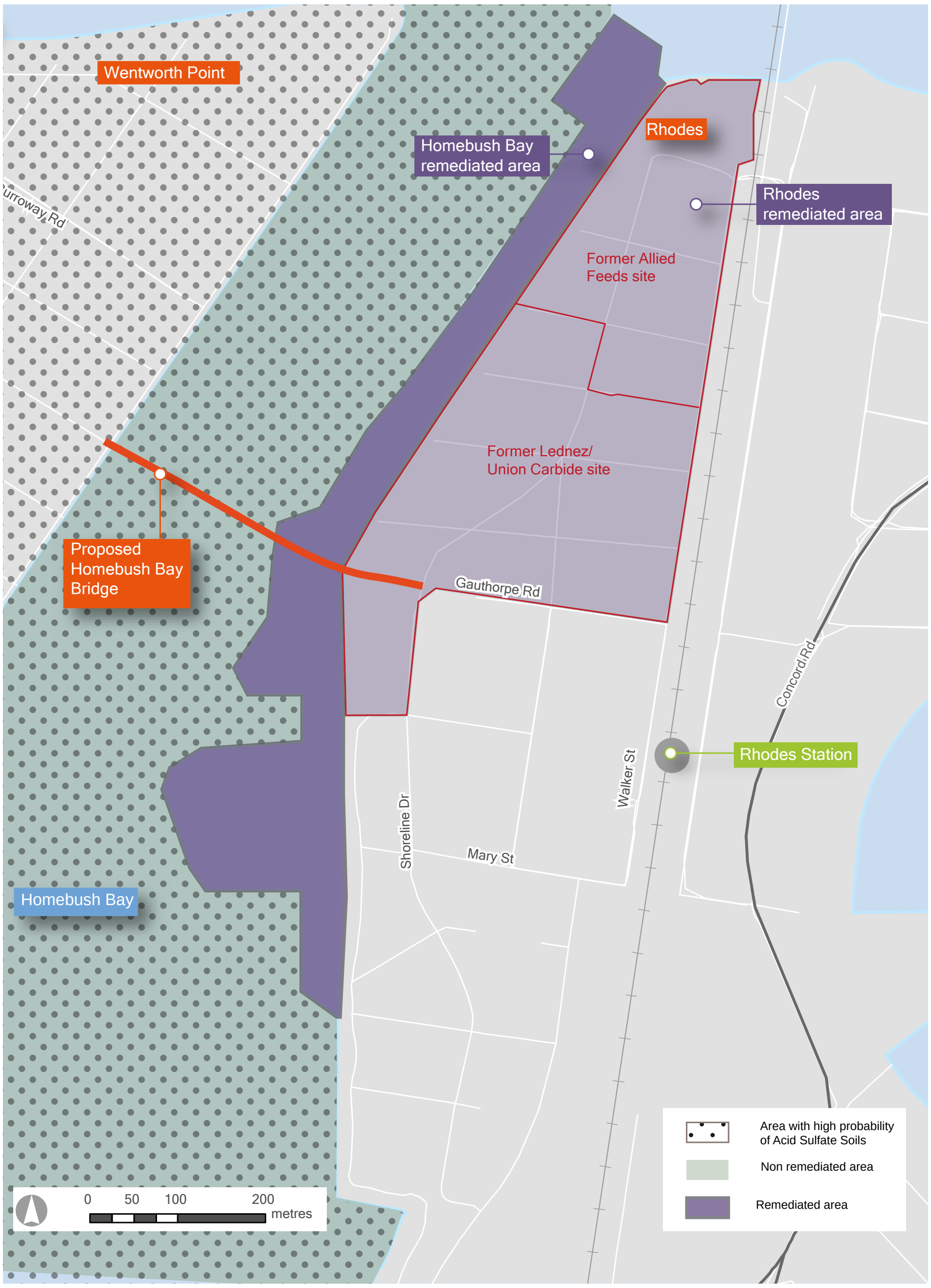

Figure 13.2 – Sediment remediation along the Rhodes foreshore

13.1.3 Existing conditions in Homebush Bay

Tidal conditions

Homebush Bay is a tidally-influenced estuarine environment, which is characterised by a deeper (up to 4 m) channel along the western margins that shoals to the eastern and north-eastern shores. Water depths near the eastern and north-eastern shores are generally less than 1 m.

Tides at Homebush Bay are semi-diurnal and asymmetric, with the tidal ranges varying significantly throughout each lunar month (spring-neap cycle) and from month to month. Very high and very low tides occur more frequently at solstices around Christmas and the mid-winter months. The spring high tide range varies from 1.8 m to 2.2 m.

Tidal currents cause a periodic flow into and out of the Bay, and coupled with turbulent mixing, this process effectively replaces the Bay water with adjacent main body estuarine water from the Parramatta River. The flushing time for Homebush Bay is estimated to be around three to four days.

Sediment quantity

Sedimentation deposition rates for Homebush Bay have been sourced from two studies, as presented in Table 13.1.

Table 13.1 – Sedimentation rates for Homebush Bay

Source	Average rate (mm per annum)	Notes
Proposed development of Homebush Bay – Sedimentation Study No 89/13 (AWACS, 1989)	25–30	For the whole bay
The source and remobilisation of contaminated sediment in Port Jackson, Australia. Unpublished PhD thesis (Taylor 2000)	6.8±1.5	For the eastern shoreline of Homebush Bay in proximity to the proposed Bridge

Sediment quality

Sediment quality investigations undertaken prior to remediation (Parametrix, 1996; EVS, 1998; and URS, 2002) are summarised in the *Environmental Impact Statement Remediation of Lednez Site, Rhodes and Homebush Bay* (PB, 2002). *The Homebush Bay Screening Level Risk Assessment report* (Parametrix and AWT Ensight, 1996) documents a screening level human health and ecological risk assessment of Homebush Bay sediments. Sediment sample locations relevant to the proposal are shown in Figure 13.3 and include locations 11, 12 and 13 and location 14 immediately downstream from the proposed bridge. Surface sediment at location 14 contained 690 micrograms per kilogram (µg/kg) of DDT and less than 0.64 µg/kg of 2,3,7,8-TCDD. It should be noted that a sample at location 9, also downstream, but not in proximity to the proposed bridge alignment, contained 1,180 µg/kg of DDT.

Subsequent sediment investigations were documented in *Detailed Human Health*

Surface sediment concentrations (ug/kg dry weight)	Sample locations relevant to the proposal			
	11	12	13	14
DDT	530	320	30	690
2,3,7,8 TCDD	65.5	0.33	0.03	<0.64

Figure 13.3 – Sediment collection locations from the Screening Level Risk Assessment study (Parametrix and AWT Ensight, 1996).

and Ecological Risk Assessment of Homebush Bay (EVS, 1988) and I*nvestigations of Dioxins in Homebush Bay Sediments, Final* (URS, 2002). The sampling was concentrated along the Rhodes seawall between the Lednez and Meriton sites, with lower sampling densities in the central, western and southern portions of northern Homebush Bay.

The results of the Homebush Bay sediment quality investigations indicated that contaminant concentrations generally decreased from the eastern shore to the western shore of the bay, and were typically higher in sediments at depths of 400-500 mm than in the surface (0-100 mm) sediments.

Acid sulfate soils

The *1:25,000 Acid Sulfate Soil Risk Map, Parramatta Sheet* prepared by the NSW Department of Land and Water Conservation, indicates that the estuarine bottom sediments in the bay have a high potential of acid sulfate soil risk.

Homebush Bay remediated area

The remediation of the eastern shore of the bay (where the approach bridge structure is proposed to be located) was completed in 2011. Sediment remediation involved the removal of sediments along the eastern foreshore of the bay adjacent to the former Lendez / Union Carbide and Allied Feeds sites. Contaminated sediments were excavated and classified and/or treated prior to placement at these sites.

Higher concentrations of contaminants in sediments have been isolated below the cap. The extent of sediment remediation is shown in Figure 13.2.

The seawall was reconstructed as part of the remediation works and a geofabirc marker layer was placed over the excavated surface prior the placement of backfill.

Samples collected by Thiess Services (the contractors who undertook the remediation) from the residual excavation surface were analysed for organic contaminants and metals. The results from the analysis were generally below the laboratory detection limits. However, it is noted that the laboratory detection limits for a number of analytes were orders of magnitude greater than the Interim Sediment Quality Guidelines 'low-guidelines' and 'high-guidelines' (Australian & New Zealand Environment & Conservation Council, 2000).

Homebush Bay Environmental Management Plan

An environmental management plan for Homebush Bay, commissioned by Roads and Maritime Services (formerly NSW Maritime) was being prepared at the time of issue of this environmental assessment. Roads and Maritime Services has advised the environmental management plan for Homebush Bay will take into account the Homebush Bay bridge proposal.

13.1.4 Existing conditions at Wentworth Point

The soils of the eastern shore consist of fill material (black sandy clay, shell and some gravel) underlain by soft, dark grey, estuarine clays. The land occupied by the bridge landing at Wentworth Point was extensively reclaimed by filling from the late 1940s.

Investigations indicate that in the area of the proposed bridge landing contamination issues are likely to be limited and localised. Remediation works involving the removal of underground storage tanks were identified at five areas on the western shore (Tankpit Validation and Additional Site Investigation, 1 Bennelong Road Homebush Bay NSW – ERM, 2003). One of the areas, area D, was located about 30 m from the location of the proposed bridge. Soil samples collected from area D as part of the site investigation works were reported to contain total petroleum hydrocarbons, benzene, toluene, ethylbenzene, xylene, inorganics and phenols concentrations which were less than the adopted site assessment guidelines (that is, the National Environment Protection (Assessment of Site Contamination) Measure Level 'D' guidelines).

The excavation of two trenches to the north of the proposed bridge landing did not indicate the potential presence of any underground storage tank or associated service lines.

Based on the excavation work, it is considered that the soils in this area were suitable for combined commercial / residential land use with minimal access to soil.

Acid sulfate soils

For the Wentworth point landing area, investigations undertaken by ERM (2004) and documented in the *1 Bennelong Road, Homebush Bay NSW, Ground Water and Acid Sulfate Soils Investigation report* indicated moderate to high potential acid sulfate soil capacity in material for depths of 1 m below ground level for Lot 121 and Lot 122 DP1156412.

13.2 Regulatory notices

A search of the contaminated land record of notices maintained by the NSW Office of Environment and Heritage was undertaken on 15th July 2011.

There is one current notice for the sediments in Homebush Bay, and eight current notices for land parcels comprising portions of the former Lendez/Union Carbide site (Rhodes).

The Environment Protection Agency (EPA within the NSW Office of Environment and Heritage) declared a portion of the bed of Homebush Bay a 'remediation site' pursuant to the *Contamination Land Management Act 1997* (notice 21001 issued 1 December 1998). The notice applies to an area of the bay adjacent to the former Lendez/Union Carbide and Allied Feeds sites in Rhodes. The EPA found that the area was contaminated with dioxin in such a way as to present a significant risk of harm to aquatic life in the vicinity of the remediation site and to humans eating aquatic biota from the bay.

Of the current notices for land parcels, four maintenance of remediation notices apply to land which may be associated with the proposed bridge (notice 28016 issued 14 January 2000; and notices 28016A, 28016B and 28016C issued 7 August 2008). The notices require the owner of the land to maintain remediation action on the land.

NSW Office of Environment and Heritage records also note that the contamination on the former Lendez/Union Carbide site and in Homebush Bay is being managed via the planning approval process under the *Environmental Planning and Assessment Act 1979*.

Copies of the current notices are presented in Appendix I.

13.3 Construction tasks that would involve disturbance of soils and sediments

The main construction tasks that would involve disturbance of soils and sediment, and have the potential for health and environmental impact, are presented below.

Note the proposed construction activities for the proposal would <u>not</u> involve excavation of contaminated sediments or material nor generation of hazardous waste.

13.3.1 Construction of marine piled structures for the main bridge (unremediated area of the Bay)

Four marine-piled structures would be constructed through the water column and sediments to bedrock, to support the cantilevered section of the bridge.

The marine piles would be installed from a barge or platform, and would involve driving precast piles and installing pile caps above the existing sediments. Each pile structure would have steel or concrete piles to be driven to the bedrock (Refer to engineering drawings S025 and S026 in Appendix C). Each pile would be either octagonal or circular in shape and would be between 0.5 m and 1 m in diameter. The number, shape and diameter of the piles will be finalised during the detailed design stage of the project.

Construction activities that would potentially impact the Bay sediments include:

- Activities from vessels (and their propeller wash) used for the placement of the sediment curtain, the piling operations and to monitor turbidity may locally resuspend ambient surficial sediments (sediments occurring on the seabed surface) into the water column.
- Driving piles through the sediment, which would displace and possibly resuspend surficial materials into the water column.

13.3.2 Construction of marine piled structures for the approach bridge (remediated area of the Bay)

The approach bridge would be launched incrementally from the Rhodes foreshore. No barges or boats would be required for the construction of this section of the bridge.

The approach bridge would be supported on piles spaced at a maximum of 4.5 m centres through the remediated area adjacent to the former Lendez/Union Carbide site to support the eastern end of the bridge. The piles would be octagonal in shape and with a diameter of 0.55 m (Refer to engineering drawing S012 in Appendix C).

The precast concrete piles would be driven through the water column, capping layer and sediments to bedrock. Driving piles through the sediment would displace and may resuspend material into the water column. Resuspended material would be virgin excavated natural material backfill. The piles are expected to perforate the geotextile marker layer without pulling it down or displacing it.

13.3.3 Land-based construction activities

The concept design includes about six precast driven piles for each bridge abutment. Piles for these would be driven through the layers of fill soil and underlying natural soil into bedrock. However the driven piles would disturb surficial soil only and would not generate spoil from below ground soil layers.

Minor earthworks would be also needed to create a level piling and work platform and involve placement of fill. Earthworks have the potential to generate spoil. Proposed land-based works on Rhodes (the former Lendez/Union Carbide sites) would include excavations to less than 1 m below the capped level, which would be limited to within the capping layer of virgin excavated natural material. The proposed land-based works on Wentworth Point would disturb surface material to a depth of about 0.4 m below existing ground level.

Other construction tasks that would involve potential disturbance of soils and sediment, and have the potential for health and environmental impact, would include:

- Excavating filled soils and natural soils landward of the two abutments and, if practical, re-using and compacting these materials in the same vicinity (engineered in-situ fill).
- Importing and compacting fill material over the engineered re-used/fill soils.
- Constructing drainage in the filled zones.
- Constructing abutment walls and retaining structures involving earthworks near the foreshores of Homebush Bay.
- Removing stockpiled waste soil (off-site disposal).

13.4 Impact assessment

13.4.1 Potential exposure pathways

This assessment has considered the potential exposure pathways resulting from construction activities described above for each receptor type (i.e. workers, pedestrians and marine ecology). These are shown in Table 13.2.

Table 13.2 – Exposure pathways considered

	Receptor		
	Workers	Pedestrians	Marine ecology
Human exposure pathway			
Incidental Ingestion of soil/sediment	✓	✗	Not applicable
Dermal Adsorption from soil/sediment	✓	✗	Not applicable
Inhalation of dust from soil	✓	✓	Not applicable
Inhalation of vapours	✗	✗	Not applicable
Ecological exposure pathway			
Dispersal of sediment and ingestion by marine species	Not applicable	Not applicable	✓
Leaching of contaminants to groundwater and waterways and ingestion by marine species.	Not applicable	Not applicable	✓

Pathways of contaminants to a receptor (including the associated routes of exposure) would not be completed (or would be significantly reduced) with the site management measures developed (See Section 13.5) to minimise dispersal of sediment and associated contaminants, prevent exposure of soil-bound contaminants to humans and minimise leaching of soil contaminants to groundwater and the receiving environment.

13.4.2 Homebush Bay

Assessment of impact from piling operations

Piling has the potential to disturb sediments. Some of these sediments may be contaminated sediments which may potentially come into contact with site workers and may affect ecological communities.

The disturbance of sediments would be minimised by using driving piles for the placement of piles in the Bay. The UK Environmental Agency (*Piling Into Contaminated Sites*, Environmental Agency 2002) notes this method places the pile by displacing material horizontally from the space to be occupied by the pile, without the removal of material to the ground surface. Based on previous experience in the Coode Island project (West Melbourne, Victoria), the predominant movement of sediments caused by driving piles would be down and sideways, with a low potential for sediments to migrate upward along the side of the pile. No dredging or use of bored piles would occur as part of the construction works.

The exposure of contaminated sediments would be prevented by the placement of an approximately 0.5 m cover of pea gravel or similar in the piling locations prior to the commencement of the works. The gravel would fill any capping voids occurring during the piling. The cover of pea gravel would be lowered into place and carefully released to minimise disturbance of the sediments near the piles.

Any sediments disturbed by the maritime based construction operations would be contained locally by a sediment control device comprising a boom and sediment curtain. The device would prevent suspended sediments dispersing throughout the Bay.

The vibration associated with the piling operations would potentially disturb sediments. However, disturbed sediments would be also contained locally by the sediment control device.

Water quality would be monitored during the maritime based construction operations and contingency response protocols would be set for the construction stage of the project as described in Section 13.5.

Assessment of impact from barges and vessels

A barge crane platform would be utilised for piling operations for the main bridge. Additional barges/vessels would be utilised to pump concrete, install/uninstall the sediment control device, take water quality monitoring measurements and other ancillary activities associated with the maritime based construction activities for the main bridge. As previously noted, no barges or vessels would be required for the construction of the approach bridge structure.

Barges and vessels used during the construction of the main bridge structure have the potential to disturb, intercept and expose contaminated sediments. Contaminated material remobilised (i.e. by propeller wash) may be potentially transported to other parts of the Bay, with potential for adverse effects on the ecology of the Bay.

It is proposed the maritime traffic occurs at higher tidal movements when feasible to minimise the potential for sediment disturbance.

Barge and vessel work sites would be surrounded by a sediment control device comprising a boom and sediment curtain. The device would prevent suspended sediments to disperse throughout the Bay.

Water quality would be monitored during piling operations and contingency response protocols would be set for the construction stage of the project as described in Section 13.6.

13.4.3 Rhodes and Wentworth Point

Assessment of land-based construction works

Land-based construction works at Rhodes and Wentworth Point have the potential to intercept and expose acid sulfate soil material and contaminated soil material. However, it is considered that there is a low probability disturbance because:

- The proposed construction works at Rhodes would have excavation limited to a depth of less than 1 m below the existing cap level. The original material in the area of the bridge landing on the former Lednez site has been excavated, assessed and/or treated prior to replacement as fill and covering with 1 m of imported virgin excavated natural material. It is considered that there is a low probability of acid sulfate soil material and contaminated soil material being disturbed by land based excavations at Rhodes.
- At Wentworth Point, proposed excavations include surface works to a maximum depth of 0.4 m below existing ground level. Based on previous investigation results summarised in Section 13.1.4, acid sulfate soils would not be disturbed by the surface works.

Notwithstanding the low likelihood of intercepting or exposing acid sulfate soil material, appropriate mitigation measures related to acid sulfate soil would be in place as described in Section 13.6.

Acid sulfate soils also have the potential to damage the bridge foundations and underground structures. However, corrosion inhibitors would be used in the concrete mix for the bridge to prevent acid sulfate soils corrosion and, in general, corrosion from other agents.

Fuel storage

Fuel may be stored at the construction sites. Fuel is likely to be stored in above ground storage tanks. Details on the type of tank, location and amount of fuel to be stored would be decided by the construction contractor. The storage capacity of any tank would be about 10,000-15,000 litres. This estimation is conservative and based on the duration of the construction works and the plant and equipment to be used on site (Refer to Section 4.8.9).

Fuels would be stored in appropriate containers with secondary containment. Details of fuel storage would be provided in a site specific construction environmental management plan prepared for the construction stage of the project.

13.5 Proposed monitoring system

This section describes the approach and principles of the monitoring system that would be in place for the water-based construction activities for the Homebush bay bridge. The detailed monitoring system will be prepared after the completion of the detailed design by the construction contractor and documented in the construction environmental management plan.

The monitoring system would comprise of three main elements:

- Visual inspections.
- Turbidity monitoring.
- Contaminants monitoring.

Visual inspections

Sediment control curtains would be inspected prior to piling commencing each working day. Defects or faults in the curtains would be repaired prior to works commencing.

Excess visual turbidity will be recorded during the turbidity monitoring operations as described in the following section.

Turbidity monitoring

Turbidity would be monitored during working hours while the piling occurs and during other construction activities with potential to resuspend sediments within Homebush Bay.

Turbidity will be measured regularly and at high frequency using a portable turbidity meter (a submersible data logger device to measure suspended particles in the water at several depths).

Adverse environmental effects are not anticipated from ephemeral, fugitive turbidity events. However, turbidity is considered to indicate the potential for contaminant dispersion based on the close affiliation between the identified chemicals of concern and sediment particle material.

Attention should be paid to the potential for anomalous turbidity readings caused by the probe fouling following contact with seabed sediments.

Measurements would be performed at 15-minute intervals at locations inside the sediment curtain and upstream and downstream of the sediment curtain (and appropriate locations as required) when piling takes place. Appropriately qualified personnel performing the measures would note the turbidity levels and record other observations including the presence of oil sheens, odours and excess visual turbidity.

Piling operations would cease if the turbidity of the water inside the sediment control device and outside the sediment control device downstream of piling operations is markedly lower than the turbidity of water upstream of the sediment control device. The cause/source of suspended sediment release (eg. faulty sediment control curtains) would be determined and rectified before piling operations recommence.

Based on the measurement results, corrective and contingency actions such as the installation of additional sediment controls may be used to manage identified releases of suspended sediments.

A tiered response, based on a three-level trigger system is proposed to address sediment releases outside the silt curtain as illustrated in Figure 13.4. The tiered response and trigger levels would be set up by the construction contractor and documented in the construction environmental management plan.

The tiered response system including monitoring locations and depths, background control locations, and actions to be taken at nominated turbidity levels above background, are to be detailed in the site specific environmental management plan prepared for the construction stage of the project once the construction methodology has been finalised. The monitoring protocols will be agreed with OEH and will be consistent with the Homebush Bay EMP being prepared for RMS.

Monitoring reports would be prepared on a weekly basis by the construction contractor. The report would include:

/ Tabulated turbidity measures.
/ Observations made during piling activities (e.g. presence of oil sheens, odours, and excessive turbidity).
/ Photographic record of site activities.
/ Record of piling activities.
/ Results of any additional chemical or physical analyses performed.

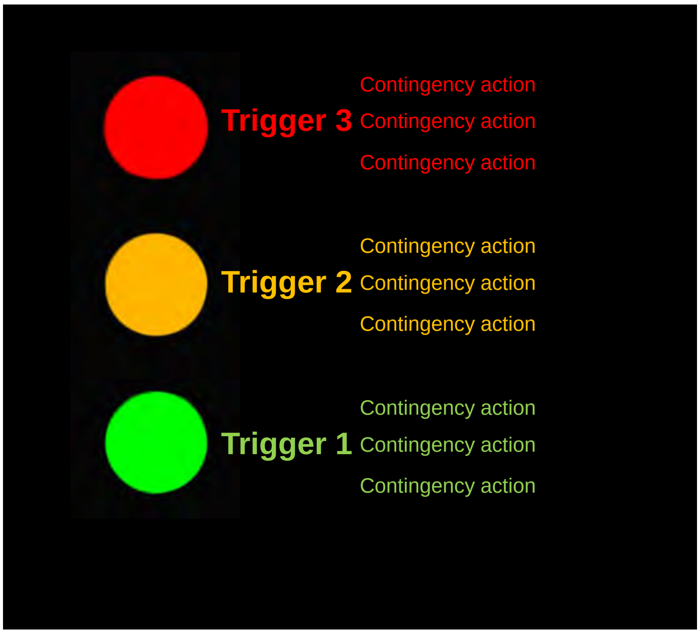

Figure 13.4 – Proposed tiered response for turbidity monitoring

Contaminants monitoring

The monitoring of contaminants of concern in the water column would be performed using semi-permeable membrane devices, or alternative devices during the construction works. The semi-permeable membrane device measures time-average concentrations of contaminants of concern during the deployment period which is typically 28 days. This monitoring would provide analytical data to complement the turbidity measurements (a proxy for contaminant measurements during day to day operations). Semi-permeable membrane devices would be used to assess the potential for concentrations of contaminants of concern (specifically dioxins) in the Bay.

The devices would be placed in the vicinity of the works area and at control locations in the Bay to assess the potential for the bridge maritime construction activities to alter concentrations of contaminants of concern in Homebush bay waters.

Contaminants monitoring protocols would be agreed with EPA.

Communications protocol

The construction contractor would set up monitoring and reporting responsibilities, authority, communication chain and protocols for the monitoring and reporting regime discussed in this section. Such details would be included in the construction environmental management plan for the bridge.

13.6 Mitigation and management measures

The measures proposed to mitigate and manage potential impacts from constructing the bridge are described in this section. These measures would require refinement in association with the finalised construction works plans. The proposed measures would aim to:

- Minimise dispersal of sediment and associated contaminants.
- Prevent exposure of soil-bound contaminants to humans.
- Minimise leaching of soil contaminants to groundwater and the receiving environment.

It is considered that with the implementation of the proposed measures, the pathways of contaminants to a receptor (including the associated routes of exposure) would not be completed or would be significantly reduced.

Management plans

A contamination management plan and acid sulfate soil management plan would be prepared and implemented for the construction stage. These would form part of the construction environmental management plan. The plans would include the mitigation measures listed in this section as well as additional measures as appropriate. They would have regard to the comments and recommendations outlined in the Site Audit Report (Appendix J). The plans would be prepared in consultation with OEH (EPA) and would be independently audited by an auditor accredited under the *Contaminated Land Management Act 1997* prior to commencement of construction works.

The acid sulfate soil management plan would be prepared in accordance with the *NSW Acid Sulfate Soil Manual* (Acid Sulfate Soils Management Advisory Committee 1998).

The contamination management plan would be endorsed by EPA before the commencement of the maritime based construction works.

Monitoring and reporting

A detailed monitoring and reporting plan for the maritime based construction works would be prepared and documented in the construction environmental management plan. The monitoring and reporting plan would be based on the monitoring system principles discussed in this chapter.

The monitoring and reporting plan would be also prepared in consultation with OEH (EPA). The plan would need to be endorsed by EPA before the commencement of the maritime based construction works.

Piling

- No dredging or use of bored piles is proposed in areas subject to Notices under the *Contaminated Land Management Act 1997*.
- Place a cover of pea gravel or similar, about 0.5 m deep, in the piling locations prior to work commencing. The gravel would fill capping voids if they occurred. The gravel should be lowered into place and carefully released to minimise disturbance of the sediments near the piles.
- A sediment control device (comprising a boom and sediment curtain) would be installed around barge works sites for over-water pile installation for the main bridge. The curtain would be the full depth of the bay (i.e. from the surface of the water to the sediment of the bay).
- The sediment control device would be installed, as much as practicable, during high-tide periods from a boat, thereby minimising any disturbance to the existing sediments. The device would be designed to rise and fall with the tide to prevent sediments disturbed during the maritime based construction operations dispersing in Homebush Bay.
- The sediment control device would be inspected prior to commencement of each working day, following storm events, daily on ebbing tides, and prior to recommencement of work following rainfall of more than 15 mm.
- At the end of the maritime based construction works, the sediment control device would be decommissioned by boat during high-tide periods to minimise disturbance to surrounding sediments.
- Prior to removing the sediment control device, the site would be inspected to verify (using visual and field instrument verification) that sediment has settled, resulting in similar water turbidity to that outside the curtain. Details of this activity are to be provided in a site-specific environmental management plan prepared for the construction stage of the project (This measure is not required once pile installation is complete, and construction activities commence for pile caps and piers above seabed level).

Land-based excavations

- Although the exposure of acid sulfate soils is unlikely, an acid sulfate soils management plan would be prepared for the construction stage of the project in accordance with the Acid Sulfate Soils Manual.

Contaminated material retained on-site

- In the event of encountering contaminated soil material in the Wentworth Point foreshore, it would be managed by placement at depth, with appropriate capping by imported ‘clean fill’ and pavement.
- Future excavations within the site (e.g. for underground services), would be managed under a long-term environmental management plan prepared for

the area, indicating the location of contaminated materials, and management processes for works in such areas.

- Details of the above management measures would be provided in a site-specific construction environmental management plan prepared for the construction and operational stage of the project.

Fuels storage

- Stored fuels would be placed in appropriate containers with secondary containment. Details of this activity would be provided in the proposal's construction environmental management plan prepared for the construction stage of the bridge.

Removed road materials

- Coal tar bitumen may be disrupted during road resurfacing works. Milled or excavated pavement material would be classified prior to off-site disposal.

Importation of fill materials

- Imported fill material would be validated and assessed in accordance with NSW Office of Environment and Heritage requirements prior to importation onto the site. Details of this activity would be provided in a site-specific construction environmental management plan prepared for the construction stage of the project.

Contaminated stormwater

- Site stormwater drains would be protected with appropriate sediment control devices during construction and resurfacing works. Details of this activity would be provided in a site-specific environmental management plan prepared for the construction stage of the project. A detailed list of mitigation measures to manage construction impacts on surface waters is presented in chapter 14 (Surface water).

Exposure pathways

- Human and ecological exposure pathways would be reviewed during the preparation of the construction environmental management plan.

13.7 Audit statement and report

The site audit statement and site audit report prepared by Environmental Strategies are presented in Appendix J.

The auditor reviewed Golder Associates' assessment of potential contamination impacts (Appendix I). The auditor considered the reviewed documentation to be suitable to meet the Director General's requirements in relation to contamination. The auditor recommends that the following documents are prepared for before construction commences:

- Construction environmental management plan.
- Acid sulfate soil management plan.
- Contaminated land management plan.

The auditor also recommends that a final site audit report is prepared at completion of construction and before bridge opening to document the success of meeting relevant environmental management objectives that will be incorporated in the project's construction environmental management plan.

14 Surface water

This Chapter provides a description of the existing surface water conditions and surface water quality of the Homebush Bay and the Parramatta River and undetakes a desktop assessment of the potential impacts on this environment as a result of the proposal and how they can be managed. Specifically, it addresses the following Director General's requirements:

- An assessment of surface water impacts on Homebush Bay and the Parramatta River. The assessment must include details of the proposed stormwater management system and management measures for the containment of pollutants (during operations).
- An assessment of risk and mitigation measures from sewage and/or oil spills from infrastructure conduits (sewage and energy supply) located on the bridge structure.

Note the proposed bridge would not have any sewage pipelines, oil pipelines or oil in electrical conduits.

14.1 Existing environment

14.1.1 Hydrology and surface waters

The proposed bridge would cross Homebush Bay, which forms part of the Parramatta River and Sydney Harbour catchment. Homebush Bay comprises about 80 hectares of tidal estuarine embayment opening into the lower reaches of the Parramatta River (Parsons Brinckerhoff, 2002).

The Homebush Bay catchment is defined as the area which drains to Homebush Bay and its tributaries, including Powells Creek and Haslams Creek – which cover about 900 and 1,700 hectares of catchment area, respectively (McKeown & Associates, 1998 and Bewsher Consulting, 2003).

Natural runoff within Rhodes peninsula generally flows west into Homebush Bay. No defined streams are present within eastern landing point of the proposed bridge at Rhodes (Lot 310 DP 1163025). However, localised drainage lines are evident along Gauthorpe Street, which drains towards the bay. The overland flow from Gauthorpe Street drains along the road and into the existing stormwater easement before discharging into Homebush Bay.

Lot 122 DP 1156412, at Wentworth Point, is relatively flat. The elevations at the site are generally 1.8 to 2.3 ms AHD, with the site generally draining east towards Homebush Bay. Stormwater on this allotment drains through a number of pits and pipe networks along the roads, with larger storm events increasingly making use of overland flow routes along roads and Auburn City Council's stormwater easement.

14.1.2 Surface water quality

Surface water quality information from the Homebush Bay area has been sourced from Sydney Water's Receiving Water Quality of Sydney's Inland and Coastal Waterways Performance Assessment Monitoring Program for the years 2007–08 and is presented in Table 14.1. The data correspond to water sampling site No PJ00 located immediately upstream of the proposed bridge alignment.

Table 14.1 – Summary of water quality for Homebush Bay (Source: Sydney Water 2008).

Parameter	Dry weather (median)	Wet weather (median)
pH	7.9	7.3
Dissolved oxygen (mg/L)	6.7	6.3
Turbidity (NTU)	-	-
Total nitrogen (mg/L)	0.48	1.39
Oxidised nitrogen (mg/L)	0.04	0.61
Total phosphorus (mg/L)	0.058	0.154
Chlorophyll-a (µg/L)	7.8	-
Faecal coliform (cfu/100 mL)	11	27,250

Table 14.1 shows that surface water quality in Homebush Bay is affected by wet weather, either due to stormwater runoff from Rhodes, Wentworth Point and upstream areas or due to the input of pollutants from sewer overflows. Surface water quality during wet weather is considered poor when compared to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000*.

Auburn City Council, City of Canada Bay Council and SOPA implement a number of ongoing water quality management initiatives with the aim of improving the quality of the Parramatta River catchment waterways. Initiatives include the installation of pollution control devices such as gross pollutant traps, water quality monitoring programs, management plans (including water recycling and stormwater reuse programs), water-sensitive urban design projects, and planning and development controls. It is understood RMS (former NSW Maritime) is commencing the preparation of an environmental management plan for Homebush Bay. The plan will contribute to improve the water quality of the Bay.

In relation to stormwater planning and development controls, all works related to stormwater drainage design within the Homebush Bay area are required to be designed according to the follow standards:

/ *Auburn City Council: Homebush Bay West Development Control Plan 2004.*
/ *City of Canada Bay: Rhodes West – Development Control Plan 2011.*
/ *NSW Maritime Authority – Engineering Standards and Guidelines for Maritime Structures 2005*.

14.2 Proposed water management system

A stormwater concept plan for the proposal is presented in Appendix C. The plan shows that the proposed bridge starts at chainage 360 ms and finishes at chainage 720 ms. The bridge has a crest at chainage 459.4 ms, which divides the bridge into two catchment areas with about 0.29 hectares draining to Rhodes peninsula and 0.12 hectares draining to Wentworth Point.

The bridge water management system would comprise pits measuring 0.45 by 0.6 ms. These would be installed at 30 m intervals on the deck of the bridge, connecting to a 225 mm diameter PVC-U carrier pipe.

The proposed water management system is designed for the 20-year ARI storm event in accordance with *Auburn DCP 2010.*

A summary of the predicted flow rates form the Homebush Bay Bridge stormwater catchments is shown in Table 14.2. It shows that the velocity product for the 20-year and 100-year ARI storm events would be well below the 0.4 m^2/s specified in *Auburn DCP 2010* and therefore is considered to be acceptable for pedestrians and buses.

Table 14.2: Hydrology summary for HBB Catchment

Catchment	ARI year	Area m^2	Flow rate (ARI_Q) m^3/s
Catchment to Wentworth Point	20	1,177	0.03
Catchment to Rhodes	20	2,880	0.06
Catchment to Wentworth Point	100	1,177	0.04
Catchment to Rhodes	100	2,880	0.09

In addition, in accordance with *NSW Maritime Authority Engineering Guidelines*, gross pollutant traps would be installed at both landing areas at Wentworth Point and Rhodes West to filter out sediments and hydrocarbons from the bridge. These would then be discharged into the existing stormwater network. The gross pollutant traps would capture 90% of the gross pollutants and hydrocarbons.

There is potential for the existing Rhodes and Wentworth Point drainage network to be modified in the near future as a result of development occurring near the proposed bridge landing areas. The proponent would liaise with Auburn City Council and City of Canada Bay Council during the concept and detailed design stage to determine any changes to the existing stormwater arrangement.

14.3 Impact assessment

14.3.1 Construction impacts

Surface water

During construction, all surface runoff from the Rhodes and Wentworth Point work sites would drain to sediment basins and be treated before discharge into Homebush Bay.

Bridge construction would not cause any adverse flooding impacts in the bay and surrounding land uses as the stormwater captured on the deck of the bridge and work sites would drain directly back into the bay (as would be the case if no bridge were constructed). If the stormwater from the bridge were channelled into an existing pipeline system, it would be necessary to divert the flow from the existing pipe system into the bay as soon as practicable to minimise the time of concentration.

Stormwater detention would not be required for the bridge as it would be located at the catchment outlets and over the bay itself.

Water quality

Constructing the bridge and associated approaches would present a potential risk to the water quality in Homebush Bay and the Parramatta River. 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 if the sediments manage to drain into the stormwater pipe system and into the bay. Existing overland flow paths would also need to be diverted to prevent surface flows from draining directly into the bay.

Above-water work, involving the in-situ casting of bridge components and grouting, would present a potential risk of material falling into the bay. However, this would only represent a minor risk to water quality as in-situ casting works over water would have a suitable falsework and formwork systems in place to avoid material falling into the bay.

Water quality issues would be managed via a construction sediment and erosion control plan which would form part of the construction environmental management plan for the proposal. A preliminary construction sediment and erosion control plan is presented in Appendix C. This concept would be further refined during the preparation of the construction environmental management plan.

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 Homebush Bay and the Parramatta River. There is a low to moderate risk that liquids may enter the bay either through the local stormwater system or directly from over-water equipment. Risk of water pollution from accidental spills would be managed through the preparation and implementation of spill emergency procedures. These procedure would be prepared as part of the construction environmental management plan for the proposal.

14.3.2 Operational impacts

The proposed concept stormwater management system is presented in Appendix C. This concept would be further refined at the detailed design stage. The bridge would increase the amount of impervious surfaces in the area, and contribute additional contaminants to Homebush Bay. Potential pollution sources would include:

- Heavy metals and organics (such as hydrocarbons) arising from tyre wear, vehicle wear (such as brake linings), pavement wear, emissions, and accidental vehicle spills, all of which could reduce water quality in the bay.
- Litter and larger waste materials, which could deposit in the bay from the roadside environment.
- Fuel and accidental oil spills from vehicles. These could potentially contaminate the bay, but the impacts are likely to be localised, and the contaminated surface water would be diverted into gross pollutant traps and filtered before being discharged into the bay.

The proposed bridge would not have any sewage pipelines, oil pipelines or oil in electrical conduits. Therefore, there would not be risk of spills into the bay from such infrastructure.

Overall, the impacts of the bridge on surface water quality within the study area would be minimal due to the installation of gross pollutant traps at the outlet of the pipe networks – which would capture litter washed from the roadway and footpaths during rainfall events and maintain existing water quality in the bay – and the implementation of the mitigation measures listed below.

14.4 Mitigation measures

14.4.1 Construction stage

Potential impacts on surface waters and water quality would be managed as part of the Construction Environmental Management Plan for the project. It would include the following components.

Consultation

Auburn City Council and City of Canada Bay Council would be consulted to determine any changes to the existing stormwater arrangement as a result of the future development surrounding the bridge landing.

Sediment and erosion control

A sediment and erosion control plan would be prepared and implemented in accordance with the requirements of *Managing Urban Stormwater: Soils and Construction 4th Edition* (Landcom 2004). The plan would focus on the minimisation of erosion and prevention of sediment movement off-site during the bridge construction and resurfacing works. The various control measures likely to be used on the work sites would include:

- Staging activities to minimise land disturbance.
- Restricting vehicle access to designated and stabilised entry and exit points.
- Providing sediment basins, sediment fences, catch drains, check dams, straw bale filters and other structures to collect and treat dirty runoff from disturbed areas. All stormwater runoff from the deck of the bridge would be captured and drained into sediment basins at the Rhodes and Wentworth Point landing points.
- Diverting clean runoff from upstream areas around disturbed construction areas.
- Monitoring control measures – and, in particular, discharges from sediment basins – to ensure compliance with regulatory requirements.
- Temporarily stabilising stockpiles and disturbed areas not associated with the ongoing remediation operations.
- Stabilising and vegetating areas immediately following completion of the works.
- Providing vegetated buffer strips to isolate undisturbed, stable and rehabilitated areas from disturbed areas.
- Ensuring that stockpiles are stabilised and remain covered.

Erosion and sedimentation control measures would be implemented prior to the start of site preparation and construction activities to stabilise and contain exposed or unconsolidated surfaces.

Spill management

Procedures to respond to emergency spills during construction would be prepared and implemented to protect water quality in Homebush Bay. The procedures would detail measures to contain, clean up and dispose of materials that may have a detrimental effect on water quality. All construction personnel would be trained in their obligations with respect to any legal requirements and site procedures.

14.4.2 Operational stage

An operation plan for the bridge would be prepared. It would include environmental management procedures related to the operation of the bridge including:

- Operation and maintenance of gross pollutant traps and drainage system.
- Operational incident response during major spills.

Gross pollutant traps would be installed to treat bridge run-off and to contain oil spills during the operation of the bridge.

14.5 Conclusion

The management and mitigation measures outlined in this Chapter would ensure that the project – during both construction and operation – would have a minimal impact on surface water quality.

15 Noise and vibration

This Chapter provides a summary of the noise impact assessment prepared by Arup to accompany this environmental assessment (refer Appendix K). It addresses the Director General's requirement for an assessment of the construction and operational noise and vibration impacts of the project, in accordance with the *Interim Construction Noise Guideline* (DECC, 2009), *Environmental Criteria for Road Traffic Noise* (EPA, 1999) and *Assessing Vibration: A Technical Guideline* (DEC, 2006).

15.1 Existing noise environment

Currently, noise at Rhodes and Wentworth Point is from:

- Traffic.
- Industrial areas in Wentworth Point.
- Construction sites at Rhodes and Wentworth Point.

Noise-sensitive receivers near the proposed bridge include residential buildings and public open space (when in use). Currently, there are no noise-sensitive receivers near the bridge landing at Wentworth Point as the area is surrounded by industrial uses.

Noise monitoring was undertaken from Monday 28 February to Monday 7 March 2011 at the following locations:

- Location 1 – 138 Lancaster Avenue, Melrose Park.
- Location 2 – 9 Jean Wailes Avenue, Rhodes.
- Location 3 – 40 Walker Street, Rhodes.

To assess potential construction noise impacts, residential receivers that currently exist, and those that are in the process of being built, were grouped into four noise catchments as follows:

- Noise catchment 1 (NC1). Located at the southern end of Rhodes peninsula. It comprises various multi-storey residential buildings currently occupied and being built immediately to the east of the entry point to the proposed bridge and extending further south on the Rhodes peninsula side of the bay.
- Noise catchment 2 (NC2). Located in Meadowbank. Residential receivers are located about 1 km to the northwest of the proposed bridge, and have an unshielded view of it.
- Noise catchment 3 (NC3). Located in Melrose Park. Residential receivers are located about 850 ms to the northwest of the western end of the proposed bridge. Residences at this location have some acoustic shielding from intervening warehouse structures in the industrial development around Wentworth Point.
- Noise catchment 4 (NC4). Located at the southern end of Wentworth Point. It comprises various multi-storey residential buildings currently occupied and being built. These are located about 600 ms to the southwest of the bridge alignment, on the outskirts of the industrial complex.

Noise monitoring locations and noise catchment areas are shown in Figure 15.1.

Figure 15.1 – Noise-monitoring locations and noise catchment areas

Table 15.1 presents the measured ambient LAeq noise indices across time periods as defined in the *Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA, 1999) relevant to the assessment of operational road traffic noise.

Table 15.1 – Ambient LAeq noise monitoring results during ECRTN defined time periods

Logger location (Refer to Figure 15.1)		Road traffic noise indices			
		Daytime (7am–10pm)		Night-time (10pm–7am)	
		$L_{Aeq(15hour)}$	$L_{Aeq(1hour)}$	$L_{Aeq(9hour)}$	$L_{Aeq(1hour)}$
1	138 Lancaster Avenue, Melrose Park	57	59	58	61
2	9 Jean Wailes Avenue, Rhodes	52	55	52	55
3	40 Walker Street, Rhodes	63	n/a	58	n/a

The noise monitoring result presented in the table above shows that:

- There is little variation between the daytime and night-time periods.
- Higher noise levels at Rhodes are likely to be due to more traffic and construction and remediation works being undertaken at the time of the survey.
- Some sites have noise levels above LAeq,15hr 60 decibels for daytime hours, and LAeq,9hr 55 decibels for night-time hours. Sites experiencing levels above these are considered to be noise affected.

15.2 Assessment of potential impacts

The assessment of construction and operational noise and vibration impacts was conducted in accordance with the *Interim Construction Noise Guideline* (DECC, 2009), *Environmental Criteria for Road Traffic Noise* (EPA, 1999) and *Assessing Vibration: a Technical Guideline* (DEC, 2006).

On 1 July 2011, the NSW Office of Environment and Heritage introduced the *NSW Road Noise Policy* to supersede the *Environmental Criteria for Road Traffic Noise*. However, the new Road Noise Policy criteria do not pertain to the subject development as per the Director General's requirements.

15.2.1 Construction noise

Construction works noise

Construction noise management levels have been developed for the construction stage of the proposed bridge for each of the noise catchments as follows:

- NC1 and NC4: 54 dBA LAeq (15minute).
- NC2 and NC3: 50 dBA LAeq (15minute).

These levels have been developed in accordance to the *Interim Construction Noise Guideline* (DECC, 2009).

Construction source noise levels have been predicted using published construction equipment noise levels from the *AS 2436 (Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites 2010), BS 5228.1 (Code of Practice* *for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise 2009) and the UK Department of Environment Food and Rural Affairs construction noise database*. Noise spectra used as the basis of this assessment for plant and equipment construction items identified in Section 4.4 were measured at 10 ms from the source. Penalties for annoying characteristics such as impulsiveness and tonality have been applied during the assessment process as appropriate.

Noise levels from construction activities have been predicted for each noise catchment area identified in Figure 15.1. Calculations take into account include: source–receiver distance; the direction of the noise source; reflections of sound from nearby surfaces, including the ground; and atmospheric absorption of sound.

Predicted cumulative noise levels are presented in Table 15.2. Exceedances of noise management levels are highlighted in bold.

Table 15.2 – Predicted L_{Aeq} noise levels per construction stage

Construction activity	Predicted L_{Aeq} noise level (dBA)			
	NC1	NC2	NC3	NC4
Reference noise management levels	54	50	50	54
Excavation and site preparation	**56**	33	33	44
Piling, pile cap, and pier construction	**60**	42	42	**55**
Installation of superstructure	46	27	27	37
Road-finishing works	**58**	39	39	48
Site compound activities	**65**	n/a*	n/a*	42
Road works at Rhodes landing	**71**	n/a*	n/a*	n/a*

*Note: L_{Aeq} noise levels have been predicted to the nearest, worst affected receiver for each noise catchment (refer to Figure 15.1). In the case of noise generated from 'site compound activities' the noise-sensitive receivers immediately adjacent to these works (NC1: Rhodes and NC4: Wentworth Point) are the only receivers affected. In the case of noise generated from 'roadworks at Rhodes landing' the noise-sensitive receivers immediately adjacent to these works (NC1: Rhodes) are the only receivers affected. Predicted noise levels for other noise catchments were found to be insignificant due to distance and shielding and therefore have been omitted from the assessment.

The predicted noise levels shown in Table 15.2 would comply with the adopted reference noise management levels at noise catchments NC2 and NC3.

Predicted noise exceedances of up to 3 dB in noise catchments NC1 and NC4 are considered to be negligible as these increases are barely perceptible by humans.

Table 15.2 shows that noise management levels would be exceeded at Rhodes (noise catchment NC1) during piling, pile cap, pier, and road construction works.

It is proposed to manage these noise exceedances by keeping residents up to date with the proposed schedule of works and by implementing the mitigation measures listed in Section 15.3. With the implementation of these measures, noise exceedances from construction works are considered to be acceptable given the temporary nature of the impact.

Construction traffic noise

As noted in Section 4.4, Wentworth Point would be the main construction site and hence would have the majority of trucks and other construction related traffic.

It is estimated that a low number of construction vehicles would be generated on the Rhodes road network. A worst-case increase in existing road traffic along Hill Road is estimated to be in the order of up to 20% of daily traffic, with a potential increase in peak hour activity of up to 25%. A doubling of traffic flows is required to result in a 3 dB increase in existing road traffic noise. This also roughly corresponds to a subjectively noticeable difference in noise level. As such, the increase in road traffic due to construction activity in Rhodes is considered to be acoustically insignificant.

Depending upon the stage of construction, the percentage of heavy vehicles accessing the Wentworth Point construction site has the potential to increase above existing flows. However, this is not expected to cause significant increases in noise levels, given the number of trucks that currently enter the Wentworth Point industrial estate.

Vibration impacts on buildings

Vibration limits to avoid damage to buildings affected by construction vibration are set by the *British Standard BS 7385: Part 2 1993*. Limits on the foundations of the building as proposed in the Standard are listed in Table 15.3 and represent the criteria adopted for the assessment.

Table 15.3 – Transient vibration guide values for cosmetic damage

Category	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures industrial and heavy commercial buildings	50 mm/s @ 4 Hz and above	
Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s @ 4 Hz increasing to 20 mm/s @ 15 Hz	20 mm/s @ 15 Hz increasing to 50 mm/s @ 40 Hz and above

The major potential sources of construction vibration would include excavation and piling activities.

Predicted vibration levels at the nearest affected residential receivers during excavation works at the Rhodes landing are calculated to be up to 0.1 mms per second (mm/s) while predicted vibration levels at the nearest affected residential receivers at Rhodes due to hammer piling are calculated to be up to 2.16 mm/s. These values are well below the threshold for cosmetic damage presented in Table 15.3. Therefore, construction vibration impacts on buildings are expected to be insignificant.

Vibration impacts on humans

Vibration limits recommended by the Office of Environment and Heritage for maintaining human comfort in residences and other relevant sensitive receivers are given for continuous/impulsive and intermittent vibration in Table 15.4.

Table 15.4 - Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime (7am–10pm)		Night-time (10pm–7am)	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80

The calculated vibration dose values for excavation works at the nearest potentially affected residential receivers on Rhodes have been estimated to be about 0.18 ms per second $(m/s)^{1.75}$ which are within the preferred levels for human comfort as stipulated in Table 15.4.

The calculated vibration dose values for piling works at the nearest potentially affected residential receivers on Rhodes have been estimated to be about 0.74 $m/s^{1.75}$ which is an exceedance of the maximum recommended levels for human comfort as stipulated in Table 15.4. In light of the temporary nature of the works and the varying distances between piles, this calculated level is likely to be overly conservative. Nonetheless, vibration may be perceptible at nearby residential receivers on Rhodes for relatively short periods of time during piling. This impact is considered to be acceptable under the circumstances.

15.2.2 Operational traffic noise

The potential impact on residential and non-residential noise-sensitive receivers exposed to noise from buses on the proposed bridge has been assessed at the four noise-sensitive receiver locations shown in Figure 15.2:

- Non-residential noise-sensitive receiver R1: Rhodes community centre.
- Residential noise-sensitive receiver R2: Rhodes multi-dwelling development.
- Residential noise-sensitive receiver R3: Wentworth point multi-dwelling development.
- Non-residential noise-sensitive receiver R4: Park (public open space).

As part of the statutory consultation for the project (refer to Chapter 6) the Office of Environment and Heritage recommended two approaches for the purpose of setting the operational noise assessment criteria. These two approaches are:

- *Calculation of Road Traffic Noise* (CoRTN) (UK Department of Transport, 1988).
- *Federal Highway Administration* (FHWA, 2004).

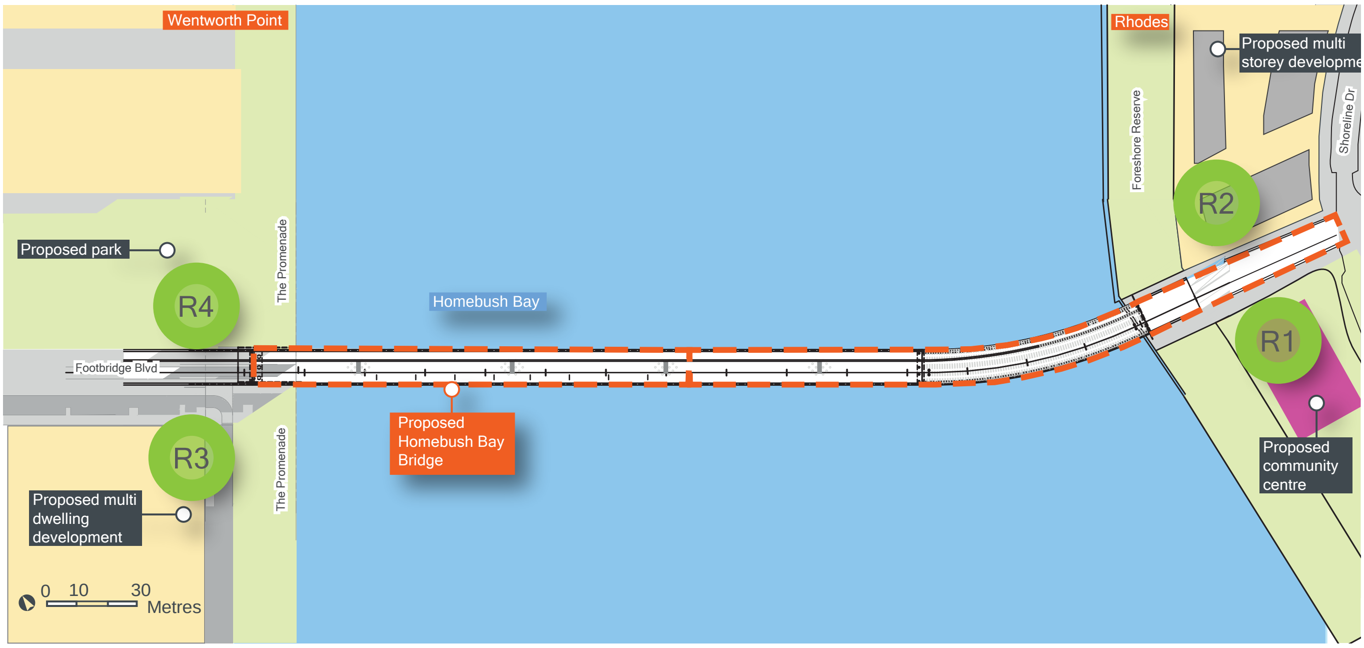

Figure 15.2 – Nearest potentially affected residential and non residential noise-sensitive receivers

The resulting noise criteria and predicted noise levels at the four noise-sensitive receiver locations are presented in Table 15.5. The noise predictions have been determined based on the following conservative assumptions:

- Rhodes and Wentworth Point are fully developed.
- Sensitive receiver heights are 1.5 ms above road level at each location.
- The road surface is asphalt, 75 mms thick, on a concrete deck.
- The type of vehicle is a standard size STA bus travelling at a speed of 50 kms per hour.
- The AM weekday peak hour traffic flow is used for assessment purposes.
- The higher predicted noise from the two approaches will be used at each receiver location.

Table 15.5 – Resultant $L_{Aeq(1hour)}$ road traffic noise levels during AM peak period at year 2023

Receiver location	Predicted noise $LA_{eq(1hour)}$ (dBA)		Noise criteria $LA_{eq(1hour)}$ (dBA)	
	CoRTN	FHWA	Daytime 7am–10pm	Night-time 10pm–7am
R1 (non-residential)	60	60	55	50
R2 (residential)	58	55	55	50
R3 (residential)	56	53	55	50
R4 (non-residential)	58	59	60	60

Table 15.5 shows that bridge traffic noise levels during the AM peak period at the nearest affected residential receivers would be up to 5 dB above the daytime criterion and up to 10 dB above the night-time criterion.

However, the predicted noise levels are for the busiest period of the day (AM peak period) and therefore apply predominantly to the daytime criterion.

The predicted noise levels are about 1 dB below the recommended noise criterion of 60 dBA for areas of "active recreation" (i.e. noise-sensitive receiver R4).

Given that the predicted worst-case exceedances of external noise criteria at the nearest affected residential receivers are in the order of 5 dB, satisfactory internal noise levels should be readily achievable provided windows and doors fronting the street are able to be kept closed during AM peak periods. Further, existing residential receivers on Gauthorpe Street benefit from acoustic shielding from solid fences at street level and balustrades on balconies. These architectural features are likely to maintain noise levels within the criteria.

The impact of traffic generated by the proposed bridge is considered to be acceptable given that the predicted noise levels summarised in Table 15.5 are conservative and likely to be experienced only during AM peak periods. Consideration of future noise levels associated with the operation of the bridge should be taken into account when assessing future residential developments along the proposed bridge approach roads.

15.3 Mitigation and management measures

15.3.1 Construction

A construction environmental management would be prepared to minimise noise and vibration impacts during construction. The plan would include the following mitigation measures:

- Rhodes and Wentworth Point residents would be kept informed and up to date with the proposed schedule of works in order to maintain good community relations and proactively managing expectations and adverse reactions.
- Workers and contractors would be trained to use equipment in ways to minimise noise.
- Construction site manager would periodically check the site and nearby residences for noise problems so that solutions can be applied in a timely manner.
- All plant and equipment would be turn off when not in use.
- Whenever reasonable and feasible, noise mitigation measures outlined in BS5228.1 and Table C1 of AS2436 would be implemented. Indicative noise mitigation measures at source relevant to the Homebush Bay construction activities are listed below.

Table 15.6 – Construction noise mitigation measures (Source: BS5228.1 and Table C1 AS2436).

Construction equipment	Noise mitigation measure	Indicative noise reduction (dBA)
Jackhammer	Muffler and screen	20
Compressor Cement mixers Hand-held tools	Screening	5
Excavators/loaders Trucks Mobile cranes Asphalt paver Bulldozers Road graders Rollers/compactors	Residential-grade silencer	10
Excavator with hammer attachment	Residential-grade silencer Screening of hammer attachment	15
Pilling impact	Resilient pad (dolly) between pile and hammerhead	10

15.3.2 Operation

Future development proposals along the proposed bridge approach roads should take into consideration the expected noise levels associated with the operation of the bridge.

16 Flora and fauna

This Chapter addresses the terrestrial and aquatic flora and fauna issues related to the proposed Homebush Bay Bridge. In particular, it responds to the following Director General's requirements that the environmental assessment include:

/ An assessment of any impacts on critical habitats, threatened species, populations or ecological communities and their habitats in the region.

/ An assessment of any impacts on the biodiversity values of mangrove and saltmarsh communities of Homebush Bay, wetlands of national importance and migratory shorebird habitats.

This Chapter draws on information from the report prepared by Biosis Research to accompany this environmental assessment (refer Appendix L). The report assesses the ecological significance of threatened plant and animal species, endangered populations and endangered ecological communities that occur, or have the potential to occur, within the area affected by the proposal, in accordance with State and Commonwealth legislation.

The Biosis Research assessment is based on desktop research and a survey of the study area undertaken on 28 March 2011 by a zoologist and botanist. The survey covered Homebush Bay and the Parramatta River foreshore vegetation opposite the inlet to the bay. This is referred to as the "study area" in this Chapter.

16.1 Existing environment

16.1.1 Terrestrial flora and fauna

Terrestrial flora

Vegetation communities within the Homebush Bay area are presented in Figure 16.1.

The *Threatened Species Conservation Act 1995* (TSC Act) lists the endangered ecological community (EEC) Coastal Saltmarsh as occurring within the study area. This EEC was recorded during field investigations for this environmental assessment. It was found to occur in a narrow strip edged by mangroves along the edge of a walking path leading out to the Shipwreck Viewing Platform located to the south of Homebush Bay.

In addition, 33 threatened plant species or their habitat have been recorded within 10 kms of the study area (OEH Atlas of NSW Wildlife and DSEWPaC Online EPBC Database). Of these, 30 species are listed under the TSC Act and 22 under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Two threatened flora populations also occur within 10 kms of the study area. Further details on these species are presented in Appendix L.

No threatened flora species were recorded during the field investigation. However, based on previous surveys adjacent to the study area and the habitat present, Narrow-leafed Wilsonia (*Wilsonia backhousei*) is considered likely to occur within the study area. This is listed on the TSC Act as a threatened flora species.

Figure 16.1 - Vegetation communities within the Homebush Bay area

Terrestrial fauna

Fauna habitat

The areas occupied by the proposed bridge landings and work sites are largely devoid of vegetation; consequently, terrestrial fauna habitat within the subject site is limited. However, the broader Homebush Bay area provides foraging habitat for birds such as cormorants, ducks, egrets and seagulls that feed on fish or crustaceans and aquatic insects.

Terrestrial fauna habitats within the proposed bridge area are considered to be in poor condition given the lack of vegetation at the water, ground and shrub levels; low abundance of trees; absence of tree hollows; absence of ground logs; absence of a litter layer; absence of mud flats; lack of large woody debris; and the highly disturbed nature of the site.

Fauna species

Within a 10 km radius of the study area:

- 90 threatened and/or migratory terrestrial animal species or their habitat (including three listed as endangered populations) have been recorded (OEH Atlas of NSW Wildlife, Birds Australia's Atlas of Australian Birds and DSEWPaC Online EPBC Database). Of these, 54 animal species are listed under the TSC Act and 60 are listed under the EPBC Act (17 threatened and 44 migratory).
- 81 threatened and/or migratory terrestrial species and three endangered populations have been recorded.

Further details on these species are presented in Appendix L.

No threatened terrestrial fauna species were recorded in the study area during the field investigation. However, potential habitat is considered to occur within the study area for 12 TSC Act-listed threatened fauna species and one endangered fauna population.

Potential habitat is considered to occur within the study area for the White-fronted Chat (*Epthianura albifrons*), which is listed as an endangered population under the TSC Act. Individuals of the Gang-gang Cockatoo (*Callocephalon fimbriatum*) endangered population (listed under the TSC Act) have been recorded within 10 kms of the study area. However, the study area is not considered to provide habitat for individuals of this species.

No migratory fauna species were recorded during the field survey. However, the study area is considered to support known and/or potential habitat for 37 migratory species.

No areas of critical habitat for flora or fauna have been declared within Homebush Bay.

16.1.2 Aquatic flora and fauna

Aquatic habitat

The proposed bridge route crosses through submerged rock-wall habitat, and muddy subtidal areas.

The rock walls at the Rhodes and Wentworth Point foreshores are smooth and homogenous when compared to the complex structures of natural intertidal reefs and rock pools and, therefore, are considered to provide poor habitat for aquatic species. This intertidal habitat is likely to support a limited diversity of intertidal biota, such as molluscs, small crustaceans and macro-algae. The remaining muddy-sediment habitat is likely to support an assemblage of fish typically found in the muddy estuaries of Sydney Harbour and Parramatta River.

Beyond the proposed bridge alignment are areas of intertidal saltmarsh and mangrove. Mangroves typically provide important nursery habitat for a number of fish species that occur in the estuaries they are associated with. The broader area also includes artificial reef structures, including a shipwreck and emerging wooden pylons, which are likely to support habitat for sessile flora and fauna, and provide habitat for mobile fauna typically associated with rocky reefs in the area.

Two tributaries of Parramatta River flow into Homebush Bay:

- Haslams Creek from the south-west. This creek runs through Sydney Olympic Park into Homebush Bay and is severely degraded from sedimentation and contamination from chemical wastes. Despite these impacts, the mangroves associated with Haslams Creek are in a healthy condition.
- Powells Creek from the south. This creek has been straightened and moved eastwards by reclamation works in 1948, when it was converted into a concrete stormwater canal. The original Powells Creek now exists as a closed-system wetland. Watery habitats within the study area are likely to be of poor quality due to past contamination and ongoing sedimentation. However, the surrounding mangroves are in relatively good condition.

Aquatic species

A desktop survey of aquatic flora and fauna has been conducted within the study area. The survey found four turtles listed on the EPBC Act – three of which are also listed on the TSC Act – potentially occur in the study area, as shown in Table 16.1.

Table 16.1 - Aquatic fauna listed on the EPBC Act for which potential habitat exists in the Homebush Bay area

Name	How listed in EPBC Act	How listed in TSC Act
Loggerhead Turtle (*Caretta caretta*)	Endangered Migratory	Endangered
Green Turtle (*Chelonia mydas*)	Vulnerable Migratory	Vulnerable
Hawksbill Turtle (*Eretmochelys imbricate*)	Vulnerable Migratory	Not listed
Leathery Turtle (*Dermochelys coriacea*)	Vulnerable Migratory	Vulnerable

16.1.3 Wetlands

Nationally-important wetlands as listed on he Australian Wetlands Database occurring in the Homebush Bay area are shown in Figure 16.2 and include:

- Badu Mangroves Wetlands, located south of the bridge alignment at Bicentennial Park, on the southern shore of Homebush Bay. The wetlands cover about 65 hectares and contain extensive mangrove stands, waterbird refuges, mudflats, a saltmarsh community and an estuarine creek system.
- Wanngal Wetland, located west of the bridge alignment at the Newington Nature Reserve (Sydney Olympic Park parklands), on the southern side of the Parramatta River, between Homebush Bay and Silverwater. The wetlands cover about 34.7 hectares and provide natural and planted areas of saltmarsh community and habitat for some 70 species of local and migratory water birds and shorebirds.

Assessment of potential impacts

Potential impacts would occur during construction of the bridge. No impacts were identified for the operational stage.

Therefore, this section provides an overview of potential impacts on flora and fauna that would occur during construction.

16.1.4 Potential impacts on terrestrial flora

There would be minimal impacts on terrestrial flora. The following aspects have been assessed:

- Native vegetation and native plant communities. There would be very minimal direct impacts on native vegetation, with only a few scattered native herbs and planted trees likely to be removed at Wentworth Point. No native plant communities would be removed by the proposal.
- Native riparian vegetation. The subject site is highly modified and contains no riparian vegetation. The riparian vegetation at the northern and southern extents of the study area and along the banks of the Parramatta River or Homebush Bay would not be disturbed and are unlikely to be impacted by the proposal.
- Removal of large woody debris. The proposal is unlikely to result in the removal of large woody debris, which was found to be largely absent from the subject site.
- Weed invasion. Weed invasion has the potential to occur in all areas cleared and disturbed by the proposal. However, given that bridge landings and proposed construction sites are already significantly cleared of vegetation, the proposal is considered unlikely to significantly increase the prevalence of weeds. Therefore, it is also unlikely that the proposal would result in the invasion of native plant communities by weeds.

Figure 16.2 - Nationally important wetlands in the Homebush Bay Area (Source: EPBC Act protected matters search tool 2011).

- Erosion and sedimentation. Impacts on water quality and aquatic habitats due to erosion and/or sedimentation would be minor given the construction management and erosion and sediment control measures proposed for the construction stage of the bridge (refer to Chapter 13 and Chapter 14). Given the highly altered nature of the subject site, any impacts from erosion and siltation of terrestrial flora and fauna habitats would be negligible.
- Dust. Construction dust may temporarily affect terrestrial and aquatic habitats and species. Given the subject site includes a large water body, dust control measures would need to be implemented to control the amount of dust potentially entering Homebush Bay.
- Noise. Construction noise and vibration may startle some fauna species and may cause temporary disruption and emigration from vegetated areas near the subject site. However, these impacts would be acceptable given the temporary nature of such disruptions and the noise attenuation practices that would be implemented as part of the proposed construction environmental management plan (refer to Chapter 15).

Impacts on endangered ecological communities and endangered populations

The proposal would be unlikely to have a significant impact on endangered ecological communities (EECs) and endangered populations.

While no endangered ecological communities (EECs) occur within the bridge alignment or proposed construction work sites, Coastal Saltmarsh occurs within the study and may be subject to indirect impacts from the proposal. An assessment of significance has been conducted in accordance with the Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act (DEC & DPI 2005) (Part 3A Assessment) in regard to this potential impact. The assessment concluded that the proposal is unlikely to have a significant impact on this EEC. (The full assessment is presented in Appendix L)

Similarly, an assessment of significance on the White-fronted Chat (*Epthianura albifrons*) found that the proposal would result in no direct impacts and only minimal indirect impacts on this species.

Impacts on threatened plant species

While no threatened plant species were recorded within the subject site during the current survey and no species have been assessed as potentially occurring, one threatened plant species – Narrow-leafed Wilsonia (*Wilsonia backhousei*) – has been assessed as potentially occurring within the study area.

A Part 3A assessment of significance was conducted in regard to the potential impact of the proposal on this species (Appendix L). The assessment concluded that the proposal is unlikely to have a significant impact on this species.

16.1.5 Impacts on terrestrial fauna

The proposal may potentially impact on threatened fauna species by causing any of the following:

- Death or injury of individuals.
- Loss or disturbance of limiting foraging resources.
- Loss or disturbance of limiting breeding resources.

Out of the 12 threatened fauna species listed in the TSC Act with known and/or potential habitat in the study area, 10 species are considered as unlikely to be subject to negative impacts resulting from the proposal. Part 3A assessments of significance were prepared for the remaining two species – the Australasian Bittern (*Botaurus poiciloptilus*) and Terek Sandpiper (*Xenus cinereus*). The assessments concluded that the proposal is unlikely to have a significant impact on these species (Appendix L).

16.1.6 Impacts on aquatic fauna

The occurrence of four turtles listed in the EPBC Act (Table 16.1) would be incidental and transient. Given that the study area does not form a significant part of these species' habitat or range, and that their potential occurrence is likely to be incidental or transitory only, these species are considered as unlikely to be subject to negative impacts resulting from the proposal. Accordingly, no Part 3A impact assessments have been prepared for these species.

16.1.7 Maintenance of biodiversity values

The site for the proposed bridge is currently disturbed and largely devoid of native vegetation.

The proposal would not require the removal of any EEC, native plant communities or terrestrial fauna habitats. However, the proposal would result in direct impacts on the aquatic habitats of the site. Provided that the proposed mitigation measures are implemented, the proposal is likely to maintain the biodiversity values of the locality including the mangrove and saltmarsh communities of Homebush Bay, wetlands of national importance and migratory shorebird habitats.

16.2 Mitigation and management measures

Mitigation measures listed in Chapter 13 Soil and contamination and Chapter 14 Sediments and water would be implemented to minimise impacts to the ecology of Homebush Bay.

17 Wind and wind-wash effects

This Chapter provides an assessment of wind and wind-wash effects on the bridge and bridge users, as listed in the Director General's requirements. A detailed assessment undertaken by Cermak Peterka Petersen Pty Ltd is included in Appendix M.

For the purposes of this assessment, wind-wash refers to the blow created by wind on and around the proposed bridge and bridge users.

17.1 Existing wind conditions

The topography surrounding the bridge alignment is essentially flat, rising slightly to the east along the Rhodes peninsula.

The prevailing winds in the study area come from the north-east, south and west, as follows:

- Winds from the north-east tend to be summer sea breezes and bring welcome relief on summer days, but dissipate with distance from the coast and are mild at Homebush Bay and almost non-existent at Bankstown.
- Winds from the south tend to be cold and tend to be associated with frontal systems that can last several days and occur throughout the year.
- Winds from the west are the strongest of the year and are associated with large weather patterns and thunderstorm activity. These winds occur throughout the year and can be cold or warm depending on the inland conditions.

The prevailing wind directions associated with rain are from the south and west quadrants. Existing wind conditions are presented in the site analysis plan in Appendix C.

The prevailing wind directions are illustrated in the wind roses for Sydney and Bankstown airports (the nearest representative available wind data locations) in Figure 17.1 and Figure 17.2.

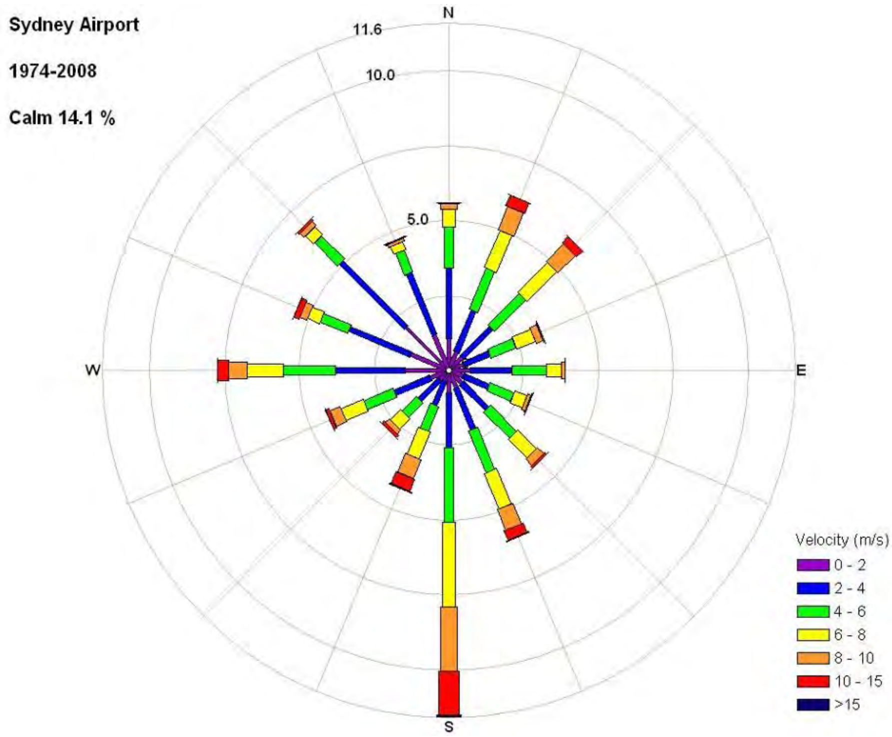

Figure 17.1 - Wind rose for Sydney Airport (Source: BOM, 2011)

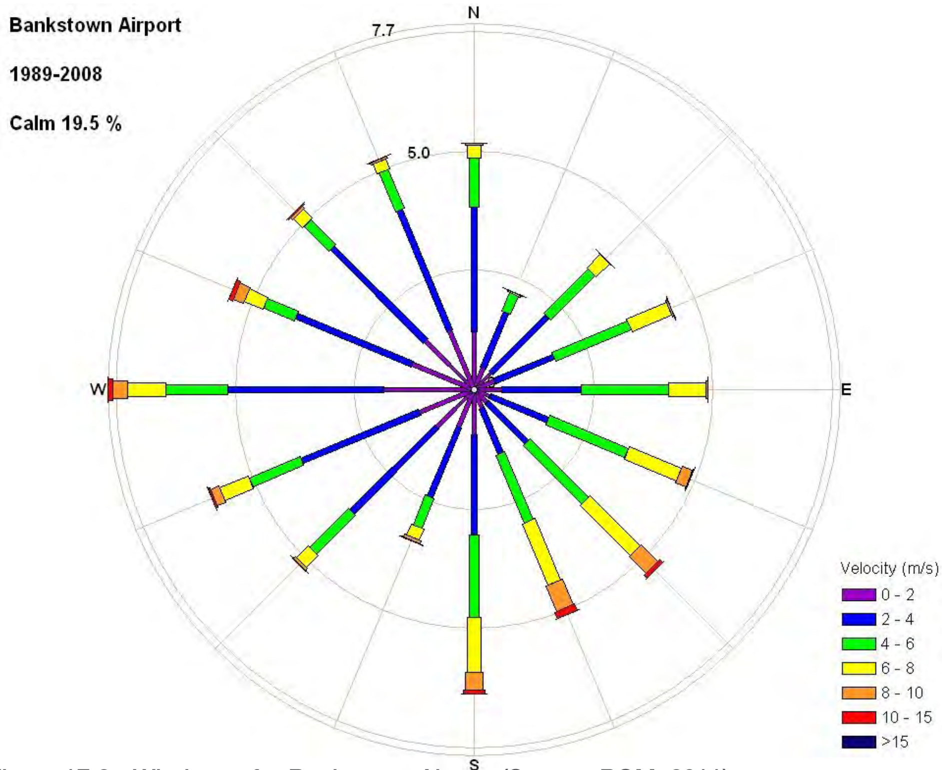

Figure 17.2 - Wind rose for Bankstown Airport (Source: BOM, 2011)

17.2 Assessment criteria

It is generally accepted that wind speed and rate of change of wind velocity are the primary variables that should be used in the assessment of how wind affects pedestrians. Local wind effects can be assessed with respect to a number of environmental wind speed criteria established by various researchers. Despite the apparent differences in numerical values and assumptions made in their development, it has been found that when these are compared on a probabilistic basis, there is remarkably good agreement.

Auburn City Council and City of Canada Bay Council do not have any specific wind criteria in their development control plans. The City of Sydney's *Central Sydney Development Control Plan 1996* specifies the once-per-annum maximum gust around proposed building developments should not exceed 16 ms per second (m/s).

As well as the once-per-annum maximum gust wind speed, the assessment for the proposed bridge is based on the University of Bristol: Department of Aerospace Engineering criteria – *Determination of the wind environment of a Building Complex Before Construction* (Lawson, 1990) – which are described in Table 17.1 for both pedestrian comfort and distress. The benefits of these criteria over many in the field are that they use both a mean and gust equivalent mean wind speed to assess the suitability of specific locations. The criteria based on the mean wind speeds define when the steady component of the wind causes discomfort, whereas the gust equivalent mean wind speeds define when the wind gusts cause discomfort.

Table 17.1 – Wind criteria for pedestrian comfort and distress (Source: Lawson, 1990)

Maximum wind speed exceeded 5% of the time (m/s)	Comfort
<2	Outdoor dining
2–4	Pedestrian sitting (considered to be of long duration)
4–6	Pedestrian standing (or sitting for a short time or exposure)
6–8	Pedestrian walking
8–10	Business walking (objective walking from A to B or for cycling)
>10	Uncomfortable
Maximum wind speed exceeded 0.022% of the time, twice per annum (m/s)	**Distress**
<15	General access area
15-20	Acceptable only where able-bodied people would be expected; no frail people or cyclists expected
>20	Unacceptable

Note: The wind speed is either a mean wind speed or a gust equivalent mean wind speed. The gust equivalent mean wind speed is equal to the 3-second gust wind speed divided by 1.85.

17.3 Assessment of potential impacts

17.3.1 Impacts on bridge users

Wind flow around a bridge would not significantly change the wind-flow pattern, or create localised high wind speeds unless there are significant solid barriers. The bridge would have some features that could potentially change the wind-flow pattern:

- Balustrades on the northern and southern edges and between the cyclist and pedestrian lanes.
- A raised central section with a relatively streamlined edge.
- Below-deck sections at the low end sections enclosed with precast panels.

However, this assessment finds that for all wind directions, the wind conditions on the bridge would be similar to those on land away from buildings, which locally accelerate the flow causing large changes in wind speed over a relatively short distance. The streamlined nature of the bridge deck and the porous nature of the southern balustrade would limit the amount of interference of the structure on the wind flow pattern. The open wind environment would generate relatively constant windy locations with a turbulence level that would not change rapidly with distance, which is important for cyclists. The windiest locations on the bridge would tend to be on the approaches near the building corners.

The solid balustrade to the north of the bridge would run parallel to the footpath and offer protection for pedestrians as it would create a calmer, but more turbulent environment. Proposed shade structures along the footpath would also offer wind protection to pedestrians.

Overall, conditions on the bridge are expected to be suitable for winds from all directions for all pedestrian and cyclist traffic.

17.3.2 Impacts on the bridge

As noted in Chapter 4, the proposed Homebush Bay Bridge would be designed as per *Australian Standard AS 5100 part 2*, which relates to bridge design loads. The bridge would be designed for a wind average return interval of 20 years for serviceability limit state and a wind average return interval of 2,000 years for ultimate limit state.

This design criterion is considered to be appropriate for the wind conditions of the Homebush Bay area.

17.4 Mitigation and management measures

No mitigation measures are proposed beyond the bridge design described in Chapter 4.

18 Consideration and management of other issues

18.1 Scouring

This section assesses the potential for removing sediment from around the proposed bridge piers.

18.1.1 Existing environment

Homebush Bay is a tidally-influenced estuarine environment, which is characterised by a deeper channel (up to four ms deep) along the western margins that shoals to the eastern and north-eastern shores. Water near the eastern and north-eastern shores is generally less than one m deep.

Tides at Homebush Bay are semi-diurnal and asymmetric, with the tidal ranges varying significantly throughout each lunar month (spring-neap cycle) and from month to month. Very high and very low tides occur more frequently at solstices around Christmas and the mid-winter months. The spring high tide range varies from 1.8 to 2.2 ms.

Tidal currents cause a periodic flow into and out of the bay; coupled with turbulent mixing, this process effectively replaces the bay water with adjacent main body estuarine water from the Parramatta River. The flushing time for Homebush Bay is estimated to be around three to four days.

Tidal current velocity near the proposed bridge alignment has been reported in several studies and is listed in Table 18.1.

Table 18.1 – Tidal current velocity in Homebush Bay calculated at the mouth of the bay

Source	Velocity (ms per second)
Preliminary model studies: Report 96/01 (Sydney Ports Corporation Coastal Section, January 1996).	Maximum: 0.2 m/s
Tidal flushing of freshwater sources in Homebush Bay: A literature review (UNSW, 2004).	Average: 0.07 m/s Maximum: 0.1 to 0.2 m/s
Evaluation of tidal flushing and mixing processes in Homebush Bay (Parsons Brinckerhoff, 2004).	Dry weather periods: 0.07 m/s to 0.14 m/s Average: 0.067 m/s
	Wet weather period - upper limit: 0.13 m/s. Average: 0.081 m/s

18.1.2 Assessment of potential impacts

Given the low cross sectional area of the piles compared with the width of Homebush Bay, the relatively low flood velocities presented in Table 18.1 and the net sedimentation rate discussed in Chapter 13.1, scour is unlikely to be an issue for the piers.

Nonetheless, a conservative design current velocity of 0.5 ms per second would be adopted for the bridge design. Adopting this design parameter would minimise the risk of scouring over the piers.

18.1.3 Mitigation and management measures

No mitigation of management measures are considered necessary.

18.2 Crime prevention through environmental design

This section provides a summary of the crime prevention through environmental design measures prepared by Scott Carver to accompany this environmental assessment (refer Appendix H). This section identifies key issues concerning crime risk and prevention at the proposed Homebush Bay Bridge and addresses these issues through a number of principles that aim to improve safety through the adoption of crime prevention through environmental design principles. The principles are found in the *Crime Prevention and the Assessment of Development Applications* (Department of Urban Affairs and Planning, 2001) and are as follows:

/ Surveillance.
/ Access control.
/ Territorial reinforcement.
/ Space management.

18.2.1 Crime potential

The use of the bridge by cyclists, pedestrians and buses would result in a low level of activity in the evenings, especially when bus services cease operating. This might result in increased potential for vandalism and personal threat as there would be a low level of activity, direct and close surveillance and supervision during these hours. However, there would be a high level of visibility over the bridge from elevated apartments and some areas of the public domain.

Solid surfaces and walls may be targeted for vandalism, indicating the need for anti-graffiti materials and finishes, and for the lighting and surveillance of potential vandalism targets.

Lighting and landscape treatments would particularly require the maintenance of direct sight lines, good visibility and face cognition at night with the avoidance of conditions that allow concealment and entrapment.

The imposition of changes in level between the foreshore, bridge and landings could also result in spaces providing increased opportunities for vandalism, concealment and entrapment.

Territorial reinforcement between public parks and streets would potentially lead to ambiguity for pedestrians. Transitional areas between the landings and the bridge would potentially result in increased risks for pedestrians at night, as landscaping, retainer walls, ramps and steps may provide opportunities for concealment.

18.2.2 Crime prevention measures

Surveillance

View lines exist over a considerable distance from residential apartments to the surrounding streetscape, the proposed bridge and surrounds. The proposed bridge would provide for clear sight lines from the street and pedestrian areas as well as along pedestrian routes and bicycle paths. Areas would be well lit with higher lighting levels at potential areas of crime risk to allow recognition of facial features, especially at night.

Access control

Symbolic and physical barriers such as changes in levels, landscaping, materials and lighting are proposed to indicate areas nominated for increased levels of activity and casual surveillance, as well as areas where public access is discouraged.

Territorial reinforcement

The proposal would create a sense of place and amenity, with a key distinction between public and transitional realms (transitional realms are the domains which are ambiguous between a bridge, park and street which have different expectations and risk perceptions from users. It also contain areas where landscaping may be contemplated to screen infrastructure but would raise safety concerns). The design language would change at the landings between the bridge, foreshore, park and public streets. This would be reinforced by changes in level, landscaping, materials, as well as perceived and physical barriers.

The design of these realms would also indicate the purpose of these different spaces to the intended users, and allow the community to develop a sense of ownership of the site and surrounds as well as a clear understanding of appropriate behaviour.

Target hardening

Targets for vandalism and criminal activity would be minimised through the selection of materials and finishes, and active and passive security measures as follows:

- At night, bridge lighting would increase the visibility of areas that may be targeted for vandalism.
- The principles of surveillance, access control, territorial reinforcement and space management have been incorporated in the bridge design. This is evident in the interrelationships between the bridge and landings as well as with surrounding areas; lighting, legibility and accessibility; ownership and space management; security and safety; and minimisation of concealment and entrapment opportunities.
- The bridge would be owned and managed by SOPA, which has expertise in managing high-level infrastructure. Its management tasks would include regularly checking external building elements for graffiti and damage; promptly repairing and removing graffiti; and general cleaning and maintenance.
- The detailed design of the bridge would carefully consider robust materials that are relatively easy to replace and/or repair if areas were damaged.

Overall, the proposed design measures discussed in this section would help to prevent crime along the bridge and road approaches.

18.3 Waste minimisation and management

This section provides an assessment of the waste minimisation and management measures to be incorporated during the construction and operation of the proposed bridge.

Potential waste streams

The following potential waste streams have been identified for the construction phase of the bridge:

- Excavation wastes such as soils and rock where it may not be possible to reuse all excavated material within the project. The detailed design of the project would aim to achieve a balance of cut and fill so that this waste is minimised. The proposed marine and land based construction activities would not involve excavation of contaminated sediments or material nor generation of hazardous waste.
- Vegetation wastes (green waste) generated from clearing operations prior to and during construction.
- Demolition waste from pavements and structures (including asphalt, concrete and road base).
- Packaging materials from items delivered to the site such as pallets, crates, cartons, plastics and wrapping.
- Surplus construction materials considered a waste product.
- Liquid wastes including waste fuels, oils and chemicals.
- Sewage effluent from the use of workers' facilities such as toilets.
- General wastes and recyclable materials such as paper, cardboard, beverage containers and food wastes.

During the operation of the bridge, a small quantity of waste would be generated by road maintenance and repair activities. Bridge users would also generate litter along the bridge and landing points.

18.3.1 Mitigation and management measures

The following waste management measures would be implemented to minimise waste impacts.

Construction stage

- Construction waste management would follow the waste hierarchy principles of avoid, reduce, reuse, recycle, recover, treat and dispose.
- All generated wastes would be managed and disposed of in accordance with relevant State legislation and government policies including the *Waste Avoidance and Resource Recovery Act 2001*, the *Waste Avoidance and Resource Recovery Strategy 2007* and the *Waste Reduction and Purchasing Policy.* The *Waste Classification Guidelines* (DECCW, 2008) would also be used to classify the different types of waste.
- Transport of materials to and from the site would be done using covered trucks where possible.
- A waste register would be maintained for the site. It would detail the types of waste collected, amounts, date/time and details of disposal.
- The construction contractor would be required to re-use materials where feasible. This would include the reuse of material collected onsite.
- Solid waste materials awaiting disposal would be appropriately contained and stored in a manner that would ensure they do not escape into the environment.

- Training in waste minimisation principles and measures would be provided as part of site inductions.

Operational stage

Rubbish bins would be placed at strategic locations.

18.4 Greenhouse gas emissions

This section provides a desktop assessment of the greenhouse gas emissions that would be generated during the construction of the bridge, and a semi-qualitative assessment of the emissions generated once the bridge is operational.

18.4.1 Construction stage

Greenhouse gas emissions from construction of the bridge were estimated based on information provided in Chapter 4 and the *National Greenhouse Accounts Factors* (Department of Climate Change and Energy Efficiency, 2010). These emissions were grouped into three categories:

- Direct greenhouse gas emissions (scope 1) associated with emissions generated on site, including fuel consumption from construction plant and equipment.
- Indirect greenhouse gas emissions (scope 2) associated with electricity used on site for lighting of the work site compounds, where actual emissions are generated elsewhere (generally at the source of the electricity generation).
- Other indirect greenhouse gas emissions (scope 3) associated with the manufacture and transport of construction materials and waste to and from the site, as well as the transport of workers to and from the site.

The estimated scope 1, scope 2 and scope 3 emissions from construction are presented in Table 18.2 and illustrated in Figure 18.1.

Table 18.2 - Greenhouse gas emissions from construction of the Homebush Bay Bridge

Scope	Source	GHG emissions (tCO_2e)[1]
Scope 1	Construction plant and equipment	571
Scope 2	Electricity use on site	132
Scope 3	Manufacture of construction materials	4,847
	Transport of construction material	23
	Transport of workers	97
	Upstream fuel extraction, transmission and distribution	67
Total		5,737

[1] tCO_2e – tonnes of CO_2 equivalent

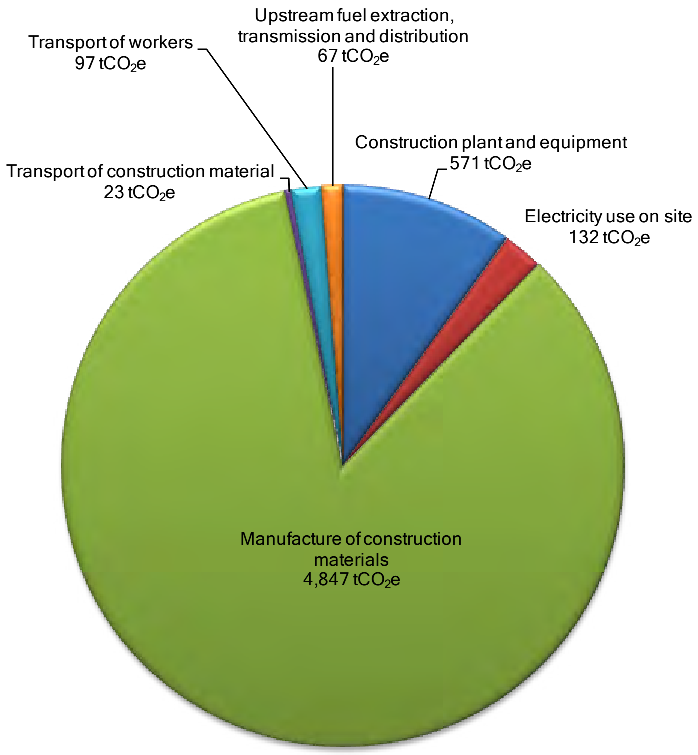

Figure 18.1 – Greenhouse gas emissions from construction of the Homebush Bay Bridge

18.4.2 Operational stage

The proposed bridge would create a link between Rhodes and Wentworth Point that would encourage a modal shift away from car use by residents, particularly at Wentworth Point.

The *Draft Wentworth Point Transport Management and Accessibility Plan (TMAP)* (Cattell & Cooper, 2011) identified that the proposed bridge would facilitate a reduction in the percentage of journey-to-work trips made by car for residents of Wentworth Point with an associated reduction in greenhouse gas emissions. Arup has undertaken a high-level analysis of the potential reductions achievable from this mode shift, as presented in Table 18.3.

Table 18.3: Greenhouse gas emissions from operation of the Homebush Bay Bridge (Source: ABS, 2006; Cattel Cooper, 2011)

Scenario	Journeys to work by car		Emission intensity[1,2]	Emissions per trip[3]	Total emissions
	% mode share	Trips per year	kgCO2e per km	$kgCO_2e$	tCO_2e
2006 (prior to bridge construction)	83%	588	0.30	1.52	0.9
2023 (without bridge construction)[4]	83%	4,187	0.28	1.41	5.9
2023 (with bridge construction)	65%	3,279	0.28	1.41	4.6
% improvement with bridge	21.7%	21.7%	0.0%	0.0%	21.7%

1. Assumes average NSW vehicle emission intensity according to *NSW Transport Facts* (Centre for Transport, Energy and the Environment & Adam Pekol Consulting, 2010).
2. Assumes vehicle efficiencies improve by 7% between 2006 and 2031 according to BITRE projections.
3. Assumes average commute distance of 5 km.
4. Assumes that mode split does not change from 2006 census without the proposed bridge.

The mode shift facilitated by the bridge would therefore result in an emission reduction of about 1.3 tCO_2e per annum by 2023. While this is relatively small compared to the construction emissions, there would likely be more widespread mode shifts as a result of the bridge within other transport zones and other non-work related trips that have not been modelled as part of this assessment.

18.5 Heritage

Aboriginal heritage

The area of the bridge landing at Rhodes was occupied by industrial uses (Lednez / Union Carbide) followed by extensive remediation works. The site is considered to be highly disturbed and with little potential to contain items of Aboriginal significance.

The area that would be occupied by the bridge approach at Wentworth point is reclaimed land formed from the deposition of dredged sediments from Homebush bay and the Parramatta River.

Therefore the areas occupied by the bridge landing are considered to have low potential to contain items of Aboriginal significance or impact the Aboriginal heritage of the Homebush Bay area.

Non-Aboriginal heritage

A search for heritage items was conducted in the following instruments:

- Commonwealth Department of Sustainability, Environment, Water, Population and Communities heritage database.
- NSW Office of Environment and Heritage database.

- Sydney Regional Environmental Plan No 24—Homebush Bay Area.
- Canada Bay Local environmental Plan 2008 and heritage map.
- Auburn Local environmental Plan 2010 and heritage map.

The search found no heritage items, heritage conservation areas or potential historical archaeological sites within or in close proximity to the proposal. Therefore the proposal is unlikely to impact on the non-Aboriginal heritage of the Homebush Bay area.

18.6 Geology and geotechnical conditions

The *Sydney Geological Map* scale 1:100,000 indicates that the crossing locality and surrounds is underlain by manmade fill that overlies Quaternary sediments.

The Quaternary sediments are described as stream alluvial and estuarine sediments comprised of silty to peaty quartz sand, silt and clay with common shell layers. The underlying bedrock comprises Ashfield Shale that overlies Hawkesbury Sandstone of the Wianamatta Group.

The geological model for the crossing is likely to comprise fill, recent alluvial deposits, overlying older alluvial deposits that in turn overlie shale or sandstone bedrock. The thickness of the recent alluvial deposit and the depth to bedrock will vary depending on the position of the crossing locality relative to the palaeo-channel that underlies Homebush Bay. The anticipated ground conditions underlying the route of the proposed crossing are as follows:

- Fill comprised of very soft to soft clays and very loose to loose sands that ranges in thicknesses from 0.2 ms to 4.6 ms. The fill is present on the eastern and western shores.
- Holocene (recent) alluvial deposits comprising very soft to soft estuarine clays and very loose to medium dense sands that ranges in thicknesses from 0.2 ms to 12.3ms, overlying.
- Pleistocene (older) alluvial deposits comprising firm to very stiff clays with some sand layers that ranges in thicknesses from 0.8 ms to 12.2 ms, overlying.
- Bedrock that comprises shale (towards the eastern shore) and sandstone under the main crossing.

A summary of the ground conditions across the proposed crossing locality is presented in Table 18.4.

In general the thickness of the alluvial deposits is controlled by the underlying bedrock level. The bedrock forms a paleo channel that increases with depth to the west and reaches an inferred maximum depth of RL -21m AHD below Lot 10 (Wentworth Point). The bedrock is predominantly sandstone but towards the Rhodes peninsula shale is present, however the thickness of the shale is unknown.

The older alluvial deposits form a relatively thin mantle over the bedrock channel but become thicker towards Hill Road to the west. The recent alluvial deposits from the majority of the profile and thicken towards the west as the palaeo-channel deepens. The maximum depth of recent alluvial deposits is likely to occur at the western abutment and approach ramp.

Table 18.4 – Summary of ground conditions across the proposed crossing locality

Unit	Typical Description	Reduced Level at Top (m AHD)	Thickness (m)
Fill[1]	Sandy CLAY, gravelly CLAY, shelly CLAY. Generally very soft to soft in consistency. Silty/clayey SAND, gravelly SAND, shelly SAND. Generally very loose to loose.	1.5 to 2.3	0.2 to 4.6
Alluvium (Recent)	Generally silty to sandy to gravelly CLAY. Very soft to soft in consistency.	1.5 to -4	1.6 to 12.3
	SAND to silty/clayey SAND. Very loose to medium dense. Generally encountered as interbedded layers.	-5.1	0.2 to 2.8
Alluvium (Older)	Generally silty CLAY, sandy CLAY to CLAY. Firm to very stiff in consistency. Some clayey SAND to SAND layers, medium dense.	-1.6 to -16.8	0.8 to 12.2
Bedrock	SHALE. Inferred extremely weathered, very low strength (eastern shore only).	1.2 to -2.2	Not proven
	SANDSTONE. Highly weathered to moderately weathered, medium strength becoming high strength.	-6.3 to -20.9	

[1]The fill description, levels and thickness is for the western shore only. Details on the eastern foreshore are presented in Chapter 13.

A detailed geotechnical investigation would be carried out to inform detailed design of the proposed bridge. The investigations would include a geophysical survey along the crossing location, boreholes along the alignment with rock coring cone penetration testing and laboratory testing to assess strength and compressibility characteristics of the alluvial deposits and bedrock for foundation design.

18.7 Cumulative impacts

The concept of cumulative impacts recognises that although individual developments may have insignificant effect by themselves, the aggregate effect of multiple developments may be significant.

This section identifies and assesses the combined effect of the impacts of the proposed Homebush Bay Bridge with impacts caused by existing and future known proposed developments. The cumulative impacts and their assessment are presented in Table 18.5.

Table 18.5 – Cumulative impact assessment

Issue	Impact assessment and management
Construction activities The proposed bridge could be built at the same time as future developments in Rhodes, Wentworth Point and the Sydney Olympic Park precinct.	Concurrent construction activities may potentially lead to cumulative traffic, access and noise impacts in the Homebush Bay area. Consultation with Auburn City Council, City of Canada Bay Council, Sydney Olympic Park Authority and relevant development application proponents would be required during the preparation of the construction environmental management plan. Consultation would aim to coordinate the timing of construction activities in order to minimise traffic, access and noise impacts during the bridge's construction period.
Traffic generation The proposal would include two bus lanes that would connect the Rhodes and Wentworth Point road network and generate bus traffic.	Bus traffic generated would potentially add to the traffic generated by existing and future developments at Rhodes, Wentworth Point and the Homebush Bay area. As discussed in Chapter 8, the traffic contribution of a future bus operation across the bridge in a worst-case scenario (i.e. during the AM peak hour period) would be up to 20 buses per hour. This traffic volume is considered to have little effect on the local and regional road network. The traffic volume generated is unlikely to change substantially the level of service of key intersections in Rhodes and Wentworth Point.
Mainland access The proposal would connect Rhodes and Wentworth Point.	This link would have a positive cumulative impact by providing an additional travel route and facilitating access to the Rhodes and Wentworth Point areas. It would also add to the transport modes available for travelling in the Homebush Bay area.

In conclusion, the proposal responds to the need for more sustainable transport mode options to the Homebush Bay area and would result in an overall net benefit to the community.

19 Draft statement of commitments

In accordance with the Director General's requirements, the proponent is required to prepare a draft statement of commitments incorporating or otherwise capturing measures to avoid, minimise, manage, mitigate, offset and/or monitor impacts identified in the environmental assessment. The statement of commitments must clearly articulate the public benefit and desired environmental outcome of the commitments. The statement of commitments must be achievable, measurable (with respect to compliance), time-specific and clearly identify who is responsible for these measures, where relevant.

The environmental commitments proposed for the Homebush Bay Bridge are presented in Table 19.1.

Table 19.1– Draft Statement of Commitments

Subject	No.	Timing	Commitment	Responsibility	Outcome
Consultation	C1	During the detailed design	City of Canada Bay Council will be consulted during the detailed design of the Rhodes bridge landing with the aim of delivering a landing level that is sympathetic with the proposed community facility and foreshore park levels.	Proponent	Rhodes landing level sympathetic with surrounding development
	C2	During the detailed design	Emergency services will be consulted during the detailed design of the bridge.	Proponent	Feedback received considered during the bridge detailed design.
	C3	Prior to commencement of construction works	Auburn City Council and City of Canada Bay Council will be advised in writing of the date it is intended to commence work. This date will also be communicated to the project reference group and the Rhodes and Wentworth Point community. A minimum 10 days notice will be given.	Proponent	Local government authorities and the community informed on the commencement of the bridge construction
	C4	Prior to commencement of construction works	Consultation with Auburn City Council, City of Canada Bay Council, Sydney Olympic Park Authority and relevant development application proponents will be undertaken during the preparation of the environmental management plan.	Proponent	Bridge construction activities are coordinated to minimise cumulative construction impacts
	C5	Prior to commencement of construction works	OEH (EPA) will be consulted during the preparation of the contamination management plan and the monitoring program for water based construction activities.	Construction contractor	Robust monitoring system and environmental management measures for construction actvities

Subject	No.	Timing	Commitment	Responsibility	Outcome
Environmental and construction management	E1	Prior to commencement of construction works	A construction environmental management plan will be prepared. The objectives of the plan will include (but not limited to): / Ensure that the proposal is protective of human health and the environment. / Ensure that proposed construction works will be conducted in a way that minimises disturbance to the sediment environment, soil and groundwater. / Ensure that sufficient construction monitoring and mitigation controls are in place. / Manage contamination during construction in a manner consistent with the Office of Environment and Heritage requirements. The construction environmental management plan will address the following topics: / Construction traffic management. / Construction navigation management. / Contamination management. / Acid sulfate soil management. / Construction sediment and erosion control. / Construction spill emergency procedures. / Construction dust control.	Construction contractor	Impacts during the construction stage are managed

Subject	No.	Timing	Commitment	Responsibility	Outcome
Traffic and access	T1	Prior to commencement of construction works	/ An access route into the work sites will be prepared for the construction vehicles.	Construction contractor	Traffic impacts during the construction stage are managed
	T2	Prior to commencement of construction works	/ A pedestrian and cycling route based on safe public paths will be formed around the proposed work sites.	Construction contractor	
	T3	Prior to commencement of construction works	/ Where reasonable and feasible, larger vehicles will deliver outside of peak periods.	Construction contractor	
	T4	Prior to commencement of construction works	/ Any deliveries by water will be timed, where feasible, to avoid conflicts with the Parramatta ferry service.	Construction contractor	
Climate change	CH1	During the detailed design	The minimum design level adopted for the bridge landing points at the sea wall will be 2.8 m AHD.	Proponent	Design addresses effects of sea level rise as a result of climate change
	CH2	During the detailed design	The landing points will be designed in accordance with current forecast of sea level rise due to climate change.	Proponent	

Subject	No.	Timing	Commitment	Responsibility	Outcome
Navigation and safety	NS1	During the detailed design	The minimum vertical clearance height above MHWS within the designated deepwater navigation channel will be 5.7 m. The minimum horizontal clearance width within the designated deepwater navigation channel will be 20 m.	Proponent	Ensure the bridge does not preclude maritime traffic and access
	NS2	During the detailed design	Rowing course – The bridge layout will allow adequate space for the six lanes required for the proposed Rowing NSW course.	Proponent	
	NS3	During the detailed design	Aids to Navigation – The provision of permanent Aids to Navigation on the bridge structure will be implemented in accordance with relevant standards.	Proponent	
	NS4	Prior to commencement of construction works	Exclusion zones will be marked around critical areas of construction activities and floating construction plant.	Construction contractor	Maritime traffic impacts during the construction stage are managed
	NS5	Prior to commencement of construction works	A proclaimed Marine Notice will be issued via RMS alerting maritime operators of ongoing construction activities.	Construction contractor	
	NS6	Prior to commencement of construction works	Provision for temporary aids to navigation will be made where reasonable and feasible (e.g. lighted buoys to mark exclusion zones).	Construction contractor	

Subject	No.	Timing	Commitment	Responsibility	Outcome
Soils and contamination	S1	Prior to commencement of construction works	A contamination management plan and acid sulfate soil management plan will be prepared and implemented for the construction stage. The plans will include the mitigation measures listed in the *Homebush Bay Bridge Contamination Management Plan* For proposed *Bridge Construction Report* (Golder Associates 2012) and will have regard to the comments and recommendations outlined in the *Site Audit Report SAN 160, Proposed Homebush Bay Bridge, Homebush NSW* (Environmental Strategies 2012). These reports are found in Appendix I and Appendix J respectively. The acid sulfate soil management plan will be prepared in accordance with the *NSW Acid Sulfate Soil Manual* (Acid Sulfate Soils Management Advisory Committee 1998). Human and ecological exposure pathways would be reviewed during the preparation of the construction environmental management plan.	Construction contractor	Pathway of contaminants to a receptor are not completed or are significantly reduced. Acid sulfate soils are managed. Sound monitoring system is in place.
	S2	Prior to commencement of construction works	The contamination management plan and acid sulfate soil management plan will be independently audited by an auditor accredited under the *Contaminated Land Management Act* 1997.	Construction contractor	
	S3	Prior to commencement of construction works	The contamination management plan and monitoring program for water-based construction activities are to be prepared in consultation with OEH (EPA). Both plan and monitoring program will need the endorsement of EPA prior the commencement of construction works.	Construction contractor	

Subject	No.	Timing	Commitment	Responsibility	Outcome
Surface water	SW1	During the detailed design	Auburn City Council and City of Canada Bay Council will be consulted to determine any changes to the existing stormwater arrangement as a result of the future development surrounding the bridge landings.	Proponent	Stormwater from the bridge operation is managed
	SW2	Prior to commencement of construction works	A sediment and erosion control plan will be prepared in accordance with the requirements of *Managing Urban Stormwater: Soils and Construction – 4th Edition* (Landcom, 2004). The plan will be part of the construction environmental management plan for the proposal.	Construction contractor	Sediment and erosion are managed during construction
	SW3	Prior to commencement of construction works	Procedures to respond to emergency spills during construction will be prepared and implemented to protect water quality in Homebush Bay. 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.	Construction contractor	Emergency spills during construction are managed
	SW4	At completion of construction and before bridge opening	An operation plan for the bridge would be prepared. It would include environmental management procedures related to the operation of the bridge including: / Operation and maintenance of gross pollutant traps and drainage system. / Operational incident response during major spills.	Proponent	Stormwater and emergency spills are managed
	SW5	Before bridge opening	Gross pollutant traps will be installed to treat bridge run-off and to contain oil spills during the operation of the bridge.	Proponent	
Public domain	P1	During the detailed design	A safety audit for the bus lanes and pedestrian footpath would be carried out in accordance with the *Austroads Guide to Road Safety Part 6: Road Safety Audit* (2009).	Proponent	Non-conformances or hazards identified and addressed.

Subject	No.	Timing	Commitment	Responsibility	Outcome
Noise	N1	Prior to commencement of construction works, and during construction	Rhodes and Wentworth Point residents will be kept informed and up to date with the proposed schedule of works in order to maintain good community relations and proactively managing expectations and adverse reactions.	Construction contractor	Noise impacts during the construction stage are managed
	N2	During construction works	Workers and contractors will be trained to use equipment in ways to minimise noise.	Construction contractor	
	N3	During construction works	Construction site manager will periodically check the site and nearby residences for noise problems so that solutions can be applied in a timely manner.	Construction contractor	
	N4	During construction works	All plant and equipment will be turned off when not in use.	Construction contractor	
	N5	During construction works	Whenever reasonable and feasible, noise mitigation measures outlined in BS 5228.1 and Table C1 of AS 2436 will be implemented.	Construction contractor	
		During construction works	Normal construction hours will be: / Monday to Friday 7am–6pm. / Saturdays 8am–1pm. / No construction works are proposed on Sundays or public holidays. Construction tasks that are required to be carried out continuously will be carried out outside normal construction hours. Also, some work will be scheduled outside normal construction hours to reduce impacts on residents or road users. Rhodes and Wentworth Point residents will be notified of any planned work outside the normal construction hours.		

Subject	No.	Timing	Commitment	Responsibility	Outcome
Flora and fauna	F1	During construction works	/ Mitigation measures listed in 'Soil and contamination' and 'Sediments and water' will be implemented to minimise impacts to the ecology of Homebush Bay.	Construction contractor	Impacts on terrestrial and aquatic flora and fauna are managed
Waste	W1	During construction works	Construction waste management will follow the waste hierarchy principles of avoid, reduce, reuse, recycle, recover, treat and dispose.	Construction contractor	Waste is minimised and managed during the construction stage
	W2	During construction works	All generated wastes will be managed and disposed of in accordance with relevant State legislation and government policies including the Waste Avoidance and Resource Recovery Act 2001, the *Waste Avoidance and Resource Recovery Strategy 2007* and the *Waste Reduction and Purchasing Policy* (NSW Office of Environment and Heritage). *The Waste Classification Guidelines* (DECCW, 2008) will also be used to classify the different types of waste.	Construction contractor	
	W3	During construction works	Transport of materials to and from the site will be done using covered trucks where possible.	Construction contractor	
	W4	During construction works	A waste register will be maintained for the site. It will detail the types of waste collected, amounts, date/time and details of disposal.	Construction contractor	
	W5	During construction works	Solid waste materials awaiting disposal will be appropriately contained and stored in a manner that will ensure they do not escape into the environment.	Construction contractor	
	W6	During construction works	Training in waste minimisation principles and measures will be provided as part of site inductions.	Construction contractor	

Subject	No.	Timing	Commitment	Responsibility	Outcome
Bridge certification	B1	Prior to commencement of construction works	The equivalent of a Construction Certificate will be obtained and issued to Sydney Olympic Park Authority. The Construction Certificate will certify that the 'for construction' bridge drawings and design specifications comply with RMS design standards and that the bridge has been designed in accordance with the relevant conditions of approval.	Proponent	Bridge is designed as per RMS design standards and relevant approval conditions
	B2	At completion of construction and before bridge opening	The equivalent of a Completion Certificate will be obtained and issued to Sydney Olympic Park Authority. The Completion Certificate will certify the final 'as constructed drawings' comply with RMS design standards and that the bridge has been constructed in accordance with the relevant conditions of approval.	Proponent	
Easements	ES1	At completion of construction and before bridge opening	All bridge easements will be registered by NSW Land and Property Information prior to bridge opening.	Proponent	Easements are registered with NSW Land and Property Information
Making good of disturbed areas	M1	Prior commencement of construction works	A plan will be prepared by a registered surveyor, showing all survey marks on public record, which may be potentially disturbed or destroyed during the course of the works. Copies of this plan will be sent to the relevant authorities.	Proponent	Areas disturbed during construction are restored
	M2	At completion of construction and before bridge opening	The proponent will make good to any damage to existing sea walls, road surfaces, concrete foot paving and landscaping that may be caused during construction. Prior to undertaking the repairs, the applicant will contact the relevant authority to inspect the site and determine the extent of the works.	Proponent	