Sydney Harbour Bridge—Deck Resurfacing
Heritage Impact Statement

Report prepared for NSW Roads and Maritime Services
December 2011
## Report Register

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1.0 Introduction and Historical Background

1.1 Introduction

This Heritage Impact Statement (HIS) has been prepared by Godden Mackay Logan Pty Ltd (GML) to assess the likely heritage impact of the proposed waterproofing and resurfacing work for the Sydney Harbour Bridge. These works are described in detail in Section 3.0.

The Sydney Harbour Bridge is listed on a number of heritage statutory listings including the State Heritage Register, City of Sydney Local Environmental Plan (LEP) and the North Sydney LEP, and the National Heritage List. It is also noted on non-statutory heritage listings including the National Trust of Australia Register. It has been assessed as having national and state significance because of its technical qualities as a world standard bridge in scale, aesthetics and design features. Details of each of the listings are provided below in Section 1.3. The SHB is an iconic element in the harbour landscape and a key link in the arterial network that connects the city to the northern suburbs.

The proposed works include removing the asphalt road surface to expose the concrete bridge deck (including the arch span and approach spans), application of a waterproofing system to the concrete bridge deck and paving then line marking a new asphalt road surface.

The proposal is essential to replace the road pavement of the bridge deck, which is nearing the end of its acceptable service life. It is also required to prevent rainwater damage to structural elements of the Sydney Harbour Bridge including the concrete bridge deck and steel support structure. Replacing the road pavement would reduce the need for reactive maintenance that can cause considerable disruption to Sydney Harbour Bridge traffic.

1.2 Study Area

The Sydney Harbour Bridge is part of the Bradfield Highway and links the southern and northern shores of Sydney Harbour, spanning from Dawes Point in the south to Milsons Point in the north (see Figure 1.1).

The bridge incorporates not only the arch spans, pylons and approach spans but also two railway lines, a cycleway, footpaths and roads between the northern and southern approach spans. This assessment details the potential impacts of the works on the fabric of the bridge and bridge structure between Chainage 0-1153 as described in Figures 1.2–1.3. The works are necessary to ensure the continuing operation of the bridge.

Unless otherwise indicated, the use of the term ‘SHB’ or ‘bridge’ includes the whole of the study area.

1.3 Existing Listings

1.3.1 Statutory Listings

The following Statutory Listings apply to the SHB.
National Heritage List (NHL)

The Sydney Harbour Bridge was included on the National Heritage List (NHL) on its 75th birthday in 2007. The legislative instrument that governs the management of places listed on the NHL is the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth) (EPBC Act).

The full listing is included in Appendix A. This is the excerpt from the NHL:

_The Sydney Harbour Bridge is considered the world's greatest arch bridge and is one of Australia's best known and photographed landmarks. An engineering masterpiece, the bridge represented a pivotal step in the development of modern Sydney and an important part of the technical revolution of the 1930s._

State Heritage Register (SHR)

The Heritage Act 1977 (NSW) affords protection for state significant items through the State Heritage Register (SHR). The ‘Sydney Harbour Bridge, approaches and viaducts (road and rail)’ was placed on the SHR in June 1999. The 'Milsons Point Railway Station group', which includes the area bounded by the bridge approach spans and reserves surrounding it, was also listed on the SHR in April 1999.

The curtilage of the SHR listing is slightly larger than that included in the NHL entry, which omits the northern end of the SHB approach spans.

The SHR listing provides standard exemptions for some maintenance and repair works and for some alterations, including:

1. maintenance and minor repairs necessary to preserve and maintain the functioning of the structure as a transport and services corridor, for example pavement resurfacing, track laying, electric catenary replacement, traffic management, toll collection and navigational infrastructure, and pipework and cabling;

The SHB listing is supported by an endorsed Conservation Management Plan (CMP) [GML 2007] and therefore is afforded additional site-specific exemptions. The boundary of the SHR listing is shown in Figure 1.4.

RTA (now NSW Roads and Maritime Services) Heritage and Conservation Register

In accordance with Section 170 of the Heritage Act, the former RTA (now RMS) has established a register to record all heritage items in its ownership or under its control. The following items are listed on the RMS Heritage and Conservation Register:

- Sydney Harbour Bridge, approaches and viaducts;
- Sydney Harbour Bridge Workshops Collection;
- Sydney Harbour Bridge Memorabilia Collection; and
- SHB Southeast Pylon Museum Collection.

RailCorp Heritage and Conservation Register

In accordance with Section 170 of the Heritage Act, RailCorp has established a register to record all heritage items in its ownership or under its control. The following items are listed on the RailCorp Section 170 Register (the Heritage and Conservation Register):
• Sydney Harbour Bridge (Rail Property Only); and
• Sydney Harbour Bridge Approaches Concrete Underbridge (Group Entry).

**Sydney Local Environmental Plan (LEP) 2005**

The southern approach spans and curtilage are identified in Schedule 8 Part 1 of the Sydney Local Environmental Plan (LEP) 2005, which lists the heritage items within the LEP area. The site is also located within the Millers Point Conservation Area, identified as a Special Area on the plans attached to the LEP.

**North Sydney Local Environmental Plan (LEP) 2001**

The Sydney Harbour Bridge and approach viaducts (NSHS No. 0030) and the north pylons (NSHS No. 0076) are listed on Schedule 3 Part 6 of the North Sydney Local Environmental Plan (LEP) 2001.

**Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 (NSW)**

The ‘Sydney Harbour Bridge, approaches and viaducts (road and rail)’ is listed as a heritage item on the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 (NSW) (REP) (Item 67).

**1.3.2 Non-Statutory Listings**

In 1988, the bridge was declared an International Historic Civil Engineering Landmark during an official visit by a delegation from the American Society of Civil Engineers (ASCE). The ASCE plaque is fixed to the eastern wall of the southeast pylon adjacent to the entrance to the Pylon Lookout. At the same time, the bridge was declared a National Engineering Landmark under the Australian Historic Engineering Plaquing Program managed by Engineering Heritage Australia. This plaque is fixed to the parapet wall opposite the eastern doorway that leads to the Pylon Lookout.

The bridge is also included in the Register of the National Trust of Australia (NSW).

The bridge was included in the Register of the National Estate, which was frozen in 2007 and has been replaced for Commonwealth statutory purposes by the National Heritage List.

**1.4 Historical Background**

**1.4.1 Construction of the Bridge**

The first sod of the construction of the Sydney Harbour Bridge was turned at the site of the future North Sydney Railway Station on 28 July 1923 by the Honourable RT Ball, Secretary for Public Works and Minister for Railways and State Industrial Enterprises.

Work on the approach spans from the north and south was carried out through 1923 and 1924, prior to the signing of the final contract for the bridge proper. The approach spans were designed and built by the Sydney Harbour Bridge Branch of the Public Works Department and the Metropolitan Railway Construction Branch of the NSW Government Railways. Construction began at North Sydney with the excavation of tunnels for the railway, followed by bridges over Eureka, Bank, Fitzroy, Burton, Lavender and Arthur Streets (completed between 1924 and 1929), and retaining walls of stepped section concrete being built at Broughton and Alfred Streets, the Bradfield and
Pacific Highways. Fill for the construction of the roadway and approach spans were provided on the north side by the excavated material from the North Sydney railway site and tunnelling operations.

In January 1925 Dorman Long began excavating at Dawes Point and built a ramp from George Street North to haul materials up from the wharf below. The foundation stone for the Southern Abutment Tower was laid in March 1925 and the first goods train of materials for the bridge arrived at North Sydney. By the end of March, the first shipment of steel had arrived from England and work to erect the fabrication workshops got underway. Two wharves were constructed in Lavender Bay where the steel was unloaded into a stockyard which contained angle benders, saws and croppers, before it was moved, via crane and light rail, first to the light workshops, where it was straightened or cut to length as required. Above the workshops was the template loft, where the templates for the bridge pieces were created. The steel was taken from the light workshops to the marking-out bay, and then to the drills for the holes needed for rivets and screws to be drilled through. From here, the pieces were transported to the heavy workshop where the steel was painted and then the pieces assembled into sections. The sections, most measuring up to 50 metres in length and weighing 100 tonnes, were then transported via overhead gantry crane to pontoons for transport out to the bridge site.

The workshops were filled with specifically designed machines, each playing an important part in the overall production process. The light workshop had a cutting and edging machine over 20 metres long; the guillotine cutters in the stockyard, cutting steel up to 54mm thick, could reputedly be heard in Manly on a calm day. Amongst these, gangs of riveters and other construction workers went about the business of working the machines and putting the pieces together. Conditions were hot and incredibly noisy throughout the Lavender Bay workshops.

As the approaches advanced from north and south towards the harbour, 5-tonne steam locomotive cranes advanced with them, erecting temporary timber trestling to support the steel work. Behind each small crane was a larger electric crane of 25 tonnes, which lifted the steel into place. The cranes moved forward on the approaches as they were constructed, stopping as they reached the site for each pier, which they also helped erect.

While the approaches were being constructed, the abutment towers were also being built. Constructed on reinforced concrete, the abutment towers include the four main bearings at the base of the lower cord of the bridge: two at Milsons Point and two at Dawes Point. The bearings take the thrust of the arch, transmitting the pressure directly to the ground where the load is spread through an area of 68 x 49 metres, excavated to a depth of 19.2 metres to solid rock and then filled with hexagonal shaped concrete blocks to the base of the abutment towers.

The towers, like the piers, have their concrete structure faced with granite from Moruya. The concrete was mixed by a gang of six men only for each side of the harbour and poured by another gang of six men for each tower. Each gang placed the reinforcing, poured the concrete and packed it by hand with rods. In total each gang poured and packed a total of 95,000 cubic metres. Once the towers reached 47 metres from ground level, reinforced concrete floors were created to build and launch the creeper cranes which would be used to build the bridge’s arch spans.

Like the cranes for the approaches, the two creeper cranes erected their own track, the arch itself, in front of themselves to advance. One creeper crane worked from each side of the harbour and they were critical elements for the bridge construction. The cranes were supplied by Wellman Smith and Owen Engineering Corporation of Great Britain, and were designed specifically to travel...
along the top of the arch, moving forward as each section of the arch was completed. Each crane was in fact a collection of five cranes, grouped on a travelling frame, working together. The main crane consisted of a main hoist with a lifting capacity of 123 tonnes. Next was a 20-tonne jigger hoist to help control the heavy bridge members as they were erected. A 5-tonne walking crane operated across the front of the girder of the creeper crane to lift working cages, while two 2.5-tonne cranes operated at the back of the frame to assist in the riveting stages of construction. Once the first section was assembled, the two creeper cranes began to move forward towards each other. To prevent slipping back, each unit was also fitted with a special braking system.

The erection of the arch spans began on 26 October 1928. Each side of the arch was held by 128 steel cables, anchored into the rock through horseshoe shaped tunnels placed between the first and second piers on each side of the harbour. The cables obviated the need for any other supports to be built during the construction phase. As the half-arches moved towards each other across the harbour, the cables were tensioned to suit the increasing weight of the structure.

The arches were manhandled by the crews working on the bridge structure. As each piece of steelwork was fabricated, it was transported from the workshops via barge out onto the harbour, where the creeper cranes would lift it into position. Up on the bridge, teams of riveters, steel fabricators, carpenters, riggers, form-workers, boilermakers, labourers and other tradesmen all worked to put the bridge pieces together. Once work started, the bridge moved quickly forward. By August 1930 the two half-arches were ready to be joined. On 7 August the cables holding the giant arches back from each other were ready to be slackened. Before they were finally joined, a severe wind storm hit Sydney. With winds of over 110 kilometres per hour, the 15,000-tonne arches swayed (albeit only 7.5cm) when less than one metre apart. Despite this excitement, at 4.15pm on 19 August 1930, the two spans touched for the first time. They briefly parted again as the cables contracted as they cooled, but were brought together finally at 10pm the same night.

The meeting of the halves was celebrated with a half day holiday for the workers, a gold sovereign for those involved in releasing the cables and two shillings for everyone else to drink a toast to their achievement. With the release of the cables, the arch spans underwent stress testing and final adjustments to bring the full load to bear on the two hinged bearings at the abutment tower bases.

As the two creeper cranes were now positioned in the middle of the arch spans, the construction of the deck and vertical hangers began from the centre and moved back towards the shorelines as the cranes returned to their starting positions. Each hanger section was lifted from a barge on the harbour directly below using a special cradle which enabled them to be positioned underneath the arch not directly accessible to the crane lifting cables. A rigger rode each section up from the harbour to fit it to the arch chord. The cradle also acted as a brace for the hangers as they were lifted from the harbour and fitted. Once the hangers were attached, the deck cross girders were placed, followed by diagonal bracing and stringers, and steel troughings to take the roadway were formed. The construction of the hangers and deck took just nine months from the time the arch span was closed.

In June 1931 the creeper cranes were dismantled and the remaining major tasks involved the completion of the pylons above the deck level and the surfacing of the deck with asphalt. The last stone, set in the northwest pylon, was set on 15 January 1932 and the last rivet on the bridge was driven on 21 January. In February the bridge was test loaded. To undertake this, the four rail lines were packed with 72 locomotives placed buffer to buffer, and then shifted, moved and removed in
different patterns to test the stresses. The bridge passed its tests easily and was prepared for opening.

On completion the bridge was the largest man-made structure in Sydney and towered over the surrounding low rise city. The Sydney Harbour Bridge was officially opened on 19 March 1932 by the then Labor Premier Jack Lang.

Figure 1.1 Proposal location. (Source: RMS)
Figure 1.2 Proposed works—southern approach span. (Source: RMS)

Figure 1.3 Proposed works—northern approach span. (Source: RMS).
Figure 1.4 SHR listing boundary. (Source: NSW Heritage Branch, OEH)
2.0 Description and Integrity of the Bridge

2.1 Physical Description

The Sydney Harbour Bridge (the bridge) spans Sydney Harbour, connecting Sydney’s northern and southern shores at Milsons Point and Dawes Point. The bridge itself comprises the arch span, four granite-faced pylons, approach spans, two railway lines, a cycleway, footpaths and roads between the northern and southern approaches.

The following description of the bridge considers the setting and the views to and from the bridge within Sydney Harbour, the fabric of the bridge and other associated elements including the surrounding parklands, subsurface remains and the movable heritage collections associated with the bridge, its construction and its continuing operation.

The full area of Sydney Harbour extends over 5,500 hectares and is one of the world’s most famous harbours. The bridge dominates most of the views within the Sydney Harbour and is visible from many places along both sides of Port Jackson, including The Rocks, Circular Quay and Bennelong Point on the southern side, and Kirribilli, Taronga Zoo and McMahons Point on the northern side.

The bridge itself offers some of the best views of the city of Sydney, the harbour and other iconic elements, including the Sydney Opera House and Luna Park.

The fabric belonging to Sydney Harbour Bridge includes not only the steel arch and Bradfield Highway surface extending 2.2 kilometres across the harbour, but also:

- long expanses of rendered retaining walls, enormous granite-faced pylons, interior spaces in the pylons, occupied tenancies under the approaches and a scattered assortment of items designed for the bridge such as commemorative plaques, light fittings and railings.

The bridge itself is constructed of silicon steel trusses and joists painted dark grey. ‘The whole structure, while appearing to be curved, is made up of riveted straight steel angles and plates.’ The deck is hung from the main arch truss by 40 silicon steel hangars, which are connected to latticed cross girders beneath the railway and road surface.

The roadway surface of the Bradfield Highway consists of steel troughing plates supported over carbon steel stringers, floor beams and cross girders, covered with coke concrete and rock asphalt. When tram travel across the bridge ceased, and the tramway rails and associated sleepers and elements were removed, the tramway was converted to an additional two roadways, with an asbestos fibre cement formwork and a reinforced concrete slab, creating the two easternmost (southbound) lanes, later named the Cahill Expressway. Toll booths are located at the southern end of the bridge to charge the toll for southbound traffic headed into the CBD.

The southern and northern approaches are characterised by large reinforced concrete retaining walls that link the distributor roads on both the north and south shores onto the Bradfield Highway. The northern and southern approach spans comprise open work steel trusses which are mounted on concrete abutments and the northern and southern abutment towers and supported by granite-faced pillars.

The following definition of the abutments and their relationship to the pylons is provided in the Sydney Harbour Bridge CMP—Inventory Records, prepared for the bridge in August 1997:
The term ‘pylons’ is widely used to refer to the whole of the masonry construction at each end of the arch. The abutment tower is the structure that supports the deck between the arch and the approach spans and takes the thrust of the main arch bearings at its base. The pylons are the two towers built on top of the abutment tower starting at deck level.

The abutment towers are divided into three large compartments by thick internal walls. The large central and side interior spaces of the southern abutment tower are utilised by RMSSHB maintenance and security as workshops, amenities and office space. The northern abutment tower space is partially used for storage and workshop space by the crews that monitor and tow broken down vehicles on the bridge.

Two train lines are situated on the western side of the bridge, separated from the motor lanes by fencing and concrete barrier. A 2.5-metre-wide cycleway is also located on the western side of the bridge, west of the North Line railway tracks. There is a pedestrian footpath on the eastern side of the bridge.

The southeast pylon is currently operated as a SHB museum and lookout, managed by BridgeClimb.

Throughout the construction of the bridge, many opportunities to publicise and promote progress were taken, with numerous ceremonies and installations of foundation stones, plaques and tree plantings. Two foundation stones are located on the Southern Abutment Tower, and were laid in 1925. Thirteen bronze plaques have also been installed along the bridge and the approaches, commemorating a variety of events including the discovery of Australia, the foundation of the Commonwealth of Australia, Australia’s participation in World War I, and the construction of the bridge itself. Other plaques were proposed and never installed or have been lost over time.

Other smaller elements located on and around the bridge include:

- a variety of bridge lighting fittings and lamps;
- fencing between the motor lanes, train tracks, cycleway and pedestrian access;
- toll booths and gantries associated with lane changes;
- stairs, ladders and catwalks (public and secured access); and
- maintenance cranes and gantries (used in construction, maintenance and ongoing painting works).

2.2 Physical Changes/Integrity

Since the opening of the Sydney Harbour Bridge in March 1932, there have been a variety of physical additions and alterations made to the structure—some great, some small—in response to changing uses and needs of the bridge. The main working purpose of the bridge is to convey public and private transport across the expanse of Sydney Harbour, and it is in regard to the balance of public and private usage that has resulted in the most change to the bridge.

In 1958 the last tram crossed the bridge and following this the tramway was converted into lanes to carry road traffic. The entrances to the Wynyard tunnels were partially blocked by the relocation of the eastern footway, while the tunnels themselves were leased to the Railway Institute for a shooting range and to the Menzies Hotel for a carpark. On the northern side, the tram station was
removed to make way for the road. By 1959 car usage was over 66,000 vehicles per day. In 1966 the former tramway arch on the northern side was also removed to allow for the connection of the Cahill Expressway and Warringah Expressway.

The creation and connection of the two expressways also created a number of major physical changes to the bridge and its immediate surrounds. On the southern side, the Cahill Expressway had been started by the mid-1950s, and the first section from the bridge across Circular Quay to Conservatorium Place was opened in 1958. The Expressway was extended to Woolloomooloo in 1962.

In a reminder of the 1920s and 1930s demolitions undertaken to construct the bridge, a large number of residential and commercial properties were demolished on the northern side to make way for the Warringah Expressway approaches. The new expressway also required the removal of the former tramway arch and bays 11–14 on Ennis Road (demolished 1966). The first stage of the Warringah Expressway, from the bridge to Miller Street, Cammeray, was opened by Sir Roden Cutler in June 1968. This was extended in 1978 by a further 1.4 kilometres, extending as far as Naremburn.

In 1972 a new southern approach was also opened with the completion of the Western Distributor which gives access to motor traffic to and from Sydney’s western and southern suburbs.

Actual traffic management on the bridge between 1932 and 1951 consisted of police on point duty at both ends during peak hour. Between 1951 and 1985, lanes were marked out by removable rubber lane markers, placed and removed by hand twice daily for peak hours. From 1977 the system began to be modified with the introduction of movable median strips. In 1986 this was followed up with the erection of new overhead gantries with lane indicator lights and electric lane control signals, phasing out the rubber lane markers.

From the opening in 1932, tolls were charged from vehicles crossing the bridge. This was viewed with some consternation and objections from residents of the North Shore who had been paying an additional land tax to pay for the bridge since 1923. Toll collectors were initially installed on a traffic island with a small rail around them until December 1932 when toll booths and toll bars were added. The toll bars were modified in 1959 and again in 1970, when automatic one-way toll collection and movable toll cabins were installed, along with new toll offices and staff amenities. More recently, cashless e-tag toll collection has also been introduced.

In 1935 the protective barriers were added to the footways, primarily to discourage suicide attempts. While these were fitted to the water side of each footway, more recently (2005–2006) mesh fencing with barb wire strands have also been fitted to the roadway side of each footway to prevent pedestrian access to the road deck. As well as these protective barriers, roadway crash barriers were installed in 1958. During the later 1980s (1987), extra security was added at the entrance to the pylon lookout, the maintenance access gates on the arch and the fences at the main bearings. The purpose of these modifications has been to restrict unauthorised people from areas of the structure that present a danger, and to reduce risk and consequent liability for the RMS.

2.3 Maintenance, Safety and Structural Issues

The proposed resurfacing works are to be carried out in response to a number of concerns in regard to the ongoing operation of the SHB. The existing asphalt surface of both the concrete bridge deck and the approach spans has been replaced since construction of the bridge, as it has a finite operational life. Replacement normally requires milling to remove the existing asphalt, repair
of any flaws and resurfacing. Due to the difficulty of closing the bridge repairs have been undertaken as patch repairs to provide drivable surfaces, rather than expose and repair underlying cracks or flaws or to provide waterproofing. The current surface is now subject to sudden failure which results in sudden closure of lanes and further ad hoc repairs to ensure safety for motorists. In addition, these failures put the concrete bridge deck at risk by allowing water to penetrate to both the slab (lighty compacted breeze concrete with coke aggregate) and the steel troughing which acts as permanent formwork. Damage to these structural elements needs to be avoided at all costs.

Figure 2.1 Section through the deck structure of the SHB.

Figure 2.2 Detail of section through the structure of the SHB. The steel troughs supporting the deck are visible.
3.0 The Proposal

The proposed works will result in the waterproofing and resurfacing of lanes 1–6 (ie the centre lanes between the pylons) on the concrete bridge deck between the bridge abutments (between Chainage 0 and Chainage 1153), extending from about 300m south of the southern pylon to about 270m north of the northern pylon. The works have been designed to resurface the Sydney Harbour Bridge and reseal the approach spans with a highly flexible polyurethane system and the arch span with a crumbed rubber bitumen seal. The works include:

- removing the existing asphalt and any residual previous membrane to expose the concrete bridge deck;
- brushing, washing and drying the concrete bridge deck;
- applying a new 3-coat (1 x polyurethane and 2 x primer on either side) waterproofing membrane system to the concrete bridge deck for the approach spans, and a heated crumbed rubber-impregnated bitumen waterproofing layer on the concrete bridge deck arch span;
- replacing the asphalt surface generally to the existing variable thickness (between 38–70mm) with an improved cross-fall in both directions; the asphalt mix is suitable for static roller compaction;
- replacing line markings on the new asphalt road surface; and
- providing two ancillary facilities including amenities, plant establishment sites, clean-up sites and stockpile sites, one near the southern approach span in Observatory Hill and one on the northern approach span beyond the work.

The existing road surface comprises asphalt sitting on a coke breeze concrete bridge deck (lightly compacted concrete with coke aggregate) which is supported by a steel structure and ribbed steel troughs which act as permanent formwork. The proposed work is necessary to avoid sudden asphalt failure, which has started to occur, and to prevent the corrosion of reinforcing and permanent steel formwork due to water penetration through the concrete bridge deck.

The asphalt surface on the concrete bridge deck (including the approach spans and the arch span) has been replaced since construction of the bridge; however, it is expected that at the base of the existing asphalt some thin layers of the original may exist. The asphalt will be removed to the concrete bridge deck (ie the level pre-determined by core samples) using a fine drum mill, with the remaining asphalt to be removed using a micro drum mill to ensure that the concrete bridge deck is not damaged. The machines would remove asphalt to within 100mm of the kerb and bridge joints. The remainder would be removed using jack hammers.

There may be earlier road surfaces present under the existing asphalt, which may include an earlier tar and hessian membrane. In recent trials in Lanes 1 and 2 between Chain 0 and Chain 291 there was no evidence of earlier road surfaces (3,000 asphalt core samples were taken to determine the existing depth of the asphalt). During the resurfacing works it will be necessary to avoid impact on the steel expansion joints which are located at 50m intervals on each of the approach spans, with two located on the bridge deck itself. These locations will be closely monitored.
The bare concrete bridge deck will be cleaned with a system that includes mechanical sweeping, water cleaning with a vacuum broom, and drying using a road heater. The vacuum is attached to the broom which sprays the water, and the water is removed almost immediately. It is a well-used system and trials have been undertaken in the past to determine that no residual water remains, providing that the equipment used is well-maintained. The heating process has not previously been used on a coke breeze slab and the drying times have been reduced to ensure that the chemical composition of the concrete bridge deck is not affected by the heat.

The provision of the three-layer Sika waterproofing system on the approach spans (one layer of polyurethane membrane and a layer of primer either side of this) will provide protection of the substrate from water penetration and will provide a lifespan of at least 50 years. The use of static rollers to compact the bitumen is necessary to ensure there is no impact or vibration damage to the concrete bridge deck. The use of the heated crumbed rubber-impregnated bitumen waterproofing layer on the bridge deck itself also provides a waterproofing layer.

The works are necessary in order to:

- reduce routine pavement maintenance;
- prevent further corrosion to steel structural members; and
- provide a safe and smooth driving surface for road users.

The condition of the steel troughs is routinely monitored from below. It could be expected that these steel members may experience a period of accelerated rusting once the concrete bridge deck conditions above change (ie once the concrete bridge deck dries out), although the paint finish will ameliorate this. Routine monitoring of these elements occurs as part of the existing maintenance regime.
4.0 Significance of the Sydney Harbour Bridge

4.1 Summary Statement of Significance

The following Statement of Significance summarises the National and State Heritage values of the SHB as reflected in their listings.

4.1.1 National Heritage Values

The Sydney Harbour Bridge is of outstanding heritage value as a feat of bridge engineering and construction, especially for a young nation that had previously not taken on a project of this scale and complexity. Even today, it continues to be the widest long-span bridge in the world and is recognised as the world’s greatest steel arch bridge because of its combination of size, load bearing capacity and the difficulties overcome in its construction.

The bridge is a symbol of national pride. At the time of its construction, it represented progress and modernity and symbolised Australia’s industrial maturity, particularly as it was constructed with extensive use of Australian engineering expertise, materials and labour. For Australians, the bridge was seen as a great achievement and a symbol of hope at a time of the worldwide Depression.

The steel arched form, art deco inspired granite pylons and composite approach spans create an iconic and dramatic composition that consistently evokes a positive response from observers. The bridge is seen as a major element of one of the most internationally recognised views of Australia and the city of Sydney, which also comprises the Sydney Opera House, the harbour and its foreshores and the city skyline. Its iconic shape has been used as the inspiration for countless decorative objects, ornaments and tourist products.

The dramatic aesthetic quality of the bridge and its setting has, since the commencement of its construction, been an inspiration to artists, photographers and film makers. It has and continues to be the subject of many works of Australian art, captured by acclaimed artists such as Grace Cossington-Smith and Roland Wakelin. The National Heritage Listing is attached as Appendix A.

4.1.2 State Heritage Values

The bridge is a monumental landmark in the centre of the city of Sydney and an important visual element in the cityscape when viewed from many key points around the harbour.

The bridge was the outcome of the personal vision and commitment of Dr JJC Bradfield, Chief Engineer, Sydney Harbour Bridge, City Transit and Metropolitan Railway Construction, and the leading figure in the development of Sydney’s transport system in the first part of the twentieth century. It is also associated with the British team of engineer Sir Ralph Freeman and contractors Dorman Long and Co. Its construction consumed a major portion of the public works capacity and budget of New South Wales, and was a very significant undertaking for the public sector at the time.

The bridge remains synonymous with the names of a broad range of personalities associated with either its construction or subsequent history, eg Premier Jack Lang, Francis De Groot, Paul Hogan.

The approach spans, concrete bridge deck and retaining walls of the bridge are important examples of the use of in situ reinforced concrete on a massive scale, combined with the fine scale use of the material for detail components such as balustrades and step and bass relief decoration. The scale and design of the viaducts forming the approach spans to the bridge are notable within the New
South Wales context. The masonry pylons and abutments of the approach spans designed by the English architect Thomas Tait exhibit a sophisticated degree of art deco design influence comparable with other examples in Sydney and New South Wales.

The bridge has been in continuous use since 1932 as the main road and rail connection across Sydney Harbour. Together with the city railway system, it constituted a radical expansion of Sydney’s transportation network, and allowed a major acceleration in the development of the northern residential suburbs, particularly in the post-World War II years, as well as the extension of the Central Business District into North Sydney in the 1960s and 1970s.

The bridge approach spans provide the physical evidence of extensive urban redevelopment within The Rocks/Milsons Point precinct and the wider North Sydney precinct where large parts of the early subdivision patterns and built forms were demolished prior to the construction of the bridge. The bridge approach spans and roadways (especially the Warringah Freeway at North Sydney) truncated established neighbourhoods, creating distinctive precincts whose land use and built forms developed separately.

The construction of the bridge affected the lives of almost a generation of workers, and its role during the Depression as the so-called ‘iron lung’ which provided employment and protected workers and their families from hardship or the dole is still remembered.

The bridge became an early focal point for political tensions and national celebrations, starting with the De Groot incident in 1932, and more recently the Walk for Reconciliation in 2000, the Sydney Olympic Games in 2000 and the annual role it continues to play as part of New Year’s Eve and Australia Day celebrations.

In terms of archaeological value, the surviving standing walls at Bradfield Park have the potential to yield further information about the early residential and commercial occupation of Milsons Point, and the archaeological remains in Dawes Point have the potential to yield further information about its early development, particularly the Dawes Point Battery and later alterations.

The SHB Movable Heritage Collection is significant as a collection of relics associated with the design, construction, official opening and ongoing operation of the bridge. The collection contains the only known relics of the temporary support structure utilised for the erection of the arch span steelwork, and evidence of the operations carried out in England for the construction of the bridge.

The collection includes items which are significant as representative examples of the materials, technical instruments, technical documentation, components and manufacturing outputs associated with the construction of the Sydney Harbour Bridge. It also contains examples of unique and specialised documents and objects used in association with the Opening Day social activities and celebrations, which are themselves evidence of the social customs and attitudes of the time. The collection contains exhibits which showcase the wide range of objects, activities and publications inspired by or produced in association with the operations of the Sydney Harbour Bridge throughout its history.

Some exhibits in the collection also have value as relics of their period, illustrating aspects of the social context, mores and activities of Sydney at the time of the construction of the bridge. The SHB Movable Heritage Collection demonstrates the ways in which icons of the era were commemorated through retention of specific materials and objects, and illustrates the social importance of the bridge at the time of construction.
4.2 Grades of Significance

4.2.1 Significance of Components

Different components of a place may make a different relative contribution to its heritage value. Loss of integrity or poor condition may also diminish significance. The following gradings have been based on the NSW Heritage Office’s publication *Assessing Heritage Significance* (2001) which sets out terms used to describe the degrees (or grades) of significance for different components of a place (see Table 4.1 below).

<table>
<thead>
<tr>
<th>Grading</th>
<th>Justification</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceptional (E)</td>
<td>Rare or outstanding element directly contributing to an item’s Local and State significance.</td>
<td>Fulfils criteria for Local or State listing</td>
</tr>
<tr>
<td>High (H)</td>
<td>High degree of original fabric. Demonstrates a key element of the item’s significance. Alterations do not detract from significance.</td>
<td>Fulfils criteria for Local or State listing</td>
</tr>
<tr>
<td>Moderate (M)</td>
<td>Altered or modified elements. Elements with little heritage value, but which contribute to the overall significance of the item.</td>
<td>Fulfils criteria for Local or State listing</td>
</tr>
<tr>
<td>Little (L)</td>
<td>Alterations detract from significance. Difficult to interpret.</td>
<td>Does not fulfil criteria for Local or State listing</td>
</tr>
<tr>
<td>Intrusive (I)</td>
<td>Damaging to the item’s heritage significance.</td>
<td>Does not fulfil criteria for Local or State listing</td>
</tr>
</tbody>
</table>

By applying the standard gradings to the major components of the bridge, the arch, pylons and approach spans are of Exceptional significance and the approach spans are of High significance. The arch span and pylons are the main recognisable components of the bridge and contribute directly to its significance. Although the approach spans are less significant structurally than the arch and the pylons, they form the connection to the shores on each side and are a vital component of the bridge. The approaches are of High significance because, although subsidiary to the arch section of the bridge and of less engineering interest, they are an integral part of the bridge construction.

4.2.2 Schedule of Significance Forms and Fabric

Tables 4.2 and 4.3 below extracts the relevant items from the full schedule of the bridge’s significant fabric and form which is included in the GML 2007 CMP.

<table>
<thead>
<tr>
<th>Bridge Component</th>
<th>Grading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arch, pylons and abutments</td>
<td>Overall form of the arch, pylons and abutments, including:</td>
</tr>
<tr>
<td></td>
<td>- the pattern of the steel structural members;</td>
</tr>
<tr>
<td></td>
<td>- the exterior form and detail of the granite clad pylons and abutments; and</td>
</tr>
<tr>
<td></td>
<td>- the clear spaces between the arch end posts and pylons and the clear space between the deck and the water.</td>
</tr>
</tbody>
</table>
Table 4.3 Grading of significant fabric.

<table>
<thead>
<tr>
<th>Bridge Component</th>
<th>Grading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arch and approach spans</td>
<td></td>
</tr>
<tr>
<td>All steelwork of the trusses, lateral bracing and hangers, portal frames at end posts, floor laterals, cross girders, stringers, joists and bearings.</td>
<td>High (H)</td>
</tr>
<tr>
<td>Lattice steel parapets, balustrades, lighting/overhead cable supports, steel cantilever arms.</td>
<td></td>
</tr>
<tr>
<td>All original access equipment, painting cranes, gantries, stairs, ladders and handrails.</td>
<td></td>
</tr>
<tr>
<td><strong>Coke concrete filling on pressed steel troughs.</strong></td>
<td></td>
</tr>
<tr>
<td>Steel curb plates, cast iron scuppers and gratings.</td>
<td></td>
</tr>
<tr>
<td>Any original railway components: ‘trainstop’ devices, signals, signage.</td>
<td></td>
</tr>
<tr>
<td>Bronze plaques.</td>
<td></td>
</tr>
<tr>
<td>Suicide fences and security barriers.</td>
<td>Moderate (M)</td>
</tr>
<tr>
<td>Steel tower supporting the air navigation beacon.</td>
<td></td>
</tr>
<tr>
<td>Evidence of conversion from tramway to roadway.</td>
<td></td>
</tr>
<tr>
<td>Pitched-roofed sheds at mid-span.</td>
<td></td>
</tr>
<tr>
<td>Roadway crash barriers.</td>
<td>Little (L)</td>
</tr>
<tr>
<td>Communication equipment, navigation beacons and lights.</td>
<td></td>
</tr>
<tr>
<td><strong>Wearing surfaces of road, rail, foot and cycleways.</strong></td>
<td></td>
</tr>
<tr>
<td>Railway tracks, concrete sleepers, timber transoms, overhead power cables, signalling equipment.</td>
<td></td>
</tr>
<tr>
<td>Steel lamp posts with curved arms.</td>
<td></td>
</tr>
<tr>
<td>Full weight concrete over area of previous tramtracks.</td>
<td>Intrusive (I)</td>
</tr>
<tr>
<td>Modern light fittings on cantilever brackets.</td>
<td></td>
</tr>
</tbody>
</table>

4.3 Implications of the Statutory Heritage Listings

The following is an analysis of the approvals process given the proposed extent of works for the resurfacing of the SHB.

Given the listing on the National Heritage List (NHL), any alterations or works that could affect the national heritage values of the bridge are subject to the procedures set out in the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and may need approval under the EPBC Act. The proposed works are not considered to have the potential to impact on the national heritage values of the SHB.

The listing of the SHB in the State Heritage Register (which has more stringent legislation than that relating to the S170 listing), requires that the approval of the Heritage Council of NSW be sought for any proposed development within the site including subdivision, works to the grounds or structures or disturbance of archaeological ‘relics’. The Heritage Act also requires the minimum standards of maintenance and repair apply to items included on the SHR to ensure that heritage significance is maintained (weatherproofing, fire protection, security and essential maintenance). Under the SHR listing there are a number of general exemptions and specific exemptions for works which, if carried out in accordance with the recommendations of a CMP, do not require approval by the Heritage Council of NSW. These exemptions include:
1. maintenance and minor repairs necessary to preserve and maintain the functioning of the structure as a transport and services corridor, for example pavement resurfacing, track laying, electric catenary replacement, traffic management, toll collection and navigational infrastructure, and pipework and cabling;

5. minor works necessary to upgrade and enhance the structural integrity of the Bridge that do not alter its overall form or shape or significantly change the appearance of bridge elements;

7. temporary works including containment areas, scaffolding and enclosures necessary for the carrying out of maintenance, enhancement or upgrading works;

It is considered that the proposed works fall under the above exemptions, and discussions with representatives of the NSW Heritage Branch have confirmed that the proposed works fall under the exemptions. Therefore, approval under the Heritage Act is not required.

Under the SREP 2005, Sydney LEP 2005 and the North Sydney LEP 2001 listings, both the City of Sydney and North Sydney Council have consent authority roles with regard to developments on the north and the south approach spans to the bridge. However, it is understood that the proposed works fall under the State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) and can be assessed under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act). Development consent from council is therefore not required however Part 2 of the ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development.

The listings under the RMS Heritage and Conservation Register and the RailCorp Heritage and Conservation Register require the RMS (and Railcorp) to maintain listed items with due diligence in accordance with State Owned Heritage Management Principles.
### 5.0 Assessment of Heritage Impact

#### 5.1 Assessment Against the CMP Policies

The following table is an excerpt of the relevant conservation policies from the GML Sydney Harbour Bridge CMP Section 7.3.\(^{21}\)

<table>
<thead>
<tr>
<th>Policy No.</th>
<th>Policy</th>
<th>Comment/Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy 1—Retention of Cultural Significance</td>
<td>1.2 Any change in ownership, future uses, maintenance, repair and/or adaptation works and asset management program should include retention and appropriate care of the significant elements and attributes of the place as a matter of highest priority.</td>
<td>The RMS has a well--established maintenance regime and a continuing works program for the SHB to ensure that it remains in good operating condition. The ongoing use of the bridge for transport is a high priority for the conservation of the structure. This project substantially contributes to the care of the significant elements of the place.</td>
</tr>
<tr>
<td>Policy 13—Integrity of Original Design</td>
<td>13.4 The fabric and design integrity of the main components of the bridge, comprising the arch, hangers, roadway, pylons, approach spans, piers and approaches including tunnels, tenancy spaces and Milsons Point railway station, should be conserved.</td>
<td>The proposed resurfacing works are essential to prevent water penetration and the resulting corrosion of structural steel elements. The asphalt surface itself has been previously replaced. The proposed works are essential to the ongoing conservation of more original elements. However, the proposed washing and drying methods to be used on the top surface of the coke breeze slab must ensure that there is no impact on the original high significance fabric of the slab and/or supporting steel troughs, from residual water remaining in the structure or from damage to the surface of the coke breeze slab.</td>
</tr>
<tr>
<td>Policy 14—Maintenance and Repair Works Generally</td>
<td>14.1 Appropriate repair and maintenance works should be carried out on an ongoing basis. The works should seek to secure fabric against further deterioration and retain as much as possible of the integrity and historical fabric and construction methods.</td>
<td>The RMS has a well-established maintenance regime and a continuing works program to ensure that the SHB remains in good operating condition. The resurfacing works will replace an asphalt surface that is not original, and seeks to protect the more original structure below. The asphalt mix is designed to facilitate rolling so that plate compaction is avoided. However, the proposed washing and drying methods to be used on the top surface of the coke breeze slab must ensure that there is no impact on the original high significance fabric of the slab and/or supporting steel troughs, from residual water remaining in the structure or from damage to the surface of the coke breeze slab.</td>
</tr>
<tr>
<td></td>
<td>14.4 A maintenance program should be prepared and regularly revised to provide the basis for the ongoing care and management of the bridge as a publicly-owned asset, and to conserve its cultural heritage significance.</td>
<td>The RMS has a well-established maintenance regime. The ongoing monitoring of the condition of the steel troughs should be continued after the asphalt replacement works.</td>
</tr>
<tr>
<td>Policy No.</td>
<td>Policy</td>
<td>Comment/Assessment</td>
</tr>
<tr>
<td>-----------</td>
<td>--------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Policy 15—Use Appropriate Specialist Personnel</td>
<td>15.2 A conservation specialist should be involved in work affecting the granite or concrete structures.</td>
<td>The proposed washing and drying methods to be used should be supervised in the initial stages by an appropriate specialist to ensure that residual water does not remain in the structure when the new waterproofing and resurfacing finishes are laid. The use of well-maintained equipment is essential to ensure controlled conditions during the wetting and heating processes.</td>
</tr>
<tr>
<td></td>
<td>15.4 Significant fabric should be retained in situ and in its current state and form, and be maintained.</td>
<td>All significant fabric remains in situ. Demolition is restricted to a previously replaced asphalt surface that has reached the end of its useful life. The proposed new finish is asphalt. Given the proposed mechanical method for removing the existing asphalt, it will not be possible to retain any of the remaining traces of earlier road surfaces that may exist under the current finish. This is considered acceptable, as the asphalt itself is of little significance compared to the significance of the overall structure. Should any sections of earlier road surfaces be uncovered they should be photographically recorded, and a sample taken if possible.</td>
</tr>
<tr>
<td>Policy 16—Records of Intervention and Maintenance</td>
<td>16.1 All works to the Sydney Harbour Bridge should be appropriately recorded and permanently stored as part of the archival recording of the history and significance of the item.</td>
<td>It is recommended that filming and photographic documentation of the works in progress be undertaken, at approximately six locations across the bridge. If any physical evidence of any earlier road surfaces is found the best pieces or samples should be kept, if possible, for permanent reference.</td>
</tr>
<tr>
<td></td>
<td>16.2 Documentation of conservation works should include the rationale and methods employed to monitor performance.</td>
<td>This HIS assists in understanding the rationale for the proposed works. Methods to monitor performance throughout the waterproofing and resurfacing works have been included in the recommendations.</td>
</tr>
<tr>
<td>Policy 20—Minimising Impacts of Change</td>
<td>20.1 Any adverse impacts related to proposed change/development on the heritage values of the place, as a whole or particular components, should be minimised by: - exercising caution and reviewing the necessity and/or role of any decision with potentially adverse heritage impacts; - examining alternative solutions and their relative impacts to determine the outcome with least detrimental effects; and - ensuring, where possible, that changes (to use, layout and fabric) are reversible and/or have minimal adverse impacts on the cultural heritage significance of the bridge.</td>
<td>The visual impact of the change resulting from the proposed waterproofing and resurfacing works will be minimal. However, the works will make a substantial contribution to the ongoing conservation of the fabric of the bridge. Monitoring recommendations have been provided below to ensure caution and to ensure that there are no detrimental impacts as a result of the works. There will be no fundamental changes to the fabric or layout as a result of the proposal.</td>
</tr>
</tbody>
</table>
### 5.2 Assessment against RMS Criteria

Sydney Harbour Bridge (National and State significance, SHR listed)

<table>
<thead>
<tr>
<th>Element</th>
<th>Significance of Element</th>
<th>Physical Impact to Heritage Fabric by Project Activities</th>
<th>Visual Impact</th>
<th>Recommendation</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coke concrete filling on pressed steel troughs.</td>
<td>High</td>
<td>The top of the coke breeze slab will be scoured during the removal of the existing asphalt using a fine drum mill. However, for removal of the final layers of asphalt a micro drum mill will be used, allowing a high level of control in the amount of fabric to be removed. The steel troughs will not be affected by removal of the asphalt. During the cleaning process a mechanical washing (with water) and drying (with heat) process is to be employed. This has the potential to impact on the fabric of the concrete bridge deck. The washing technique has previously been used by the RMS on coke breeze slabs; however, the drying technique has not. The amount of time that the concrete bridge deck will be exposed to heat has been reduced to minimise any potential impacts. The steel will not be affected by the washing and drying process.</td>
<td>Nil</td>
<td>Impact acceptable providing visual monitoring undertaken to ensure surface of concrete bridge deck is not removed. Impact acceptable providing monitoring undertaken to ensure concrete bridge deck conditions are not markedly altered.</td>
<td>The proposed washing and drying methods to be used should be supervised in the initial stages by an appropriate specialist to ensure that residual water does not remain in the structure when the new waterproofing and resurfacing finishes are laid.</td>
</tr>
</tbody>
</table>

The proposed 3-coat polyurethane membrane will be bonded to the top of the existing concrete approach spans. It will only be removable by physical methods. However, this is considered an acceptable change given the long-term benefits of inserting the membrane.

The heated crumbed rubber-impregnated bitumen material will be sprayed onto the concrete of the bridge deck.

The proposed new layer of asphalt will replace an existing asphalt finish. The slight changes to the fall of the surface will not be perceptible. The asphalt mix is designed to facilitate rolling so that plate compaction is avoided.
<table>
<thead>
<tr>
<th>Element</th>
<th>Significance of Element</th>
<th>Physical Impact to Heritage Fabric by Project Activities</th>
<th>Visual Impact</th>
<th>Recommendation</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearing surfaces of road, rail, foot and cycleways.</td>
<td>Little</td>
<td>The existing asphalt finish between Chainage 1 and 1153 between lanes 1 and 6 will be removed and replaced with new asphalt.</td>
<td>Minor. Surface will be slightly blacker.</td>
<td>Impact acceptable. Contributes to maintenance of more significant fabric.</td>
<td>Works are acceptable and will make a substantial contribution to the ongoing conservation of the fabric of the bridge.</td>
</tr>
</tbody>
</table>
5.3 Assessment Against the NSW Heritage Office Questions

The following table addresses the issues and questions set out in the Heritage Office, Department of Planning guidelines document *Statements of Heritage Impact*, which are relevant in the assessment of heritage impacts arising from the proposed works.

<table>
<thead>
<tr>
<th>Proposed Works</th>
<th>Recommended Questions (Heritage Impact Statement Guidelines)</th>
<th>Comment/Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor partial demolition (including internal elements)</td>
<td>Is the demolition essential for the heritage item to function? Are important features of the item affected by the demolition (eg fireplaces in buildings)? Is the resolution to partially demolish sympathetic to the heritage significance of the item? If the partial demolition is a result of the condition of the fabric, is it certain that the fabric cannot be repaired? Is the resolution to partially demolish sympathetic to the heritage significance of the item?</td>
<td>Demolition is restricted to a previously replaced asphalt surface that has reached the end of its useful life. The demolition process includes mechanical washing and drying of the concrete bridge deck. The proposed washing and drying methods to be used on the top surface of the coke breeze slab should be supervised in the initial stages by an appropriate specialist to ensure that residual water does not remain in the structure when the new waterproofing and resurfacing finishes are laid. Should any sections of the earlier road surfaces be uncovered they should be photographically recorded, and a sample taken if possible. The demolition is essential to allow for waterproofing and resurfacing works to replace an asphalt surface that is not original, and to protect the more original structure below. The ongoing use of the bridge for transport is a high priority for the conservation of the structure. This project substantially contributes to the care of the significant elements of the place. Therefore the impact of the demolition is considered acceptable.</td>
</tr>
</tbody>
</table>

| Minor additions (see also minor partial demolition) | How is the impact of the addition on the heritage significance of the item to be minimised? Can the additional area be located within an existing structure? If no, why not? Will the additions visually dominate the heritage item? Is the addition sited on any known, or potentially significant archaeological deposits? If so, have alternative positions for the additions been considered? Are the additions sympathetic to the heritage item? In what way (eg form, proportions, design)? | There will be no fundamental changes to the fabric or layout as a result of the proposal. The visual impact of the change resulting from the proposed resurfacing works will be minimal. However, the works will make a substantial contribution to the ongoing conservation of the fabric of the bridge. NA The waterproofing and resurfacing works will replace an asphalt surface that is not original, and seeks to protect the more original structure below. |

5.4 Summary of Heritage Impact

The proposed resurfacing works are essential to prevent water penetration through the concrete bridge deck and the resulting corrosion of structural steel elements. It is essential for the ongoing conservation of more original and significant elements of the structure.

There would be no fundamental changes to the fabric or layout of the SHB as a result of the proposal. The proposed waterproofing and resurfacing works would replace an asphalt surface that is not original and has reached the end of its useful life, and seek to protect the more original structure below. The asphalt mix is designed to facilitate rolling so that plate compaction is avoided.
Given the proposed mechanical method for removing the existing asphalt, it will not be possible to retain any of the remaining traces of earlier road surfaces that may exist under the current finish. This is considered acceptable, as the asphalt itself is of little significance compared to the significance of the overall structure. Should any sections of any earlier road surfaces or membranes be uncovered they should be photographically recorded, and a sample taken if possible.

The proposed work includes mechanical washing and drying of the concrete bridge deck. The proposed mechanical washing and drying methods to be used on the top surface of the coke breeze slab must ensure that there is no impact on the original high significance fabric of the slab and/or supporting steel troughs, from residual water remaining in the structure or from damage to the surface of the coke breeze slab. The proposed washing and drying methods should be supervised in the initial stages by an appropriate specialist to ensure that residual water does not remain in the structure when the new waterproofing and resurfacing finishes are laid. The ongoing monitoring of the condition of the steel troughs should be continued after the asphalt replacement works, and anti-corrosion works undertaken should accelerated corrosion occur.

The use of well-maintained equipment is essential to ensure controlled conditions during the wetting and heating processes.

The ongoing use of the bridge for transport is a high priority for the conservation of the structure. The RMS has a well-established maintenance regime and a continuing works program to ensure that the SHB remains in good operating condition. This project substantially contributes to the care of the significant elements of the place; therefore, the impact of the proposed work is considered to be minor and positive. Monitoring recommendations have been provided below to ensure caution and to ensure that there are no detrimental impacts as result of the works.
6.0 Recommendations

The proposed resurfacing works will ensure the long term conservation of the bridge structure. While, it is not likely that there will be adverse impacts from the proposed mechanical washing and drying methods to be used on the top surface of the coke breeze slab, monitoring in the initial stages of work has been recommended. The proposed work will have long term benefits, and any potential impacts can be overcome by monitoring and corrective action.

The following actions are recommended to ensure that significant elements of the SHB are appropriately conserved during the resurfacing works.

- It is proposed that spotters accompany the profiling machines to minimise removal of any fabric of the original coke concrete bridge deck, and to identify any unexpected finds.
- A heritage specialist will be on-call during the profiling (ie milling work). Should any sections of the earlier road surfaces be uncovered the heritage specialist should photographically record the finishes and take a sample if possible.
- The use of well-maintained equipment is essential to ensure controlled conditions during the wetting and heating processes, and this should be written into the RMS QA specification.
- The proposed washing and drying methods to be used on the top surface of the coke breeze slab should be supervised in the initial stages by an appropriate specialist to ensure that residual water does not remain in the structure when the new waterproofing and resurfacing finishes are laid.
- The ongoing monitoring of the condition of the steel troughs should be continued after the asphalt replacement works.
- The resurfacing project should be filmed and photographed, at approximately six locations across the bridge, to provide a documentary record of the process. Copies of these recordings added to the Roads and Maritime Services’ permanent documentary archive.
- All crew working on the site should attend a toolbox talk to highlight the heritage significance of the bridge, and the management measures in place to protect the heritage value.
- No further referral for Commonwealth consent in accordance with the EPBC Act is required as the work will not impact upon the national heritage values of the SHB.
- As the work is consistent with site-specific exemptions under the SHR listing there is no requirement to seek an exemption or other approval from the NSW Heritage Council or delegate.
- As the Infrastructure SEPP applies to the project there is no further requirement for heritage referrals to either Sydney or North Sydney councils.
- All stakeholders should be advised of the works and the results of this heritage impact statement.
7.0 Endnotes

2  ibid, p 34.
3  ibid, p 37.
4  ibid, p 39.
5  Roads and Traffic Authority, op cit, p 10.
6  ibid, p 11.
7  ibid, p 11.
9  ibid, Inventory Record 3.1, p 3.
10  ibid, Inventory Record 3.1, p 3.
11  ibid, Inventory Record 0.3, pp 1–3.
12  ibid, Inventory Record 08, p 1.
13  ibid, Inventory Record 0.5, p 1.
14  ibid.
15  ibid, Inventory Record 0.5 p 2.
16  Lalor, op cit, p341.
18  ibid, p 58.
19  ibid, p 58.
20  Discussions held between RMS (N Forrest) and the NSW Heritage Branch. (V Sicari and R Maini)
8.0 Appendices

Appendix A

National Heritage Listing
Environment Protection and Biodiversity Conservation Act 1999

INCLUSION OF A PLACE IN THE NATIONAL HERITAGE LIST

I, Malcolm Bligh Turnbull, Minister for the Environment and Water Resources, having considered, in relation to the place listed in the Schedule of this instrument -

(a) the Australian Heritage Council’s assessment whether the place meets any of the National Heritage criteria; and

(b) the comments determined to have been given to the Council under section 324JH of the Environment Protection and Biodiversity Conservation Act 1999; and

being satisfied that the place specified in the Schedule has the National Heritage value or values specified in the Schedule include, pursuant to section 324JJ of the Environment Protection and Biodiversity Conservation Act 1999, the place listed in the Schedule in the National Heritage List.

Dated 12 day of March 2007

Malcolm Bligh Turnbull
Minister for the Environment and Water Resources
SCHEDULE

STATE
Local Government Areas
Name          Location / Boundary       Criteria / Values

NEW SOUTH WALES
North Sydney City and Sydney City

Sydney Harbour Bridge
Bradfield Highway, Dawes Point in the south and Milsons Point in the north, comprising bridge, including pylons, constructed approaches and parts of Bradfield and Dawes Point Parks, being the area entered in the NSW Heritage Register, listing number 00781, gazetted 25 June 1999, except that part of this area north of the southern alignment of that part of Lavender Street between Harbour view Crescent and Cliff Street, Milsons Point.

Criterion          Values
(a) the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history.

The building of the Sydney Harbour Bridge as a transport facility linking the city with the north shore was a major event in Australia's history, and represented a pivotal step in the development of modern Sydney and one of Australia's most important cities. The bridge became a symbol for the aspirations of the nation, a focus for 'optimistic prognostications of a better future' following the Depression. The bridge represented an important step in transforming the city of Sydney into a modern metropolis. Internationally, the bridge was recognised as a symbol of progress and a vision of a splendid future.

The building of the Sydney Harbour Bridge was an important part of the technical revolution of the 1930s and seen as evidence of Australia's industrial maturity. The bridge represented the mechanical age displacing the pastoral and agricultural way of life on which Australia's economy had been based. The scale of the operations was enormous and at the time of its construction, it was the widest long-span bridge in the world.

The Sydney Harbour Bridge includes a steel arch spanning the harbour between Milsons Point on the north side and Dawes Point on the south side, and elevated approaches to the arch from both the north and south sides. The arch is made up of two 28-panel arch trusses set in vertical planes, 30 metres apart centre to centre, and braced together laterally. Two granite-faced concrete pylons, with a height of 89 metres above mean sea level, are located at each end of the arch. A deck carrying road and rail traffic is suspended from the arch. Pairs of hangers, ranging in length from 7.3 metres to 58.8 metres, support cross-girders, each weighing 110 tonnes, which support the deck. The northern and southern approaches each contain five spans, constructed as pairs of parallel-chord, six-panel steel trusses. The spans are supported by pairs of concrete piers faced with granite. The combined length of the approach spans is 646 metres.
Criterion

(a) continued

Values

The Sydney Harbour Bridge is an outstanding cultural landmark for the nation and represents a highly significant place in Australia's cultural history. The opening of the Sydney Harbour Bridge was a momentous occasion, drawing remarkable crowds estimated at nearly one million people.

Since its opening in 1932, the Sydney Harbour Bridge has become a famous and enduring national icon and symbol of Australia. The bridge remains one of Australia’s most identifiable symbols.

(e) the place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.

Sydney Harbour Bridge is an integral component of the Sydney Harbour vista and represents one of the most recognisable and iconic images in the world. It is the picturesque blending of the natural environment and man-made structures around the harbour foreshores that has proved an inspiration for generations of artists and writers. In its harbour setting, it has inspired a rich and diverse range of images in a variety of mediums – paintings, etchings, drawings, linocuts, photographs, film, poems, posters, stained glass - from the date of its construction through to the present day.

The bridge is conceivably one of Australia’s most photographed cultural landmarks, and striking images of the bridge have been captured by some of Australia’s best-known photographers.

The Sydney Harbour Bridge has also been replicated in tourist posters, postcards, crafts and the folk arts, its image reproduced in media including glass, ceramic, metal, shells and crochet cotton, embroidery and etchings in a huge array of objects.

(f) the place has outstanding heritage value to the nation because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period.

The Sydney Harbour Bridge may be considered the world's greatest arch bridge. Although not the longest arch span in the world, its mass and load capacity are greater than other major arch bridges. No other bridge in Australia compares in its technical significance with the structure of the Sydney Harbour Bridge and its pylons and constructed approaches between Argyle Street in the south and Arthur Street in the north.

The construction of Sydney Harbour Bridge combined available technology with natural advantages provided by the site. The bridge is an outstanding technical and construction achievement of the Twentieth Century. The designers took advantage of the sandstone base on which Sydney was built - which enabled them to tie back the cables during construction of the arch and to experiment with massive structures. Although designed during the 1920s and 1930s the bridge has still not reached its loading capacity.
Criterion (g) the place has outstanding heritage value to the nation because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.

Values

It was part of John Job Crew Bradfield's vision for the bridge that it be used at times of national rejoicing. Since its opening it has regularly supported flags, banners, and especially fireworks, becoming a focus for national and local celebrations. Community ceremonial and celebratory occasions centred on Sydney Harbour Bridge, either for the people of Sydney or the broad Australian community, are well recognised and have been widely noted. Since 1932, the broad Australian community has identified the Sydney Harbour Bridge as one of the most nationally and internationally recognised symbol of Australia and the bridge in its harbour setting represents a composite national symbolic image.

Criterion (h) the place has outstanding heritage value to the nation because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history.

Values

John Job Crew Bradfield ranks with other engineers whose close involvement in a broad range of projects contributed to Australia's national development. As principal design engineer for the New South Wales Public Works Department, Bradfield was largely responsible for finally bringing the Sydney Harbour Bridge to fruition. As Chief Engineer, he prepared the general design specification and supervised the whole project on behalf of the Government of New South Wales, also integrating the bridge into the Sydney road, tram and rail system.

Bradfield was nationally recognised through his appointments to the Australian National Research Council and the Australian Commonwealth Standards Advisory Committee. The Institution of Engineers, Australia awarded him the Peter Nicol Russell Memorial Medal in 1932, and he also received the Kernot Memorial Medal from the University of Melbourne in 1933, and the Telford Gold Medal from the Institution of Civil Engineers, London in 1934.

For a description of any references quoted above, and more information on each of the places please search the Australian Heritage Database at http://www.deh.gov.au/cgi-bin/ahdb/search.pl using the name of the place.