Sydney Harbour Bridge Replacement of arch maintenance units

Review of Environmental Factors

Transport for NSW | January 2020

NSW GOVERNMENT

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Title	Sydney Harbour Bridge Replacement of arch maintenance units Review of Environmental Factors
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Executive summary

The proposal

Transport for NSW proposes to replace the four existing Sydney Harbour Bridge arch maintenance units (AMUs) with two new AMUs, each consisting of a movable gantry, each featuring two smaller building maintenance units (BMUs). The proposal is needed to allow better access and safety for inspections and maintenance on the Sydney Harbour Bridge arch.

The main features of the proposal are as follows:

- Removal of the four existing AMUs
- Installation of a track system along the top of bridge arches
- Installation of two new AMUs
- Relocation of the existing walkways on the bridge arch, from the centre to the outer edge

Subject to approval, installation works would commence in 2021 and may take up to five years to complete.

Need for the proposal

The existing AMUs, which were installed in 1997, do not provide suitable access. This has resulted in a limited capacity to carry out necessary maintenance works and inspections. The proposal would provide improved accessibility and safety for maintenance workers on the Sydney Harbour Bridge arch.

Proposal objectives

The objectives of the proposal are to:

1. Provide a safe, reliable and efficient way to continue to maintain the Sydney Harbour Bridge
2. Provide an access system that is sympathetic to the heritage values of the Sydney Harbour Bridge and has minimal visual impact

Options considered

The following options were considered:

- Option 1 – Upgrade and maintain the four existing AMUs
- Option 2 – Replace the existing AMUs with like for like AMUs
- Option 3 – Replace the four existing AMUs with two new AMUs as described above.

Option 3 (install upgraded AMUs) is the preferred option because it would best address the proposal objectives by providing a safe and efficient arch maintenance system (proposal objective 1). While there would be minor to moderate impacts to components of the Sydney Harbour Bridge main arch structure (that were considered against proposal objective 2), the overall impact to the bridge as a whole has been assessed as minor and is offset by the opportunity to enhance the bridge's structural integrity and longevity.

A 'do nothing' option was not considered due to the need to maintain the Sydney Harbour Bridge.

Statutory and planning framework

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.

Clause 94 of the ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposal is for a road and road infrastructure facilities and is to be carried out by Transport for NSW, it can be assessed under Division 5.1 of the EP&A Act. Development consent from the council is not required.

The Sydney Harbour Bridge is listed on the State Heritage Register. On 6 June 2018, the Heritage Council approved the proposed replacement of the AMUs under section 63 of the Heritage Act, subject to eight conditions.

The assessment of potential proposal impacts found that it would be unlikely to cause a significant impact on matters of national environmental significance or the environment of Commonwealth land. A referral to the Australian Government Department of the Environment and Energy under the *Environment Protection and Biodiversity Conservation Act 1999* is not required.

Community and stakeholder consultation

The Heritage Council was consulted about the proposal as part of the Heritage Act approval process. Conditional approval under the *Heritage Act 1977* was subsequently granted on 6 June 2018.

The REF will be publicly displayed for comment in February 2020. Following the public display of the REF, all comments received would be recorded and addressed in a Submissions Report detailing how each issue raised would be considered. The Submissions Report will be made available to the public on the project webpage.

Notification would occur in relation to work proposed outside standard construction hours.

Consultation has already commenced with key stakeholders and will continue as the project progresses.

Environmental impacts

Detailed technical investigations have been carried out to identify, assess, manage and minimise the proposal's potential impacts. The following outlines the proposal's main impacts on the environment and surrounding community. The safeguards and mitigation measures identified in this REF would help minimise any expected adverse impacts.

Non-Aboriginal heritage

The installation of the AMUs would have direct impacts on the fabric of the Sydney Harbour Bridge including:

- Removal and replacement of the existing AMUs (which themselves are of little heritage significance) near more significant elements of the bridge
- Removal of the existing metal walkways which have high heritage significance
- Removal of a relatively small number of rivets (in the context of about 6 million rivets used on the bridge).

Following installation of the AMUs there would be improvements to critical maintenance activities. The new AMUs would have a permanent visual impact on the bridge. Visual impacts on the nearby World Heritage listed Sydney Opera House have been assessed as minimal while impacts on nearby heritage items in Millers Point, Dawes Point and Milsons Point were assessed as negligible.

Safeguards and management measures have been proposed to address heritage impacts including using compatible materials (and colours) for new bridge elements, reducing physical and visual impacts through design with the advice of an experienced heritage specialist, and protecting significant bridge elements during works. The *Heritage Act 1977* approval requires further detailed design development to minimise both heritage and visual impacts.

Noise and vibration

When works are occurring at the nearest point to residential and recreation receivers, construction noise management levels could be exceeded during standard hours and out-of-hours periods. The largest predicted exceedances are for Dawes Point and Bradfield Park, due to their proximity to the bridge. However, in many cases works would be occurring at substantially greater distances from these receivers as the majority of activities would be taking place on the main bridge span resulting in lower noise impacts.

The proposal is not expected to generate ongoing noise requiring assessment under the *Noise Policy for Industry* (Environment Protection Authority, 2017).

Safeguards and management measures have been proposed to address noise and vibration impacts, including minimising noise at its source where possible minimising out of hours works and notifying potentially affected people when noise management levels could be exceeded.

Air and water quality

The proposal has the potential to discharge lead contaminated dust (associated with removal of paint around rivets prior to removal) paint overspray into the surrounding environment during any rivet removal and minor paint repair activities.

Safeguards and management measures have been proposed to address air and water quality impacts, including the use of I containment systems to collect dust.

Landscape character and visual impact

The proposal would have a moderate to high landscape character impact, primarily due to the introduction of the following elements within a sensitive area:

- New AMUs with gantry structure spanning between arch trusses
- Replacement and relocation of walkways.

Moderate or higher visual impacts were identified from the following locations (which are discussed in more detail in Section 6.5.3):

- Pier 2/3 view, Dawes Point
- Sydney Harbour Bridge / Bradfield Highway heading north
- Bridge climber / aerial view
- Pedestrian Walkway on Sydney Harbour Bridge heading south
- Helicopter view
- Campbell's Cove
- Milsons Point Ferry Wharf
- Beulah Street Wharf, Kirribilli
- Sydney Harbour Bridge / Bradfield Highway heading south

Potential visual impacts have already been minimised as part of the design refinement process to minimise the visual bulk of new elements (such as use of more transparent materials like mesh where suitable). Safeguards and management measures have also been proposed to address visual impacts including identifying a "parking position" for the AMUs which minimises impacts on key views when the AMUs are not in use.

Traffic and transport

There is potential for minor delays to pedestrians, cyclists and motorists during construction associated with lane closures on the bridge or works adjacent to the pedestrian walkway or cycleway. Access for emergency vehicles would be maintained at all times.

No additional impacts to railway operations would result due the proposed work.

Safeguards and management measures have been proposed to address traffic and transport impacts including minimising the duration of any access restrictions.

Justification and conclusion

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in some heritage, noise and visual impacts. Mitigation measures as detailed in this REF would minimise these expected impacts. The proposal would provide improved maintenance access and safety for maintenance workers on the Sydney Harbour Bridge. On balance, the proposal is considered justified.

Display of the review of environmental factors

This REF is on display for comment between from 4 February 2020 to 25 February 2020. You can access the documents in the following ways:

Internet

The documents are available as pdf files on the Transport for NSW website at:

www.rms.nsw.gov.au/projects/sydney-harbour-bridge/index.html

Printed copies

Printed copies of the REF will be publicly displayed at Transport NSW Office (former Roads and Maritime Services Office) at 20-40 Ennis Road, Milsons Point, NSW, 2061.

Copies by request

Printed copies are available by contacting:

- Email: sydneyharbourbridgeprojects@rms.nsw.gov.au
- Phone: 1800 581 595.

How can I make a submission?

To make a submission about this proposal, please send your written comments to:

sydneyharbourbridgeprojects@rms.nsw.gov.au

Submissions must be received by 5pm on 25 February 2020.

All information included in submissions is collected for the sole purpose of assisting in the assessment of this proposal. The information may be used during the environmental impact assessment process by relevant Transport for NSW staff and contractors.

Where the respondent indicates at the time of supply of information their submission should be kept confidential. Transport for NSW will attempt to keep it confidential. However, there may be legislative or legal justification for the release of the information, for example under the *Government Information (Public Access) Act 2009* or under subpoena or statutory instrument.

The supply of this information is voluntary. Each respondent has free access at all times to the information provided by the respondent but not to any identifying information provided by other respondents if a respondent has indicated the representation should be kept confidential. Any respondent may make a correction to the information they have provided by writing to the same address the submission was sent.

The information will be held by Transport for NSW.

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1 Introduction

1.1 Proposal identification

Transport for NSW proposes to replace the four existing Sydney Harbour Bridge arch maintenance units (AMUs) with two new AMUs, each consisting of a movable gantry, each featuring two smaller Building Maintenance Units (BMUs). The proposal is needed to allow better access and safety for inspections and maintenance on the Sydney Harbour Bridge arch.

The main features of the proposal are as follows (refer also to Figure 2-1 which identifies each key element of the bridge):

- Removal of the four existing AMUs
- Installation of a track system along the top of bridge arches
- Installation of two new AMUs
- Relocation of the existing walkways on the bridge arch from the centre to the outer edge.

The proposal is located on the Sydney Harbour Bridge which spans Sydney Harbour between Dawes Point and Milsons Point and is within the City of Sydney and North Sydney local government areas. The location of the proposal is shown in Figure 1-1 and an overview of the proposal is provided in Figure 1-2. Chapter 3 describes the proposal in more detail.

Figure 1-1 Location of the proposal

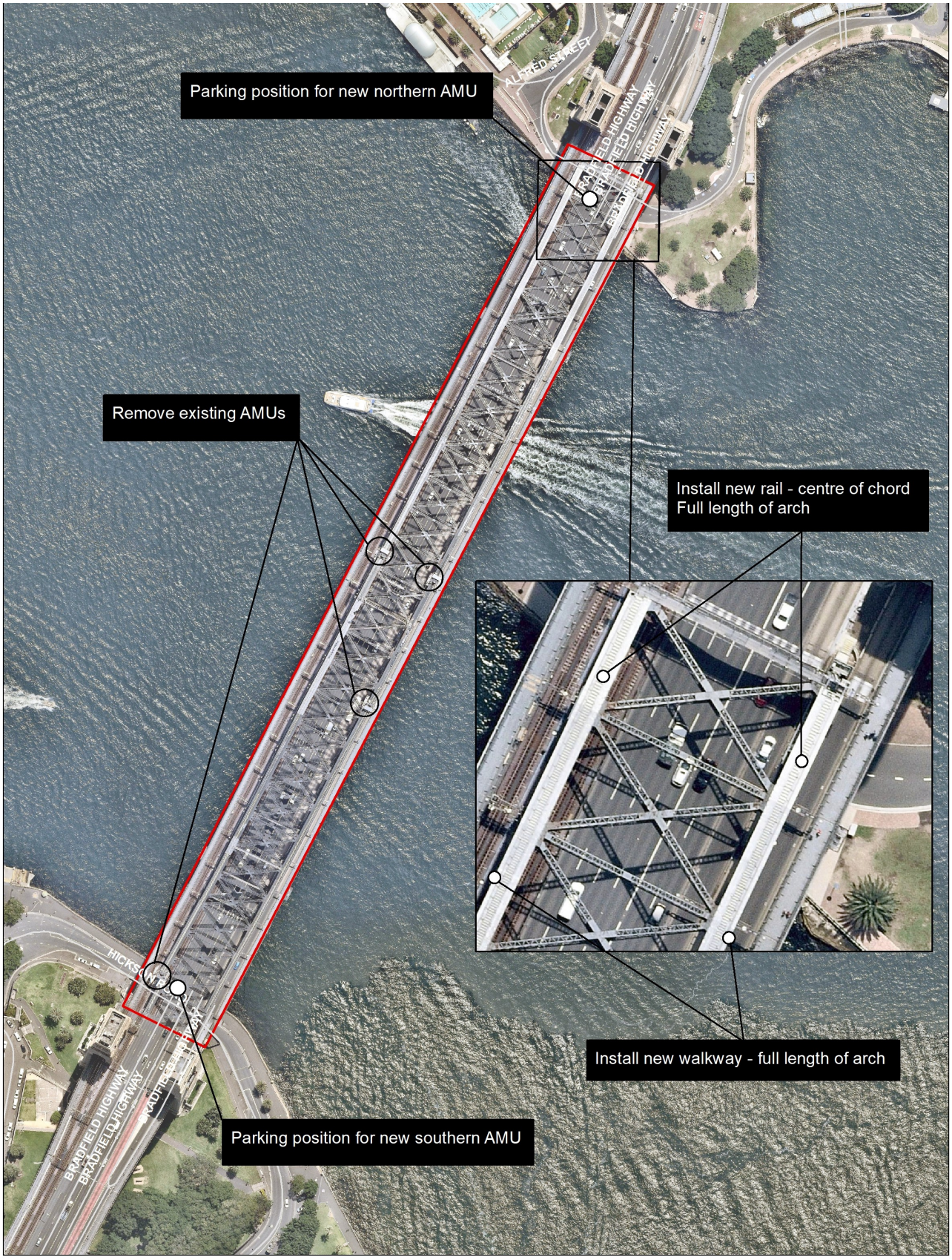


Figure 1-2 The proposal

1.2 Purpose of the report

This REF has been prepared by Hills Environmental on behalf of Transport for NSW (Sydney Maintenance). For the purposes of these works, Transport for NSW is the proponent and the determining authority under Division 5.1, of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail protective measures to be implemented.

The description of the proposed work and associated environmental impacts have been undertaken in the context of clause 228 of the *Environmental Planning and Assessment Regulation 2000*, the factors in *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (Is an EIS required? guidelines) (Department of Urban Affairs and Planning, 1995), *Roads and Related Facilities EIS Guideline* (Department of Urban Affairs and Planning, 1996), the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In doing so, the REF helps to fulfil the requirements of Section 5.5 of the EP&A Act that Transport for NSW examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or Biodiversity Development Assessment Report
- The significance of any impact on nationally listed biodiversity matters under the EPBC Act, including whether there is a real possibility that the activity may threaten long-term survival of these matters, and whether offsets are required and able to be secured
- The potential for the proposal to significantly impact any other matters of national environmental significance or Commonwealth land and the need, subject to the EPBC Act strategic assessment approval, to make a referral to the Australian Government Department of the Environment and Energy for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

2 Need and options considered

2.1 Strategic need for the proposal

2.1.1 Proposal need

Bridges are important in both social and economic terms by benefiting communities and facilitating the growth of the National and State economies. Bridges are strategic long term assets and the management of the State's bridges must therefore be planned with a long-term view to ensure optimum value is achieved.

The Sydney Harbour Bridge is an iconic feature of Sydney with national heritage values, but also a key transportation asset conveying an estimated 204 trains, 160,435 vehicles and 1650 bikes each day. Maintaining the Sydney Harbour Bridge to meet these demands, while preserving its heritage values, is therefore a high priority for Transport for NSW. Transport for NSW as the owner and management authority for the Sydney Harbour Bridge has a responsibility to maintain structural integrity of the asset now and into the foreseeable future.

The proposal forms part of a suite of current and planned projects for the Sydney Harbour Bridge that seek to enhance the accessibility, functionality, safety and maintenance. The overall combined impact of these projects will maintain the key transport function of the bridge and support its ongoing use and longevity as an item of national and state heritage significance.

The existing AMUs, which were installed in 1997, do not provide suitable access. This has resulted in a limited capacity to carry out necessary maintenance works and inspections. The proposal would provide improved accessibility and safety for maintenance workers on the Sydney Harbour Bridge arch.

2.1.2 Sydney Harbour Bridge Conservation Management Plan

The *Sydney Harbour Bridge Conservation Management Plan* (Godden Mackay Logan, 2007) provides a framework for the bridge's ongoing care and management, including decisions about conservation, use and development.

The Conservation Management Plan notes that due to the age of the bridge and nature of the physical environment (and the corrosive environment of the harbour setting to the materials of the bridge), and the importance of its continued operation as the main Sydney Harbour vehicular crossing, ongoing maintenance should be a fundamental priority for the care and management of the significant components and fabric of the Sydney Harbour Bridge.

Policy 14 (Maintenance and Repair Works Generally) within the Conservation Management Plan includes the following which are directly relevant to the proposal:

- 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
- 14.3 Structures, machinery/equipment and other elements should be regularly inspected and maintained
- 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.

Policy 18 (Management of Adaptation and Change) includes the following which are directly relevant to the proposal:

- 18.1 All decisions for intervention and change should be evaluated in terms of the nature of the proposal, its purpose, long term context and how this relates to the identified cultural heritage values of the bridge. Protection and enhancement of the fundamental significant elements of

the place through appropriate adaptation and change for new or additional necessary functions should be a key management goal.

By assisting the ongoing maintenance of the Sydney Harbour Bridge and the retention of heritage values (including fundamental significant elements such as the lateral steel members), the proposal supports the policy directions set out in the Conservation Management Plan. Further consideration of the plan is provided in Section 6.1.3.

2.1.3 Future Transport 2056

The *NSW Future Transport Strategy 2056* (Transport for NSW, 2018) outlines a clear framework to address transport challenges in NSW over the next 40 years and is an update of the NSW Long Term Transport Master Plan released in 2012. It integrates planning for roads, freight and all other modes of transport and sets out initiatives, solutions and actions to meet NSW transport challenges.

By providing improvements to effectiveness, efficiency, accessibility and safety of critical maintenance activities, the proposal would support the following transport customer outcome:

Transport services and infrastructure are delivered, operated and maintained in a way that is affordable for customers and the community

2.1.4 NSW State Infrastructure Strategy 2018-2038

The *NSW State Infrastructure Strategy* 2018–2038 (NSW Government, 2018) sets out the NSW Government's infrastructure vision for the state over the next 20 years, across all sectors. One of the focus areas of the strategy is active asset management that ensures infrastructure operates to the high standards expected by the community for as long as possible. By supporting the ongoing cost-effective maintenance of the Sydney Harbour Bridge, the proposal is consistent with this strategic direction.

2.2 Existing road and infrastructure

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. The bridge incorporates not only the arch, pylons and approach spans but also two railway lines, a cycleway, footpaths and roads between the northern and southern approaches. The main bridge elements are illustrated by Figure 2-1, while the key characteristics of the bridge include the following:

- Length of the arch span: 503 metres
- Height of the top arch: 134 metres above mean sea level
- Width of the deck: 49 metres.
- Clearance for shipping: 53 metres
- Height of the pylons: 89 metres above mean sea level
- Base of each abutment tower: 58 metres across and 49 metres long
- Total length of bridge: 1149 metres including approach spans
- Bearing pins: each of the four pins measure 4.2 metres long and 368 millimetres in diameter
- Thrust on bearings: under maximum loads approximately 20,000 tonnes on each bearing
- Number of rivets in the bridge: approximately 6,000,000
- Largest rivet: 3.5kg and 395mm long
- Longest hanger: 58.8 metres
- Shortest hanger: 7.3 metres.

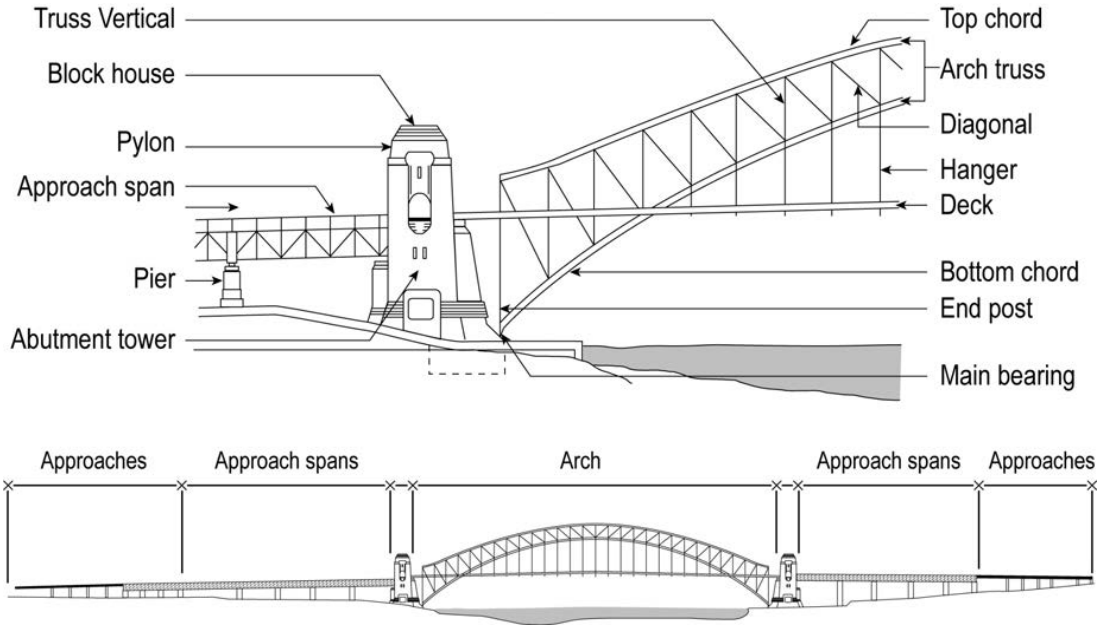


Figure 2-1 Sydney Harbour Bridge - main elements

The Sydney Harbour Bridge main arch structure is constructed of silicon steel trusses and joists. These steel members are painted dark grey. The entire structure comprises riveted straight steel angles and plates. The bridge deck is hung from the main arch truss by 40 silicon steel hangers that are connected to latticed cross girders beneath the railway and road surface.

There are four existing AMUs on the Sydney Harbour Bridge main arch structure, with two installed on each truss of the arch. The AMUs operate between the crown of the bridge and the lower end of the top chord. Designed to be similar in appearance and configuration to the original SHB painting cranes, the AMUs feature two jibs supporting a working platform.

The AMUs travel along the top chords and pass over the central walkways. Bordered by steel handrails, these metal stairs were installed to provide safe access for maintenance workers. Five original catwalks cross the top chords, at each end post, at the crown of the arch and midway up. The apex of the arch features an air navigation beacon, comprising a flashing red light on a seven-metre-tall steel tower. Several modern aerials have also been installed.

Figure 2-2 shows selected features of the Sydney Harbour Bridge, including the current AMUs.

	
View north east along the top of the arch towards the east top chord stairway.	View east along top of the arch towards an existing AMU operating on the east top chord.

	
View south east from the west top chord of the arch, showing air navigation tower in centre.	View northeast across trusses towards an existing AMU operating on the east top chord. Catwalks seen in foreground.

Figure 2-2 Key features of the Sydney Harbour Bridge, including the existing AMUs

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The objectives of the proposal are to:

1. Provide a safe, reliable and efficient way to continue to maintain the Sydney Harbour Bridge
2. Provide an access system that is sympathetic to the heritage values of the Sydney Harbour Bridge and has minimal visual impact.

2.3.2 Development criteria

The development criteria for the proposal include:

- Preserve the heritage value of the bridge
- Minimise bulk and massing of new elements by minimising height and maximising slenderness of structural elements. For the walkways, investigate the use of different materials and how they maximise transparency and minimise bulk of structure – steel versus aluminium vs hybrid steel/aluminium
- Maximise transparency – utilise structural designs that maximise views through the structure and provide a web-like transparency sympathetic to the existing Sydney Harbour Bridge structure
- Conceal any services/ pipes in the structure
- Consider maintenance issues such as painting and galvanising.

2.3.3 Urban design objectives

Urban design objectives for the proposal are:

- Respect the heritage importance and integrity of the Sydney Harbour Bridge and its approaches
- Protect views to and from the Sydney Harbour Bridge, particularly from the Opera House, Sydney Harbour Bridge Climb, aerial views, northern and southern carriageway approaches and Sydney Harbour views
- Ensure elements and materials are visually sympathetic with the Sydney Harbour Bridge.

2.4 Alternatives and options considered

2.4.1 Methodology for selection of preferred option

The process of option selection had two broad stages:

1. A consideration of whether the proposal in any configuration could be justified. This is an evaluation of the 'do nothing' option
2. An evaluation of options by reference to their respective impacts and benefits, and whether they meet the proposal objectives.

A 'do nothing' option was not considered due to the need to maintain the Sydney Harbour Bridge.

2.4.2 Identified option for evaluation

The following options were considered:

- Option 1 – Upgrade and maintain the four existing AMUs
- Option 2 – Replace the existing AMUs with like for like AMUs
- Option 3 –Replace the four existing AMUs with two new AMUs, each consisting of a movable gantry and two smaller BMUs in each.

2.4.3 Analysis of options

Option 1 – Upgrade existing AMUs (long term)

While the Option 1 would avoid the potential physical and visual impacts of interventions, this option would not address the problems currently encountered with the existing AMUs, which limit and undermine the accessibility, safety and efficiency of critical maintenance activities.

Option 1 was not considered appropriate as it does not address the identified need and does not meet proposal objective 1 (safe and efficient arch maintenance system).

Option 2 – Upgrade existing AMUs (short term) then replace with equivalent

As for Option 1, Option 2 was not considered appropriate as it does not address the identified need and does not adequately meet proposal objective 1 (safe and efficient arch maintenance system).

Option 3 – Upgraded AMUs

Option 3 was found to best respond to objective 1 (safe and efficient arch maintenance system),. Importantly, Option 3 would allow for access to steel members that cannot be reached (and therefore maintained) by the existing AMUs. While this option involves minor to moderate impacts to components of the Sydney Harbour Bridge main arch structure, the overall impact to the bridge as a whole has been assessed as minor and is offset by the opportunity to enhance the bridge's structural integrity and longevity.

A variation of this option was considered, whereby the metal walkways on the top chords would be retained in their current location and the new rail for the movable gantries and AMUs would occupy the adjacent inner section of the top chords. This variation, however, was found to potentially affect the structural integrity of the bridge arches and was therefore discounted.

2.5 Preferred option

Option 3 (install upgraded AMUs) is the preferred option because it would best address the proposal objectives by ensuring safe and efficient maintenance access to all steel members (proposal objective 1). While there would be minor to moderate impacts to components of the Sydney Harbour Bridge main arch structure (that were considered against proposal objective 2),

the overall impact to the bridge as a whole has been assessed as minor and is offset by the opportunity to enhance the bridge's structural integrity and longevity.

The principles of ecologically sustainable development encourage the integration of economic, social development and environmental considerations into the decision-making process for all developments. The development of the proposal is consistent with these principles as demonstrated by the inclusion of heritage/visual considerations in the proposal objectives and the assessment of options against those objectives. The preferred option supports the longevity of a national heritage asset and therefore aligns with the principle of intergenerational equity.

2.6 Design refinements

Two AMU design refinements were considered with the aim of achieving improved safety and maintenance access outcomes: These were:

- Design refinement 1: Enclosed Box Gantry
- Design refinement 2: Truss Gantry

The advantages and disadvantages of each design refinement are outlined in Table 2-1, while design refinements 1 and 2 are shown by respectively. Option 2 was selected as the preferred approach primarily due to its lower visual impact and lower long-term corrosion risk.

Table 2-1 Design refinements – advantages and disadvantages

Design Refinement	Advantages	Disadvantages
1	• Minimises overall height of structure with handrails and lower than existing AMUs • Easier to inspect structure. • Can store maintenance equipment out of sight • Easier to conceal services in box section • Easier to galvanise achieving a high-quality finish and therefore providing a structure less susceptible to corrosion • Decrease in design time, manufacture, assembly as a less complex structure to a truss	• Visually appears bulky, opaque and unsympathetic to the existing web-like Sydney Harbour Bridge structure • Greater surface area for corrosion to occur over • Higher wind loading • Openings to access storage small.
2	• Increased transparency which is more sympathetic to the existing web-like Sydney Harbour Bridge structure, minimising any adverse visual impacts on the Sydney Harbour Bridge • Consistency of elements and materials with other gantries on the Sydney Harbour Bridge • Smaller surface area for corrosion to occur over	• Structure is higher in overall height. • More complex design increases design time, manufacture, assembly • Structure cannot be easily hot dipped galvanised • The open structure will be occupied with additional components (control boxes, hydraulic systems etc.) which would reduce transparency. Services will need to be carefully

Design Refinement	Advantages	Disadvantages
	• Lighter weight to overall structure.	placed to minimise visibility and ensure maintainability.

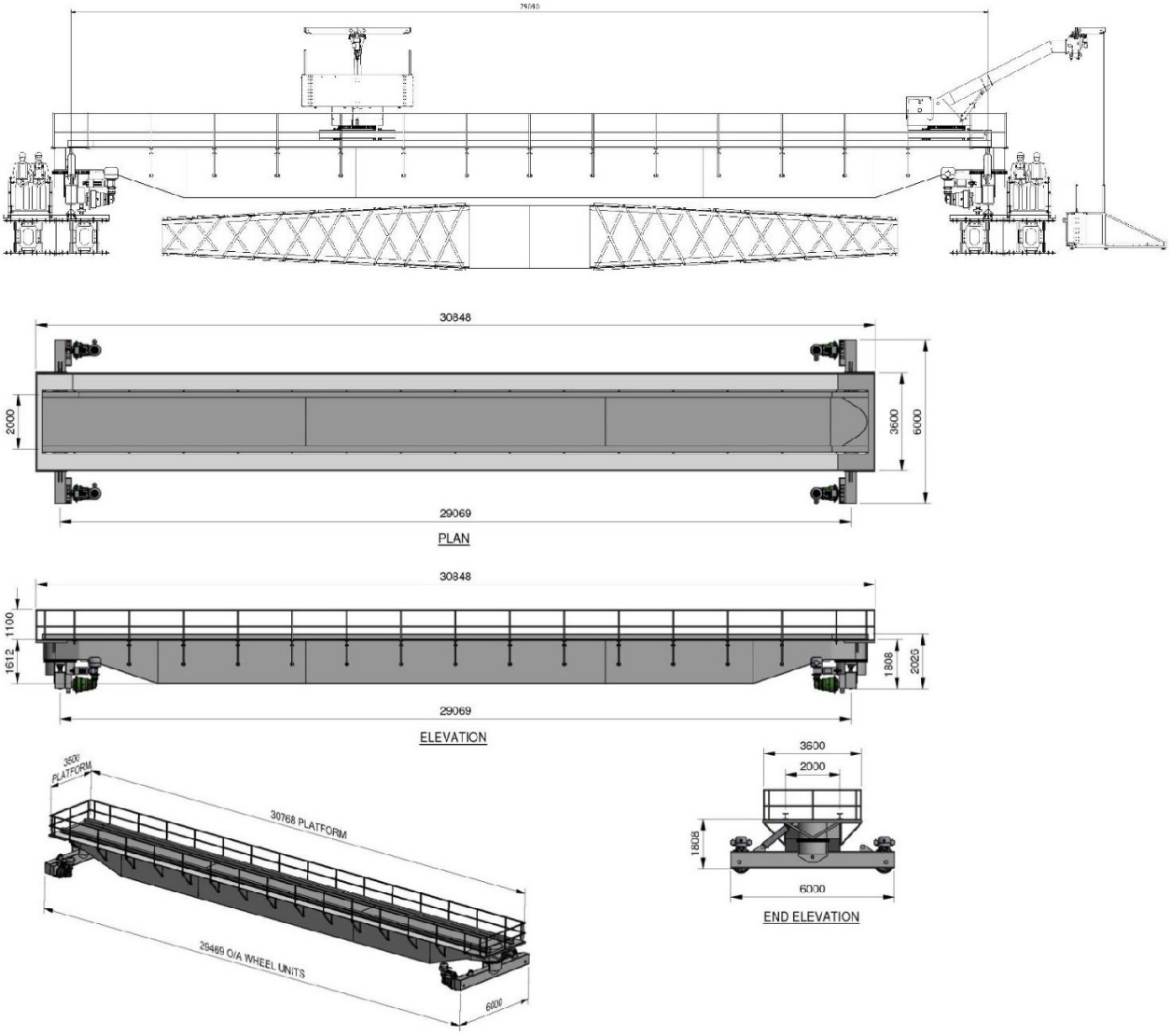


Figure 2-3 Enclosed box gantry AMU

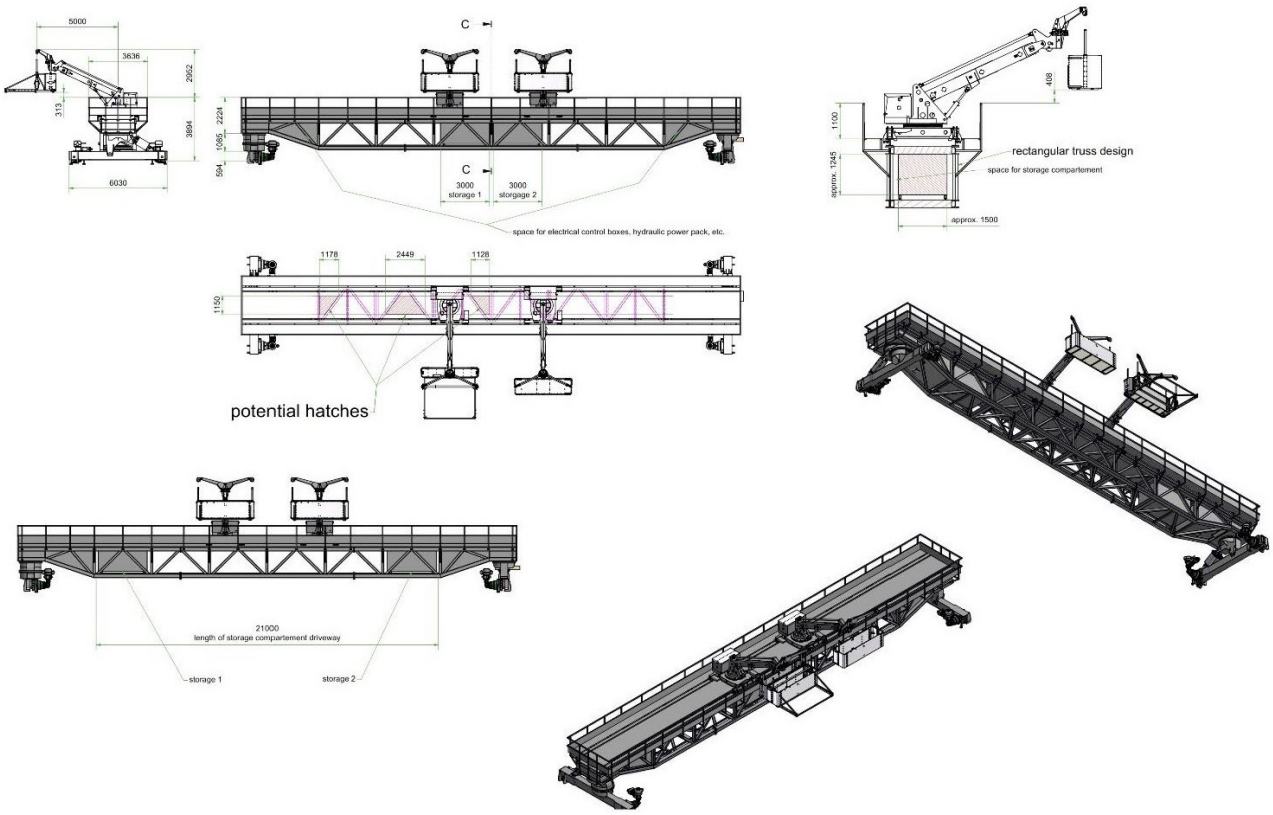


Figure 2-4 Truss gantry AMU

3 Description of the proposal

3.1 The proposal

Transport for NSW proposes to replace the four existing Sydney Harbour Bridge AMUs with two new AMUs, each consisting of a movable gantry, each featuring two BMUs. The proposal is shown by Figure 1-2.

Key features of the proposal would include:

- Removal of the four existing AMUs
- Installation of a track system along the top of bridge arches
- Installation of two new AMUs
- Relocation of the existing walkways on the bridge arch from the centre to the outer edge.

3.2 Design

3.2.1 Design criteria

The AMUs will be designed and manufactured in accordance with European Standard EN1808:2015, *Safety requirements for suspended access equipment - Design calculations, stability criteria, construction - examinations and tests*. Relevant parts of the following Australian Standards AS1418 and AS2550, both of which relate to cranes, hoists and winches will also be used.

The proposal would be carried out consistent with relevant work health and safety requirements. Applicable standards and procedures include:

- Australian Standard AS/NZS 4389:2015 *Roof safety mesh*
- Australian Standard AS/NZS 4994.3:2010 *Temporary edge protection*
- Australian Standard AS/NZS 4361.1:2017 *Guide to hazardous paint management Part 1 Lead and other hazardous metallic pigments in industrial applications*
- Transport for NSW work health and safety procedure PN066P03 *Working at heights – Managing the risk of falls at workplaces* (Roads and Maritime Services, 2017).

3.2.2 Engineering constraints

The proposal has the following identified constraints:

- Heritage significance – the SHB is of National and State heritage significance. The proposal is necessary to support the functioning of the bridge and has been developed to minimise visual impacts and impacts to heritage fabric
- Bridge operation – the Sydney Harbour Bridge provides a major road and rail transport connection. Any lane closures and rail possessions therefore need to be minimised
- Impacts on bridge concessionaire access.

3.2.3 Major design features

The key design features of the proposal are the new AMUs (with associated BMUs) and the replacement metal walkways on the out edge of the top chords. These features are illustrated below by Figure 3-1 to Figure 3-4 and described further below.

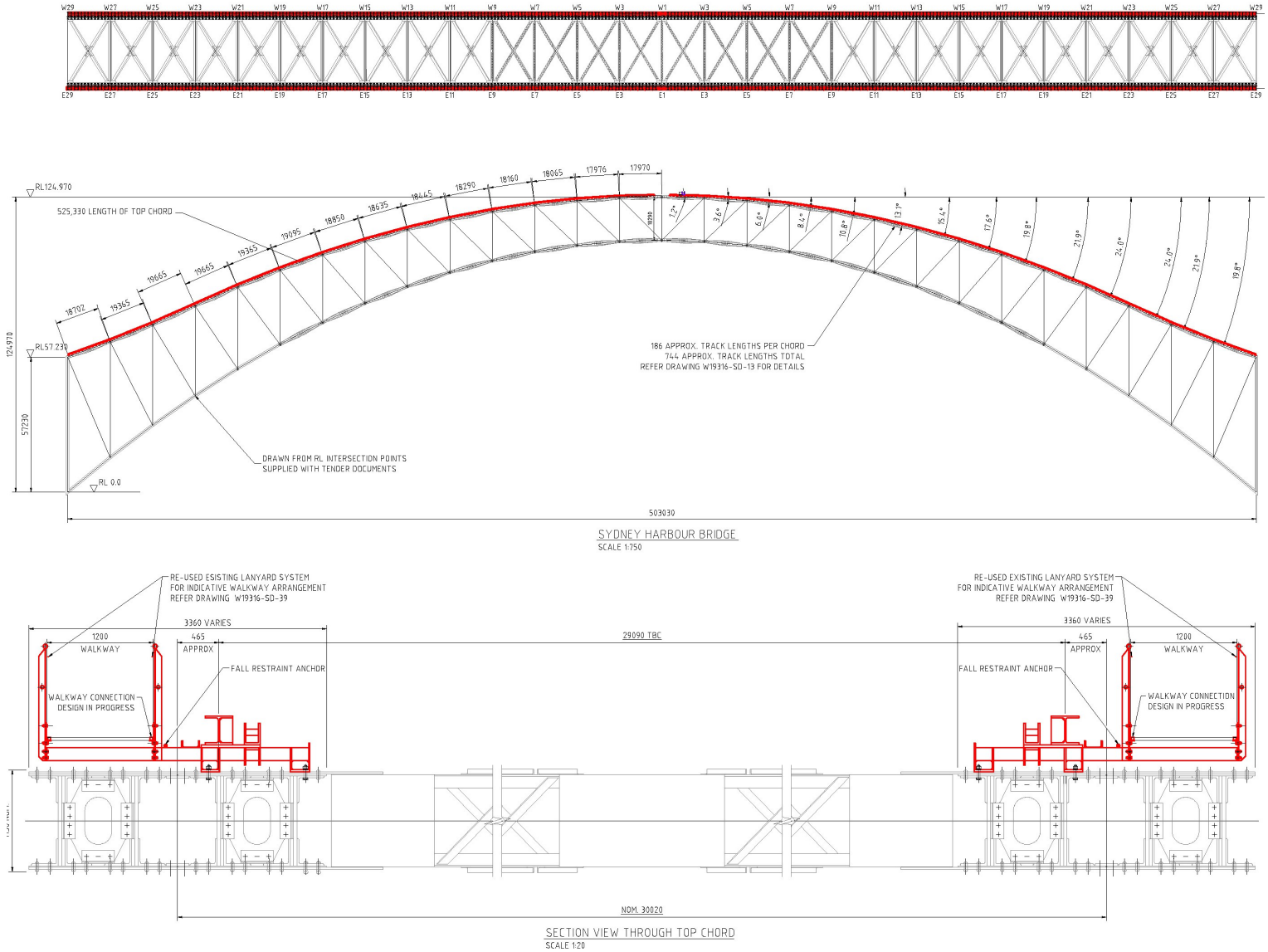


Figure 3-1 AMU plan and sections and indicative new walkways (Source: Mannetch)

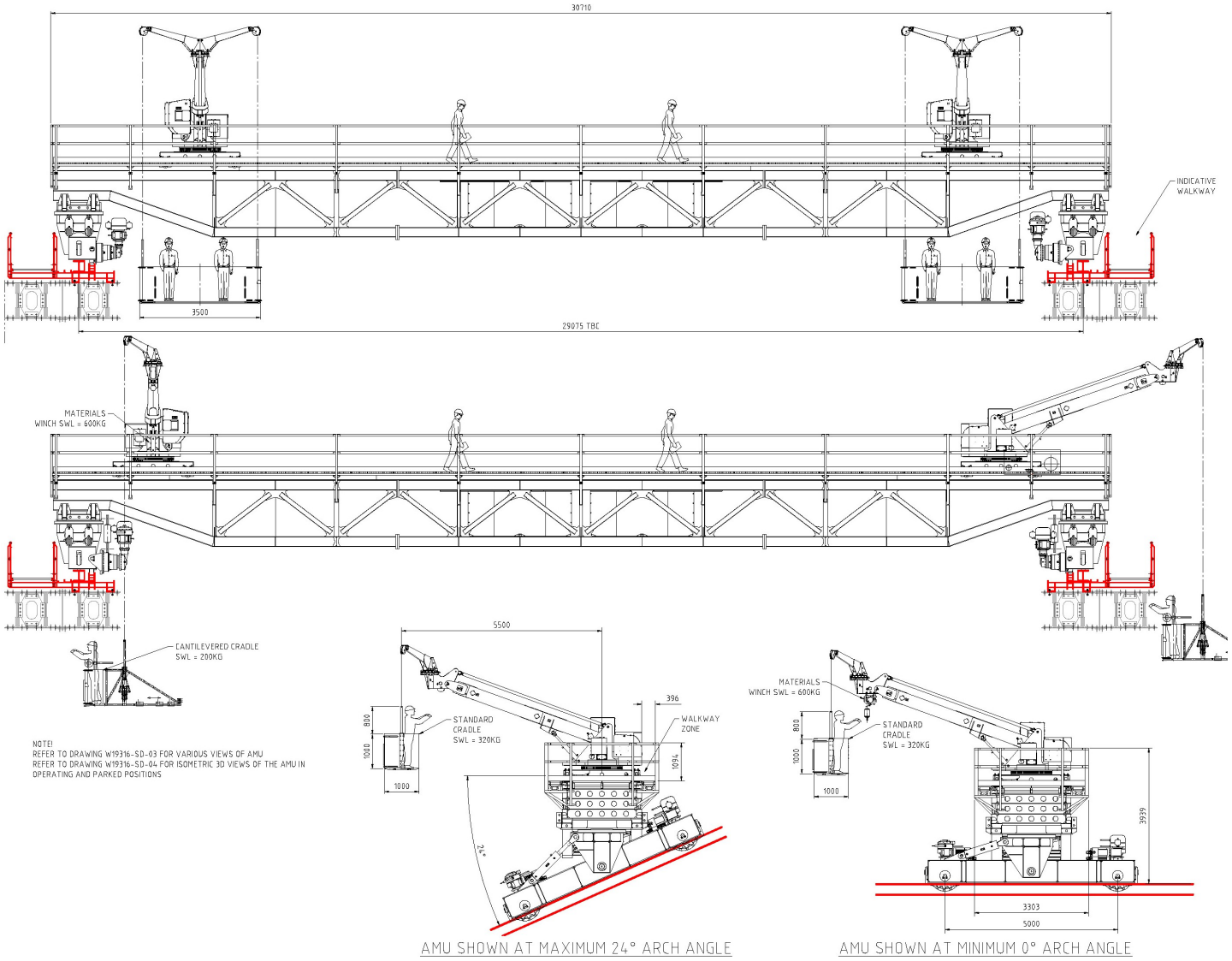


Figure 3-2 AMUs sections - indicative new walkways (Source: Mannetch)

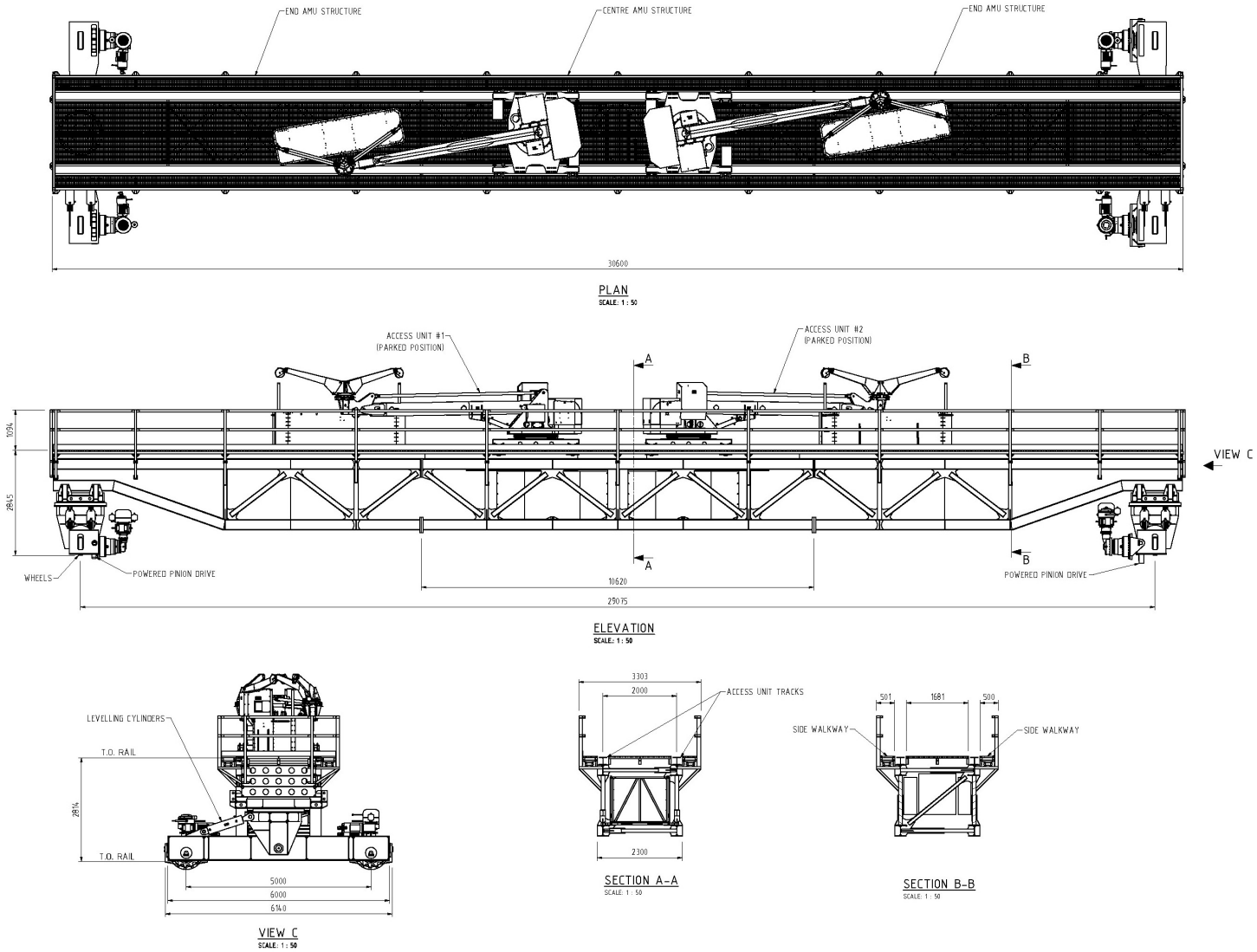


Figure 3-3 Plans, elevation, sections - proposed AMUs (Source: Mannetch)

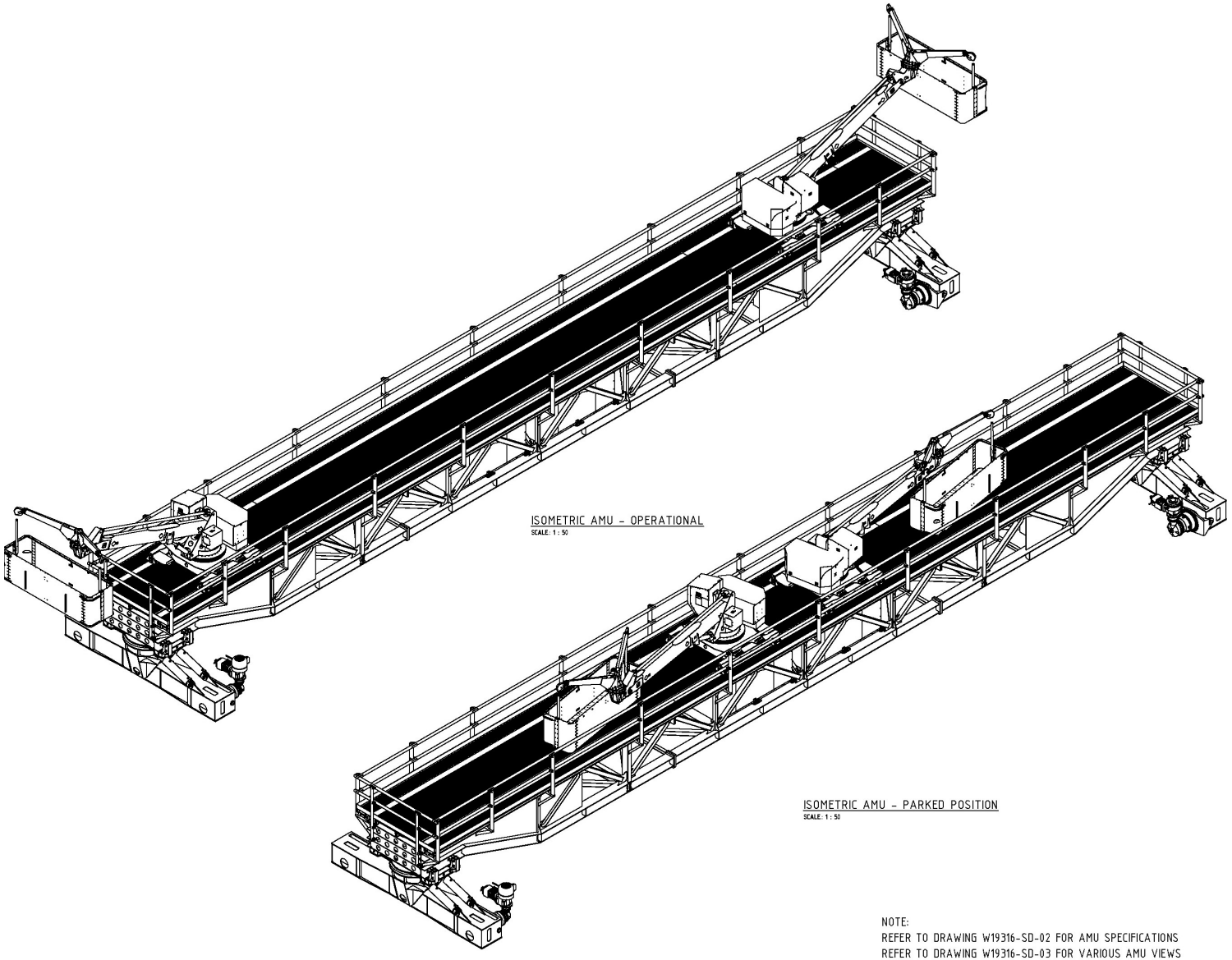


Figure 3-4 Isometric drawings of the proposed AMUs (Source: Mannetch)

AMUs and associated BMUs

Two mechanised AMUs with truss gantries are proposed, with one installed on each of the north and south sides of the bridge and traversing the full length of the arch via a rack and track system fixed to the top chords. Each AMU include two BMU's with luffing jibs and cradles.

The truss gantry would also provide two fixed large and movable storage compartments (3.0m long x 1.5m wide x 1.2m deep) for storage of maintenance equipment. These storage compartments would be accessible via access hatches on the top of the gantry structure and would movable for suitable clearance from BMU operation. A hydraulic levelling system would be installed to ensure that the gantry platform is level and safe to perform work on the bridge.

Each AMU would travel along the bridge arch via twin rack and pinion drive units on a track system mounted onto the bridge chord structure, with each drive unit having two pinions for additional safety in case of any failure to one motor. The motors would also have a brake to ensure any external forces or loads will not move the AMU in stationary position.

Two BMUs would be operating on a mounted twin track system installed on the top of each AMU truss gantry. The BMU's would be fitted with three types of cradles, a standard cradle (personnel box), cantilevered cradle and a corner drop cradle for difficult to access areas.

Walkways

The proposal includes the removal of the existing walkways and brackets on both top chords of the bridge to allow the new rack and track system to be installed. New walkways (including replacement of the hand rails and stair treads) would then be fitted to the outer edge of the chords. Figure 3-5 illustrates the proposed new walkway position adjacent to the rack and track system.

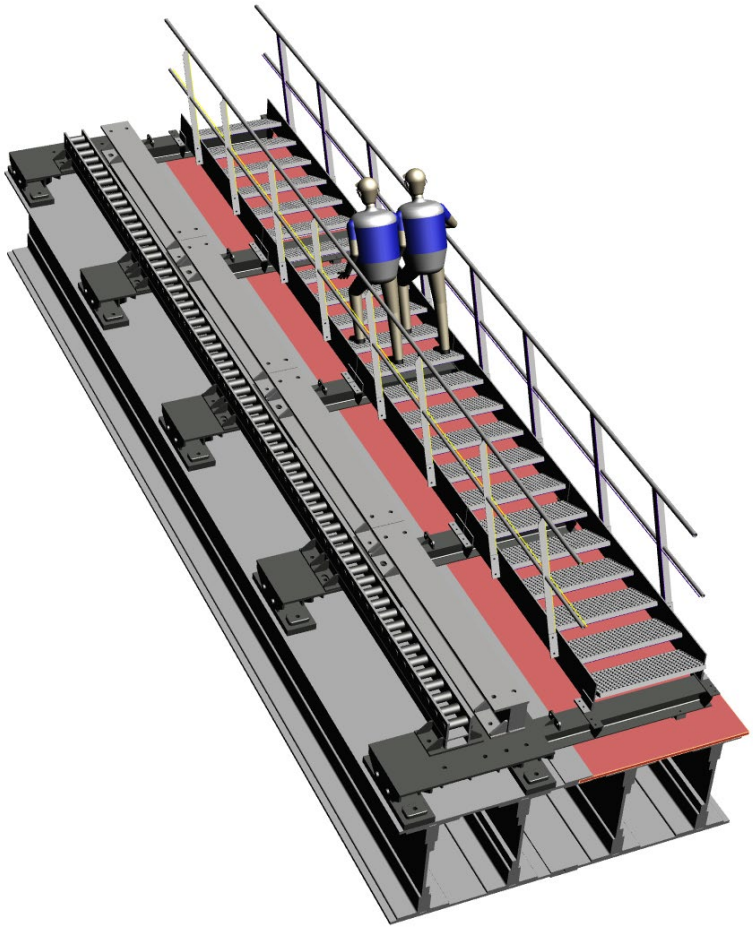


Figure 3-5 Illustration of new walkway position (Source: Manntech)

The new walkways would be wide enough for two people to safely pass would accommodate the existing Bridge Concessionaire safety systems. New cable trays, power junction boxes, power outlets (about every 25 metres), air supply system and a fall arrest system would be mounted on the walkway stanchions or between the track and walkway. Brackets to support this equipment would be required along the full length of the walkway and “open” steel shape sections would be used where possible for improved corrosion protection.

3.3 Construction activities

3.3.1 Work methodology

Work methodology overview

The proposals would be implemented in the following broad sequence:

- Site establishment works
- Initial site works
- Removal of existing BMUs
- Installation of AMU gantry including installation of the initial rail section (30 metres)
- Installation of remaining pedestals, track and rack works
- Demobilisation works.

Each of each of these broad work stages are described further below.

Site establishment works

Site establishment works would involve securing and setting up the compounds (refer to section 3.4), establishing temporary access to the bridge structure, installing temporary power/services and installing safety nets. Temporary hoists would be installed on at the northern and southern ends of the main bridge arch.

A suitable area for staging of oversize vehicles would also be established.

Initial site works

Initial site works would involve the following:

- Installation of temporary bypass walkways for the Bridge Concessionaire to allow climbers to access the bridge while the new walkway is being installed
- Removal of initial section of walkway and handrails from the top chord
- Removal of paint around rivets prior to removal. This would occur within a plastic lined enclosure which would be swept/vacuumed during or at the end of each shift
- Removal of rivets on top chord and preparation of surfaces around fixing locations using a lead--free paint system. Rivets would be removed using a combination of cutters, twist drills and magnetic drills combined with a cutting compound. Turnings, filings, or shavings and cutting fluid would be removed and captured using magnetic catch trays inside the bridge chord and the inside flange
- Bolting of new components to the top chord.

Removal of existing BMUs

Removal of the existing BMUs would involve:

- Partial in place pre-demolition of BMUs
- Implementation of partial bridge closure and track possessions
- Mobilisation of crane (60 tonne mobile crane) and support vehicles to bridge deck
- Lifting of existing BMUs down to bridge deck and remove from site with low loader.

Installation of AMU gantries

Installation of AMU gantries would involve:

- Installation, bracing and alignment of drive units
- Implementation of full bridge closure (except one lane for emergency vehicles)
- Transport of gantry to site. Lift and place gantry platform using 250-350 tonne mobile crane
- Lifting and installation of BMUs
- Lifting of temporary loader cranes and place on gantry.

Installation of remaining pedestals, track and rack works

Installation of remaining pedestals, track and rack works would involve:

- Demolition of next section of existing walkway, temporarily storing removed components on gantry platform
- Lifting of new walkway components onto gantry platform for walkway installation during day shift
- Installation of new walkway in 2.5 metre sections of walkway, tracks and rack
- Delivery of next section of walkway materials and lifting onto gantry platform during night shift.

Demobilisation works

Demobilisation works would involve:

- Removal of temporary loader cranes from AMUs
- Removal of temporary hang nets, safety lines, etc
- Removal of temporary services
- Demobilisation from site compound areas, including site clean-up.

3.3.2 Construction hours and duration

Where possible, construction works would occur during standard hours as follows:

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 8:00am to 1:00pm
- Sunday: No work
- Public holidays: No work

Works outside standard construction hours would be required where they are in the rail corridor and need to occur during track possession periods, or where they require lane closures (primarily for the lifting of large items such as removal of existing AMUs and the placement of new AMUs). Mitigation measures for out of hours works have been proposed in accordance with the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) (refer to section 6.2).

Subject to the terms of approval, works would commence in 2021 and may take up to five years to complete. If work scope, methodology or other circumstances change, this REF would be reviewed in consultation Transport for NSW environment staff and appropriate approval sought.

3.3.3 Plant and equipment

The proposal would involve the use mobile cranes (60 tonne and 350-350 tonne), hoists, temporary loading cranes (on the new AMU gantry), traffic control equipment, lighting and hand tools (cutters, twist drills and magnetic drills).

3.3.4 Earthworks

The proposal does not involve earthworks.

3.3.5 Source and quantity of materials

The proposal would require moderate quantities of materials including steel (new AMUs, BMUs, tracks/racks, walkways, bolts and fixings), componentry for electrical and mechanical functions, paint, and cutting fluid.

The quantities of material required would not result in a regional or local supply shortage and none are likely to be in short supply in the foreseeable future. Materials would be sourced from local commercial suppliers where available.

Non-renewable resources such as petroleum fuels would not be used in large quantities.

3.3.6 Traffic management and access

Some major activities (refer to section 3.3.1) would require part or full bridge closure (except lane for emergency vehicles) on the Sydney Harbour Bridge. More frequent one to two lane closures would be required for material deliveries. Where required, lane closures would generally be between 10pm and 6am and would be implemented in accordance with an applicable Road Occupancy Licence and Traffic Control at Worksites (Roads and Traffic Authority (NSW), 1998). During any lane closure period, up to about ten additional truck movements between the bridge deck and compounds could be generated.

Some activities may require the temporary closure of either the pedestrian walkway (eastern side of the bridge deck) or the cycleway (western side of the bridge). Closures would generally be limited between 10pm and 6am and access across the bridge would, in all except full bridge closures, be maintained by keeping one of the pathways open during this period. While temporary diversions are in place, cyclists would need to walk their bikes across the bridge.

If access to the rail corridor is required, this would occur during designated track possession periods and in consultation with Sydney Trains.

3.4 Ancillary facilities

Existing Sydney Harbour Bridge maintenance facilities and worker amenities (located beneath the southern and northern pylons) would be used for the proposal (refer to Figure 3-6). Additional dedicated site compounds would not be required.

Access between maintenance facilities and the bridge structure is available via the pylons (for workers with hand tools) and via vehicles (where larger equipment and materials are required). The vehicle access routes would be as described below and as shown in Figure 3-6:

- Access to site from southern pylon maintenance facility – Lower Fort Street, Argyle Street and Kent Street
- Return to southern pylon maintenance facility – Grosvenor Street, Gloucester Street, Essex Street, Cumberland Street and Lower Fort Street
- Access to site from northern pylon maintenance facility – Alfred Street, Fitzroy Street, Broughton Street, Clark Road and High Street
- Return to northern pylon maintenance facility – Lavender Street and Alfred Street.

A temporary facility may be required for storage and partial assembly of AMU components after important. If required a suitable site would be identified and appropriate further assessment would be carried out.

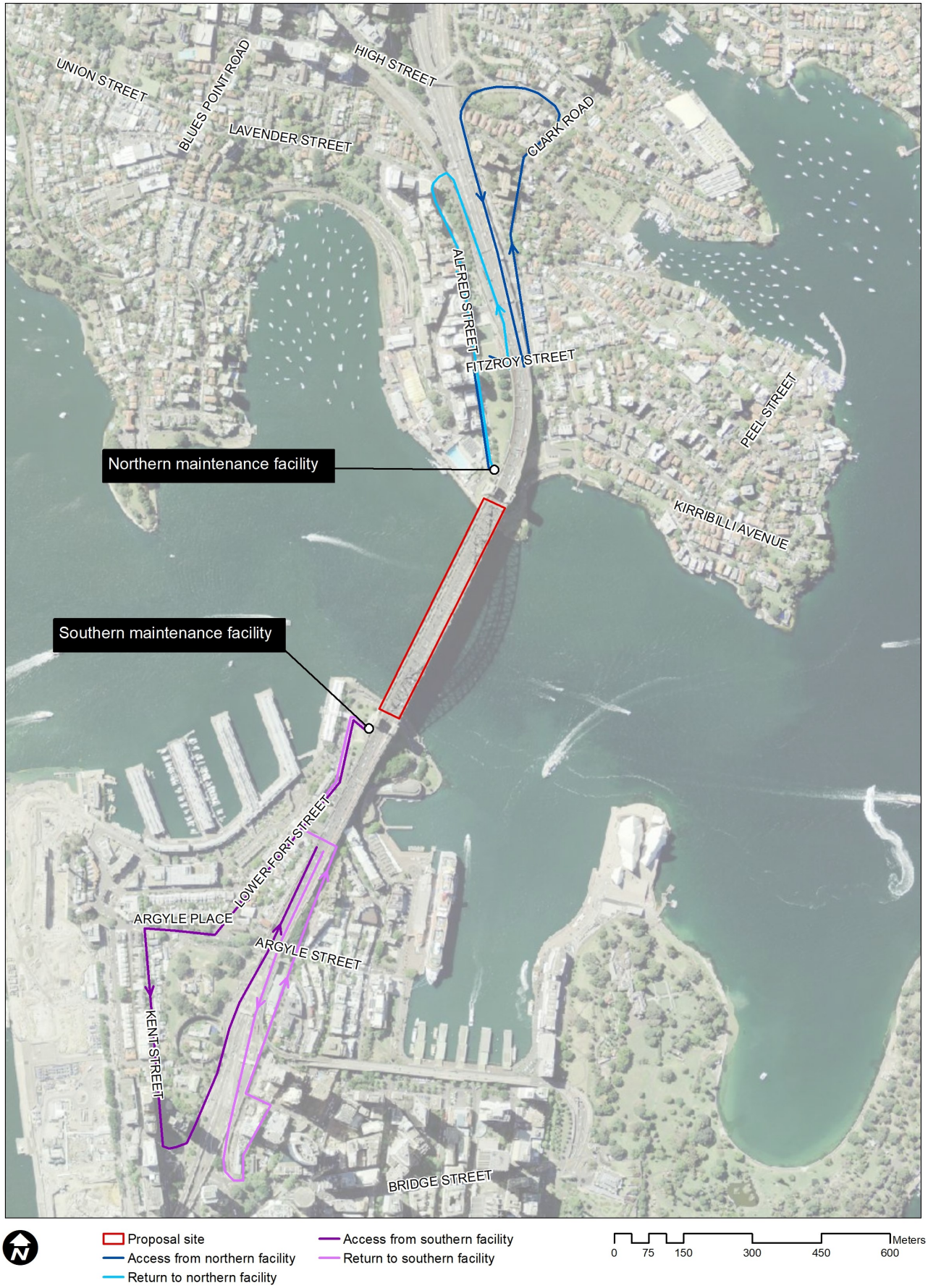


Figure 3-6 Maintenance facilities and access routes

3.5 Public utility adjustment

No adjustments to public utilities are required for the proposal.

3.6 Property acquisition

Property acquisition is not required for the proposal.

4 Statutory and planning framework

4.1 State Environmental Planning Policies

4.1.1 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.

Clause 94 of the ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposal is for a road and road infrastructure facilities and is to be carried out by Transport for NSW, it can be assessed under Division 5.1 of the EP&A Act. Development consent from the council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not and does not require development consent or approval under State Environmental Planning Policy (Coastal Management) 2018, State Environmental Planning Policy (State and Regional Development) 2011 or State Environmental Planning Policy (State Significant Precincts) 2005.

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. Consultation, including consultation as required by ISEPP (where applicable), is discussed in Chapter 5 of this REF.

4.1.2 Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005

Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 (Sydney Harbour REP) is a deemed SEPP. The consistency of the proposal with the aims set out in clause 2 of Sydney Harbour REP is considered in Table 4-1.

Table 4-1 Sydney Harbour REP aims

Clause	Matter	Comment
1(a)	to ensure that the catchment, foreshores, waterways and islands of Sydney Harbour are recognised, protected, enhanced and maintained: (i) as an outstanding natural asset, and (ii) as a public asset of national and heritage significance, for existing and future generations,	The proposal would not affect the catchment, foreshores, waterways and islands of Sydney Harbour. Safeguards and management measures have been proposed to address the risk of waterway pollution.
1(b)	to ensure a healthy, sustainable environment on land and water,	The proposal would not compromise the aim of a healthy, sustainable environment on land and water. Safeguards and management measures have been proposed to address human health risks and the risk of waterway pollution.
1(c)	to achieve a high quality and ecologically sustainable urban environment,	The proposal would have short-term impacts on the urban environment (pathway and lane closures) but would

Clause	Matter	Comment
		contribute to the longer-term retention of the Sydney Harbour Bridge key transport infrastructure and a national heritage asset. The principles of ecologically sustainable development are considered in section 8.2.
1(d)	to ensure a prosperous working harbour and an effective transport corridor,	The proposal is necessary to maintain a key road transport harbour crossing. There would be no maritime traffic beneath the Sydney Harbour Bridge resulting from the proposal.
1(e)	to encourage a culturally rich and vibrant place for people,	The proposal would not compromise the aim of providing a culturally rich and vibrant place for people.
1(f)	to ensure accessibility to and along Sydney Harbour and its foreshores,	Accessibility within Sydney Harbour and along its foreshores would not be affected by the proposal.
1(g)	to ensure the protection, maintenance and rehabilitation of watercourses, wetlands, riparian lands, remnant vegetation and ecological connectivity,	The proposal would not affect watercourses, wetlands, riparian lands, remnant vegetation or ecological connectivity.
1(h)	to provide a consolidated, simplified and updated legislative framework for future planning.	Not relevant to the proposal.

The land which the proposal traverses is part unzoned, part zoned W1 Maritime Waters and part zoned W8 Scenic Waters Passive Use. The consistency of the proposal with the objectives of the W1 and W8 zones is provided in Table 4-2.

Table 4-2 Sydney Harbour REP zone objectives

Zone	Objective	Comment
W1	(a) to give preference to and protect waters required for the effective and efficient movement of commercial shipping, public water transport and maritime industrial operations generally,	The proposal would not affect the effective and efficient movement of commercial shipping, public water transport and maritime industrial operations
W1	(b) to allow development only where it is demonstrated that it is compatible with, and will not adversely affect the effective and efficient movement of, commercial shipping, public water transport and maritime industry operations,	The proposal would support essential maintenance of an existing road transport infrastructure asset with national heritage value. It is not a new development.
W1	(c) to promote equitable use of the waterway, including use by passive recreation craft.	The proposal would not involve or affect waterway usage.
W8	(a) to give preference to unimpeded public access along the intertidal zone, to the visual continuity and significance of	The proposal would not affect public access along the intertidal zone, to the visual continuity and significance of the

Zone	Objective	Comment
	the landform and to the ecological value of waters and foreshores,	landform and to the ecological value of waters and foreshores.
W8	(b) to allow low-lying private water-dependent development close to shore only where it can be demonstrated that the preferences referred to in paragraph (a) are not damaged or impaired in any way, that any proposed structure conforms closely to the shore, that development maximises open and unobstructed waterways and maintains and enhances views to and from waters in this zone,	The proposal does not constitute low-lying private water-dependent development.
W8	(c) to restrict development for permanent boat storage and private landing facilities in unsuitable locations,	The proposal does not constitute permanent boat storage or private landing facilities.
W8	(d) to allow water-dependent development only where it can be demonstrated that it meets a demonstrated demand and harmonises with the planned character of the locality,	The proposal does not constitute water dependent development.
W8	(e) to ensure that the scale and size of development are appropriate to the locality and protect and improve the natural assets and natural and cultural scenic quality of the surrounding area, particularly when viewed from waters in this zone or areas of public access.	The proposal would support essential maintenance of a road transport infrastructure asset with national heritage significance. The proposal would have moderate heritage impacts (refer to section 6.1) but would assist in preserving the heritage values of the Sydney Harbour Bridge in the longer term by providing better access for maintenance. There proposal would have some visual impacts, mainly for views either from the bridge itself or directly adjacent such as from the pedestrian pathways or road carriageways. Safeguards and management measures have been proposed to address these impacts (refer to section 6.1.6 and section 6.5.4).

Clause 18 of the Sydney Harbour REP regulates development in zoned areas. The proposal is not one of the uses specifically named by Clause 18 and accordingly its permissibility would ordinarily be subject to the consent authority forming a view regarding its consistency with zone objectives and the potential for adverse impacts.

In addition, the Sydney Harbour Bridge including approaches and viaducts (road and rail) is listed as a heritage item by the Sydney Harbour REP (Item 67). By operation of Clause 55 of the Sydney Harbour REP, development consent is ordinarily required for, amongst other things, the alteration of a listed heritage item.

As discussed in section 4.1.1, the ISEPP operates to remove otherwise applicable consent requirements and prohibitions. This includes those potentially arising from the operation of Clause 18 of the Sydney Harbour REP and those potentially arising from the operation of Clause 55.

Part 3 Division 2 (and Part 5 in relation to heritage) of the Sydney Harbour REP sets out matters that need to be considered by determining authorities (under Division 5.1 of the EP&A Act). The Part 3 Division 2 matters are considered in Table 4-3 while the Part 5 matters are considered in Table 4-4.

Table 4-3 Sydney Harbour REP Part 3 Division 2 matters

Clause	Matter	Comment
21	Contains a number of matters in relation to biodiversity, ecology and environmental protection.	The proposal is expected to have a neutral effect on water quality with the implementation of appropriate safeguards and mitigation measures.
22	Public access to foreshores and waterways	No impact.
23	Maintenance of a working harbour	No impact.
24	Interrelationship of waterway and foreshore uses	No impact.
25	Scenic quality	The proposal would result in a negligible change to the visual environment. It is not considered that this would affect scenic quality.
26	Maintenance, protection and enhancement of views	The proposal would not obstruct or reduce the quality of views.
27	Boat storage	No impact.

Table 4-4 Sydney Harbour REP Part 5 heritage objectives

Clause		Comment
53(1)(a)	To conserve the environmental heritage of the land to which this Part applies	The proposal would have some heritage impacts (refer to section 6.1) but would also assist in preserving the heritage values of the Sydney Harbour Bridge, which is a nationally significant heritage item.
53(1)(b)	To conserve the heritage significance of existing significant fabric, relics, settings and views associated with the heritage significance of heritage items.	The proposal would have some heritage impacts (refer to section 6.1) but would also assist in preserving the heritage values of the Sydney Harbour Bridge, which is a nationally significant heritage item.
53(1)(c)	To ensure that archaeological sites and places of Aboriginal heritage significance are conserved.	The proposal would not affect Archaeological sites or places of Aboriginal heritage significance.
53(1)(d)	To allow for the protection of places which have the potential to have heritage significance but are not identified as heritage items.	Not relevant to the proposal.

Clause 63 sets out matters in relation to the protection of wetlands which must be considered by public authorities before carrying out activities to which Division 5.1 of the EP&A Act applies. These matters are considered in Table 4-5.

Table 4-5 Sydney Harbour REP Clause 63 matters

Matter	Comment
Neutral or beneficial effect on water quality. Adequate erosion and sedimentation control.	The proposal is expected to have at least a neutral effect on water quality with the implementation of appropriate safeguards and mitigation measures. See section 6.2.
Impacts on flora and fauna and their habitats. Protection of native vegetation.	The proposal would not affect flora, fauna or their habitats. There would be no loss of native vegetation.
Impacts on surface and groundwater characteristics of the site.	No impact.
Measures to protect the environment.	See Chapter 6.
Protection of the intertidal zone from pollution.	The proposal would not affect the intertidal zone.
Protection of aquatic ecological communities.	The proposal would not directly affect aquatic ecological communities. With the implementation of the proposed safeguards and mitigation measures, indirect impacts are also not expected.
Preservation or enhancement of surrounding wetlands.	There are no wetlands near the subject site.

4.2 Local Environmental Plans

Most of the area traversed by the main span is generally not subject to the provisions of a local environmental plan. The Sydney Harbour REP (discussed in section 4.1.2) applies to this area. The North Sydney Local Environmental Plan 2013 (North Sydney LEP) applies to a small area at the northern extent of the subject site while the Sydney Local Environmental Plan 2012 (Sydney LEP) and Sydney Cove Redevelopment Authority Scheme apply at the southern extent. The zoning of the subject site is shown in Figure 4-1.

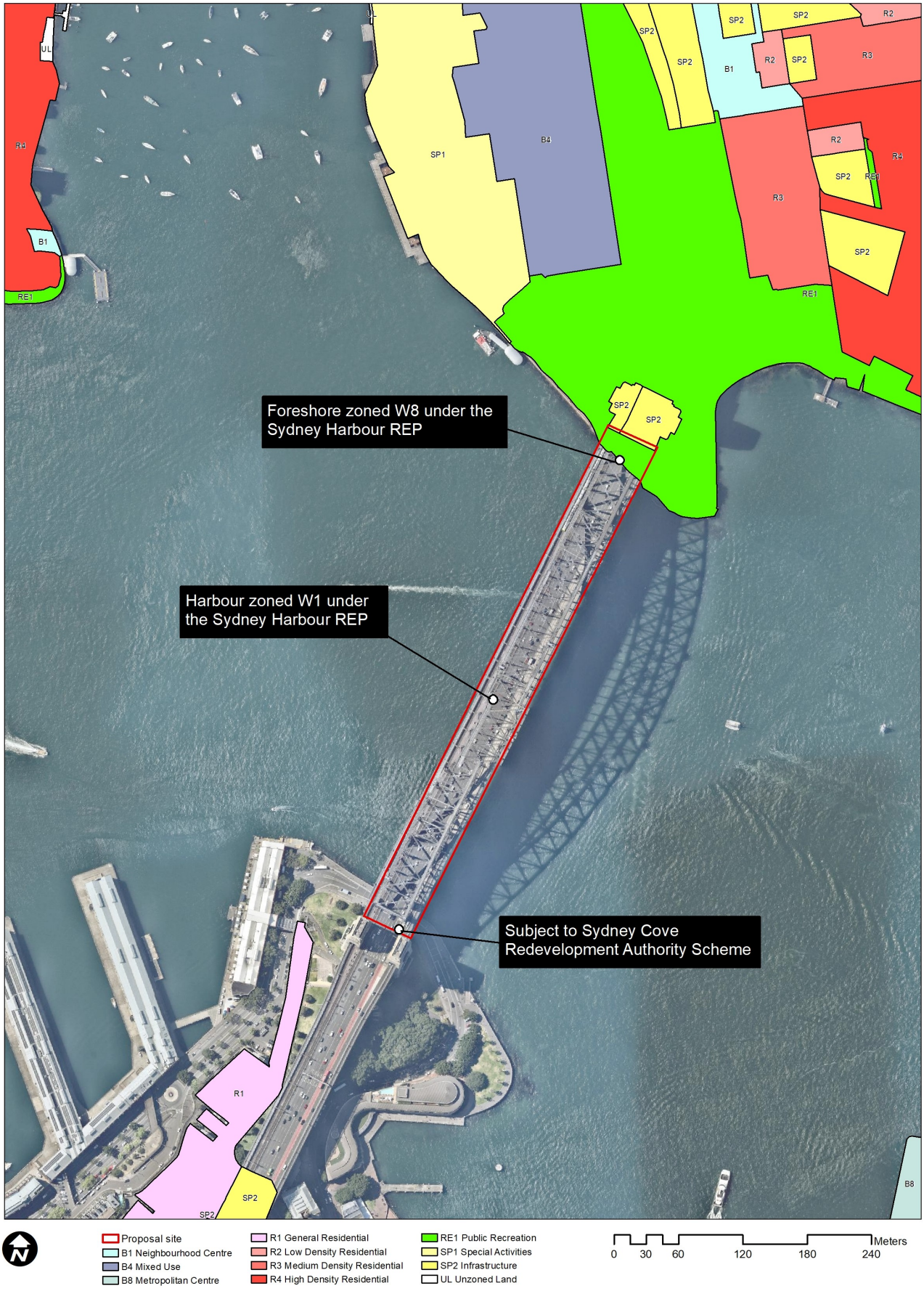


Figure 4-1 Land use zoning

4.2.1 North Sydney Local Environmental Plan 2013

The North Sydney LEP zones the northern extent of the subject site as RE1 Public Recreation and SP2 Infrastructure. Development for the purposes of roads is permitted with development consent in both these zones. Clause 94 of the ISEPP operates to remove those consent requirements (refer to Section 4.1.1). The consistency of the proposal with the objectives of the RE1 and SP2 zones is provided in Table 4-6.

Table 4-6 North Sydney LEP zone objectives

Zone	Objective	Comment
RE1	To enable land to be used for public open space or recreational purposes.	The proposal would not affect the use of land within the RE1 zone for public open space or recreational purposes.
RE1	To provide a range of recreational settings and activities and compatible land uses.	The proposal would not compromise provision of a range of recreational settings and activities and compatible land uses
RE1	To protect and enhance the natural environment for recreational purposes.	The proposal would not affect natural environment for recreational purposes. Safeguards and management measures have been proposed to address human health risks and the risk of waterway pollution.
RE1	To ensure sufficient public recreation areas are available for the benefit and use of residents of, and visitors to, North Sydney.	The proposal would not affect the availability of public recreation areas for the benefit and use of residents of, and visitors to, North Sydney.
SP2	To provide for infrastructure and related uses.	The proposal involves essential maintenance of a road transport infrastructure asset and is therefore consistent with this objective.
SP2	To prevent development that is not compatible with or that may detract from the provision of infrastructure.	Not relevant to the proposal.

Schedule 5 of the North Sydney LEP identifies two heritage items at the northern extent of the subject site. These are Item I0540 - Seawall and wharf site and Item I0541 - Sydney Harbour Bridge north pylons. Clause 5.10 of the North Sydney LEP requires development consent for demolishing, moving, altering, disturbing a heritage item or subdividing and/or erecting a building on land on which a heritage item is located. None of these activities are proposed in relation to the two North Sydney LEP listed items. It is also noted that Clause 94 of the ISEPP operates to remove otherwise applicable consent requirements (refer to Section 4.1.1).

4.2.2 Sydney Local Environmental Plan 2012

The Sydney LEP zones the area adjacent to the southern extent of the subject site as SP2 Infrastructure. Development for the purposes of roads is permitted with development consent in both this zone. Clause 94 of the ISEPP operates to remove this consent requirement (refer to Section 4.1.1). The objectives of the SP2 zone in the Sydney LEP are the same as those in the North Sydney LEP and are considered in Table 4-6.

4.2.3 Sydney Cove Redevelopment Authority Scheme

The southern extent of the subject site is within the area to which the Sydney Cove Redevelopment Authority Scheme applies. Under the scheme and under Schedule 1, Part 8, Clause 29 of the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017* development of any kind requires development consent. Clause 94 of the ISEPP operates to remove that consent requirement (refer to Section 4.1.1).

4.3 Other relevant legislation

4.3.1 Protection of the Environment Operations Act 1997

Section 120 of the *Protection of the Environment Operations Act 1997* (POEO Act) prohibits the pollution of waters. The proposal includes measures to address the risk of water pollution - see Section 6.5.

Air pollution-related sections 124 to 126 (Chapter 5, Part 5.4., Division 1) of the POEO Act require activities to be conducted in a proper and efficient manner, while section 128 (Chapter 5, Part 5.4., Division 1) of the POEO Act requires that all necessary practicable means are used to prevent or minimise air pollution. Air quality is addressed in section 6.3.

Pollution of land and waste is covered by Part 5.6 of the POEO Act. The Act defines 'waste' for regulatory purposes and establishes management and licensing requirements for waste.

It defines offences relating to waste and sets penalties. The POEO Act also establishes the ability to set various waste management requirements via the Protection of the Environment Operations (Waste) Regulation 2014. Lead paint waste (arising otherwise than from residential premises or educational or child care institutions) is pre-classified as hazardous waste under the *Waste Classification Guidelines Part 1: Classifying Waste* (Environment Protection Authority, 2014) is subject to waste tracking requirements under Part 4 of the Protection of the Environment Operations (Waste) Regulation 2014. Waste and contamination is addressed in section 6.8.

Part 3.2 of the POEO Act requires an Environmental Protection Licence for scheduled development work and the carrying out of scheduled activities. The proposal does not trigger these requirements.

4.3.2 Heritage Act 1977

Section 57 of the *Heritage Act 1977* regulates development affecting items on the State Heritage Register or the subject of an interim heritage order. The Sydney Harbour Bridge (and approaches) is listed on the State Heritage Register. Section 57 provides among other things:

57 Effect of interim heritage orders and listing on State Heritage Register

(1) When an interim heritage order or listing on the State Heritage Register applies to a place, building, work, relic, moveable object, precinct, or land, a person must not do any of the following things except in pursuance of an approval granted by the approval body under Subdivision 1 of Division 3:

(a) demolish the building or work,

(b) damage or despoil the place, precinct or land, or any part of the place, precinct or land,

(c) move, damage or destroy the relic or moveable object,

(d) excavate any land for the purpose of exposing or moving the relic,

(e) carry out any development in relation to the land on which the building, work or relic is situated, the land that comprises the place, or land within the precinct,

(f) alter the building, work, relic or moveable object,

(g) display any notice or advertisement on the place, building, work, relic, moveable object or land, or in the precinct,

(h) damage or destroy any tree or other vegetation on or remove any tree or other vegetation from the place, precinct or land.

The proposal directly affects an SHR listed item being the Sydney Harbour Bridge approaches and viaducts (road and rail) (database number 5045703) and is not within the scope of approval exemptions. Approval from the Heritage Council is therefore required.

On 6 June 2018, the Heritage Council approved the proposed replacement of the AMUs under section 63 of the Heritage Act, subject to eight conditions (refer to Appendix C). The requirements of the approval conditions have been incorporated into the heritage related safeguards and management in section 6.1.6.

4.4 Commonwealth legislation

4.4.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) a referral is required to the Australian Government for proposed 'actions that have the potential to significantly impact on matters of national environmental significance or the environment of Commonwealth land. These are considered in Appendix A and chapter 6 of the REF.

The Sydney Harbour Bridge is a place identified by the National Heritage List. In relation to listed places, an approval requirement arises where an action has, will have or is likely to have a significant impact on the National Heritage values of a National Heritage place (see section 15B of the EPBC Act). The National Heritage values for the Sydney Harbour Bridge are identified in the relevant Commonwealth of Australia Gazette notice (No. S49 of 19 March 2007).

A referral is not required for proposed road actions that may affect nationally listed threatened species, populations, endangered ecological communities and migratory species. This is because requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted under the EPBC Act by the Australian Government in September 2015. Potential impacts to these biodiversity matters are also considered as part of Chapter 6 and in Appendix A.

The assessment of potential proposal impacts found that it would be unlikely to cause a significant impact on matters of national environmental significance or the environment of Commonwealth land. A referral to the Australian Government Department of the Environment and Energy is not required.

4.5 Confirmation of statutory position

The proposal is categorised as development for the purpose of a road and/or road infrastructure facilities and is being carried out by or on behalf of a public authority. Under clause 94 of the ISEPP the proposal is permissible without consent. The proposal is not State significant infrastructure or State significant development. The proposal can be assessed under Division 5.1 of the EP&A Act.

Transport for NSW is the determining authority for the proposal. This REF fulfils Transport for NSW's obligation under section 5.5 of the EP&A Act to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

A referral under the EPBC Act is not required.

5 Consultation

5.1 Consultation strategy

The consultation strategy for the proposal involves several engagement tools which would be used to consult with the community and identified stakeholders. These include:

- Project notifications and project updates for nearby residents, businesses and stakeholders
- Door-knocking nearby residents and businesses
- Meetings and briefings for stakeholders, businesses and residents (as required)
- Letters, emails, social media posts and targeted correspondence
- Updates on the Transport for NSW website: www.rms.nsw.gov.au/projects

The REF will be displayed on the Transport for NSW website. A community update will be letterbox dropped to residents and businesses, and additional stakeholders will receive the community update with a covering email/letter.

5.2 Community involvement

The Heritage Council was consulted about the proposal as part of the Heritage Act approval process (refer to section 4.3.2) and this included a presentation to the November 2017 Heritage Council Government Subcommittee meeting. Information about Heritage Council decision on the proposal is included in the minutes of the Heritage Council meeting of 6 June 2018, which are available on the Office of Environment and Heritage website.

The proposal has the potential for some impacts on bridge users (motorists, pedestrians, cyclists, climbing customers) and nearby residents. The REF will therefore be publicly displayed for comment in 2020. Following the public display of the REF, all comments received would be recorded and addressed in a Submissions Report detailing how each issue raised would be considered in finalising the proposal design. The Submissions Report will be made available to the public on the project webpage on the Transport for NSW website.

5.3 Aboriginal community involvement

The proposal has been considered against the requirements of the *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime Services, 2011). This procedure is generally consistent with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (Department of Environment, Climate Change and Water, 2010). The main stages in the procedure are described in Table 5-1.

Table 5-1 Summary of Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Stage	Description
Stage 1	Initial Transport for NSW assessment
Stage 2	Site survey and further assessment
Stage 3	Formal consultation and preparation of a cultural heritage assessment report
Stage 4	Implement environmental impact assessment recommendations

The proposal would be confined to the Sydney Harbour Bridge structure and would not affect Aboriginal cultural heritage. There is no requirement to proceed to Stage 2 of the PACHCI.

5.4 ISEPP consultation

Part 2 Division 1 of the ISEPP outlines circumstances where consultation with councils and other public authorities is required. The consultation requirements at clauses 13-16 of the ISEPP have been reviewed and it is considered that formal consultation with local councils and other agencies is not required.

5.5 Government agency and stakeholder involvement

Given the ongoing nature of the proposal, specific consultation with agencies and stakeholders (except the Heritage Council) has not occurred during environmental assessment. Consultation with the Bridge Concessionaire and selected government agencies would occur as needed, depending on the nature and location of the works. Refer to section 5.6.

5.6 Ongoing or future consultation

Consultation already occurs periodically with Property NSW (which now has the functions of the former Sydney Harbour Foreshore Authority) and the Bridge Concessionaire regarding works on the Sydney Harbour Bridge and this would continue for the proposal as appropriate (with works expected to start in the first quarter of 2021).

By agreement with the Transport for NSW, the Bridge Concessionaire requires 30 days' notice for planned works and 24 hours' notice for emergency of works requiring diversion of climbing routes.

Other organisations that would be consulted periodically, depending on the location and nature of the works, would include:

- Sydney Trains
- Sydney Ports
- North Sydney Council.

Notification of works (via letterbox drop) would occur in relation to any works proposed outside standard construction hours and which are predicted to exceed noise management levels as determined by *Construction Noise and Vibration Guidelines* (Roads and Maritime Services, 2016) and associated Construction Noise Estimator. Notifications and any other community engagement would be consistent with the Transport for NSW Community Involvement e-Toolkit.

6 Environmental assessment

This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted by the proposal are considered. This includes consideration of:

- Potential impacts on matters of national environmental significance under the EPBC Act
- The factors specified in the guidelines *Is an EIS required?* (Department of Planning, 1995) and the *Roads and Related Facilities – EIS Guideline* (Department of Urban Affairs and Planning, 1996). The factors specified in Clause 228(2) of the Environmental Planning and Assessment Regulation 2000 are also considered in Appendix A.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

6.1 Non-Aboriginal heritage

6.1.1 Methodology

A Statement of Heritage Impact (SoHI) has been prepared for the proposal (Appendix D). The methodology for the assessment of non-Aboriginal heritage impacts is set out in section 1.4 of the SoHI and involved initially grading the significance of Sydney Harbour Bridge elements with reference to the standard scale in Table 6-1.

Table 6-1 Standard grades of non-Aboriginal heritage significance

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

The potential non-Aboriginal heritage impacts were then assessed on a scale of magnitude as shown in Table 6-2.

Table 6-2 Terminology for assessing the magnitude of heritage impact

Grading	Justification
Major	Actions that would have a long-term and substantial impact on the significance of a heritage item. Actions that would remove key historic building elements, key historic landscape features, or significant archaeological materials, thereby resulting in a change of historic character, or altering of a historical resource. These actions cannot be fully mitigated.

Grading	Justification
Moderate	Actions involving the modification of a heritage item, including altering the setting of a heritage item or landscape, partially removing archaeological resources, or the alteration of significant elements of fabric from historic structures. The impacts arising from such actions may be able to be partially mitigated.
Minor	Actions that would result in the slight alteration of heritage buildings, archaeological resources, or the setting of an historical item. The impacts arising from such actions can usually be mitigated.
Negligible	Actions that would result in very minor changes to heritage items.
Neutral	Actions that would have no heritage impact.

6.1.2 History

Sydney Harbour bridge

The following is a summary of the historical information provided in the NSW Heritage Database entry for the Sydney Harbour Bridge and in the Sydney Harbour Bridge Conservation Management Plan (Godden Mackay Logan, 2007). Further detail is included in the Appendix D.

In 1922 legislation was passed authorising the construction of the Sydney Harbour Bridge. Tenders were invited in 1923 in accordance with general plans and specifications prepared by Dr J.J.C. Bradfield, Chief Engineer, Sydney Harbour Bridge and Railway Construction. The plans and specification provided the alternatives of a cantilever bridge or an arch bridge.

First work on the bridge commenced in 1924, with construction of the bridge approaches and the approach spans. While the approach spans were being built, the foundations on either side of the harbour were prepared to take four steel bearings consisting of large hinge pins and massive steel bases for support of the arches. At each end of the arch span of the bridge, and just behind the bearings, large abutment towers supporting the pylons were constructed.

As the erection of the steelwork was proceeding, the approaches were being constructed, including Milsons Point and North Sydney railway stations, and roadway approaches on both sides of the harbour. The bridge was opened to roadway, railway and pedestrian traffic by the then Premier of New South Wales, Mr J.T. Lang, on the 19th March 1932.

Various changes have been made to the Sydney Harbour Bridge since its construction, generally in response to changes in transport, traffic management and safety standards. The approaches of the bridge have been modified over time to facilitate increased traffic since the opening of the bridge. This has included connection with the Cahill Expressway and the replacement of the tramways in 1958, connection with the Warringah Expressway in 1968, and the establishment of bus lanes in 1972.

The metal walkways on the top chords of the bridge arches were originally installed during the bridge's construction to provide safe access for maintenance workers. In 1988, commercial bridge climbing activities commenced on the bridge, offering an experience for the general public to climb the southern end of the east top chord. During this time, sections of the stairs were replaced in some locations.

Other changes have involved additions of new features along the deck of the bridge. In 1935, protective barriers were added to the water side of the footways on each side of the Bridge, primarily to discourage suicide attempts. Roadway crash barriers were installed in 1958, and in 2005-6 mesh fencing was erected along the roadway side of each footway to prevent pedestrian access to the road deck

Arch maintenance units

Four AMUs were part of the original design for the Sydney Harbour Bridge to provide access for the ongoing maintenance activities to the bridge. In 1930, two AMUs were installed to service the southern half of the bridge, and in 1931, two AMUs were installed to service the northern half of the bridge.

In 1997, after 67 years of operation, the original AMUs were deemed to have reached the end of their working life. By this time, the AMUs had become outdated pieces of maintenance equipment, and were non-compliant with new legislation regarding work health and safety. The increased role of tourism at the Sydney Harbour Bridge and proposed climbing experience provided an additional impetus for the removal of the original AMUs, which posed a physical barrier for climbing groups.

The original AMUs were replaced with new maintenance cranes in 1997. The new AMUs were designed to be similar in form and appearance to the original cranes, and featured a double jib supporting a working platform. To facilitate improved access and circulation of visitors climbing the bridge, the design of the new AMUs featured a space underneath to allow visitors to pass without mounting or passing through the AMU cabin. Despite these changes, however, the new AMUs largely operated in the same manner as the original cranes. Replacement of the current AMUs was first proposed in 2015.

6.1.3 Policy setting

The management of non-Aboriginal heritage within NSW occurs within the assessment and approval frameworks established by the EP&A Act and the *Heritage Act 1977*. For items on the National Heritage List the National Heritage management principles are set out in the Environment Protection and Biodiversity Conservation Regulations 2000 are also relevant and are considered in

Table 6-3 Relationship of heritage impacts to statutory and policy provisions

Provision	Comment
The objective in managing National Heritage places is to identify, protect, conserve, present and transmit, to all generations, their National Heritage values	The proposal contributes to the conservation of National Heritage values by preserving heritage fabric through essential maintenance and repair.
The management of National Heritage places should use the best available knowledge, skills and standards for those places, and include ongoing technical and community input to decisions and actions that may have an adverse impact on their National Heritage values.	The proposal is consistent with current standards for maintenance and repair of heritage structures. There would be no adverse impact on National Heritage values.
The management of National Heritage places should respect all heritage values of the place and seek to integrate, where appropriate, any Commonwealth, State, Territory and local government responsibilities for those places	The management of the Sydney Harbour Bridge is the primary responsibility of Transport for NSW. This occurs in consultation with other stakeholders and regulators as required.
The management of National Heritage places should ensure that their use and presentation is consistent with the conservation of their National Heritage values	The proposal contributes to the conservation of National Heritage values by preserving heritage fabric through essential maintenance and repair.
The management of National Heritage places should make timely and appropriate provision for community involvement, especially by people who:	Community engagement in relation to the Sydney Harbour Bridge occurs in accordance with Policy 35 of the Sydney Harbour Bridge Conservation Management Plan. The REF will

Provision	Comment
a. have a particular interest in, or association with, the place; and b. may be affected by the management of the place	be placed on public display and submissions will be invited.
Indigenous people are the primary source of information on the value of their heritage and the active participation of indigenous people in identification, assessment and management is integral to the effective protection of indigenous heritage values	Aboriginal cultural heritage is considered in section 5.2 and Section 6.7.
The management of National Heritage places should provide for regular monitoring, review and reporting on the conservation of National Heritage values.	Monitoring, review and reporting on the conservation of heritage values occurs within the framework of the Sydney Harbour Bridge Conservation Management Plan.

For the Sydney Harbour Bridge the key policy document is the Sydney Harbour Bridge Conservation Management Plan (Godden Mackay Logan, 2007). The plan includes the following general policy statement:

- The Sydney Harbour Bridge is a place of outstanding cultural significance in the local, state and national context which should be conserved.
- 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.
- All current and future owners, managers and consent authorities responsible for the care and management of the Sydney Harbour Bridge and/or its setting should be advised of, and be jointly responsible for, the conservation of the heritage significance of the bridge.
- Conservation of the Sydney Harbour Bridge should accord with the definitions and principles of The Burra Charter: the Australia ICOMOS Charter for Places of Cultural Significance 1999, and include all significant components and attributes of the place, including its setting, fabric, movable items, archaeological relics and non-tangible values.
- Alternatives to actions with adverse heritage impacts to the heritage values of the Sydney Harbour Bridge must be explored before such actions are undertaken.
- The Sydney Harbour Bridge must be protected from physical or environmental damage by appropriate security, maintenance and management procedures.

The proposal is consistent with the general policy statement, in particular the requirement that the bridge be protected from damage through appropriate security, maintenance and management. In addition to the above general policy statement, the Sydney Harbour Bridge Conservation Management Plan includes 37 other specific policy statements. Of particular relevance to the proposal is Policy 14 (Maintenance and Repair Works Generally), which is discussed in section 2.1.2.

6.1.4 Existing environment

Sydney Harbour Bridge

The Sydney Harbour Bridge is renowned as an engineering achievement of international importance. Although the bridge is not the largest spanning bridge in the world, it is still recognised as the greatest steel arch because of its combination of span, width and load bearing capacity.

The Sydney Harbour Bridge is listed on the State Heritage Register as 'Sydney Harbour Bridge, approaches and viaducts (road and rail)' (Listing #00781). It is also listed as an item of national significance on the National Heritage List (Listing #105888). Figure 6-1 shows the relative extent of

each listing while assessments of the bridge against the national and NSW heritage assessment criteria is provided in Table 7 and Table 8 below.

The statement of significance for the bridge on the State Heritage Register notes the following:

The bridge is one of the most remarkable feats of bridge construction. At the time of construction and until recently it was the longest single span steel arch bridge in the world and is still in a general sense the largest. The bridge, its pylons and its approaches are all important elements in townscape of areas both near and distant from it. The curved northern approach gives a grand sweeping entrance to the bridge with continually changing views of the bridge and harbour. The bridge has been an important factor in the pattern of growth of metropolitan Sydney, particularly in residential development in post-World War II years. In the 1960s and 1970s the Central Business District had extended to the northern side of the bridge at North Sydney which has been due in part to the easy access provided by the bridge and also to the increasing traffic problems associated with the bridge.

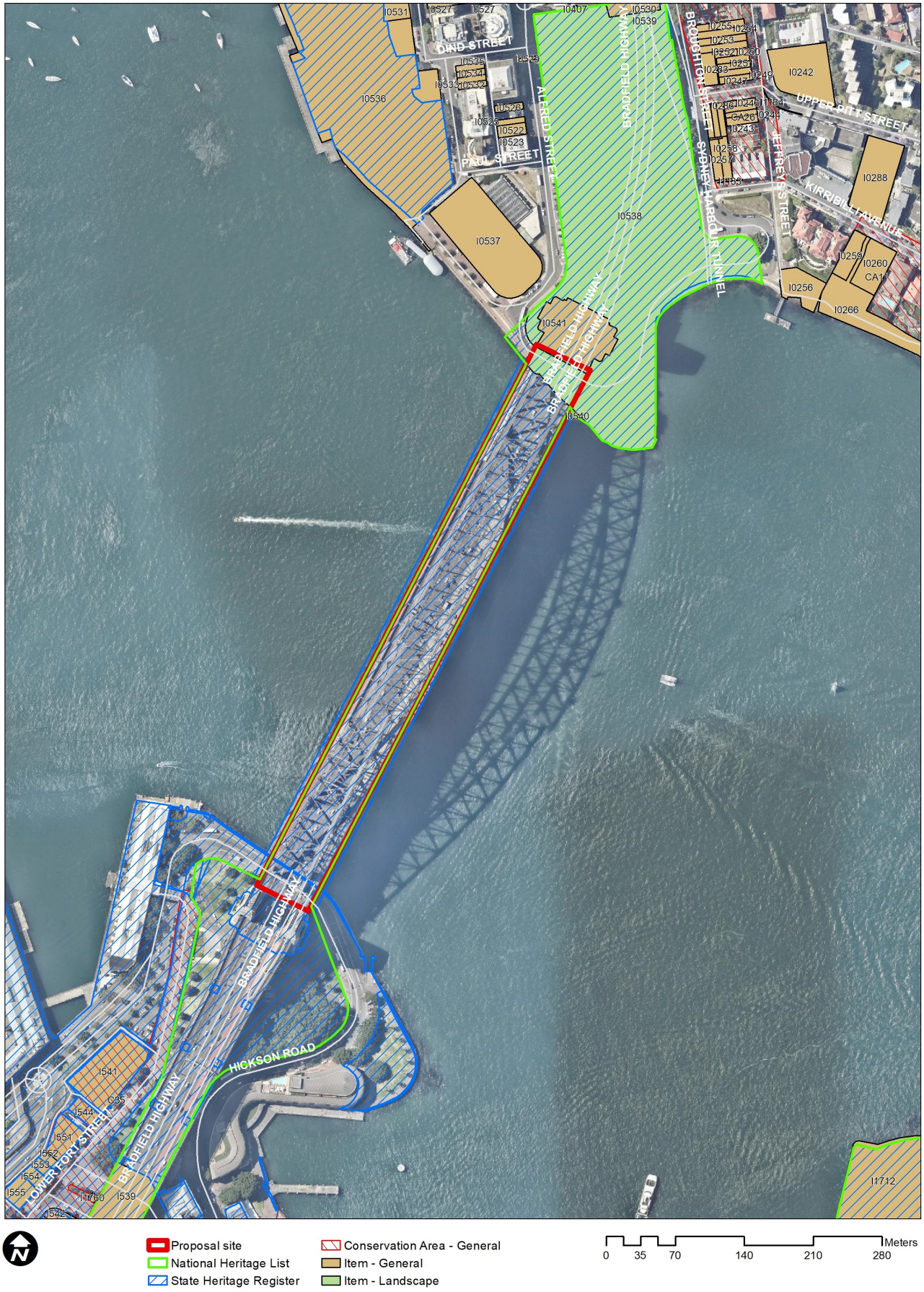


Figure 6-1 Sydney Harbour Bridge and surrounding heritage listings

Table 6-4 Significance assessment – NSW heritage assessment criteria

Criterion	Comment
A Historical Significance	The bridge is one of the most remarkable feats of bridge construction. At the time of construction and until recently it was the longest single span steel arch bridge in the world and is still in a general sense the largest (Walker and Kerr 1974). BRADFIELD PARK NORTH (SANDSTONE WALLS): "The archaeological remains are demonstrative of an earlier phase of urban development within Milsons Point and the wider North Sydney precinct. The walls are physical evidence that a number of 19th century residences existed on the site which were resumed and demolished as part of the Sydney Harbour Bridge construction" [Statement of Heritage Impact - Sandstone Walls: Bradfield Park North, Milsons Point (2003: 8), McFadyen and Stuart, HLA Envirosciences].
B Associative significance	The Sydney Harbour Bridge has strong associations with Dr JJC Bradfield, who was primarily responsible for its conception, design and construction. Bradfield was the 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. The construction of the bridge is also associated with the British team of engineers, Sir Ralph Freeman and contractors Dorman Long and Co. The bridge was the outstanding work of Freeman's career, but his contribution was marred by a dispute with Bradfield regarding who was actually responsible for its design. The bridge has strong associations with the families and descendants of the workers who built it, and who recognise its role during the Depression as the so-called 'iron lung' in providing employment and protection from hardship or the dole.
C Aesthetic or Technical Significance	The bridge, its pylons and its approaches are all important elements in townscape of areas both near and distant from it. The curved northern approach gives a grand sweeping entrance to the bridge with continually changing views of the bridge and harbour (Walker and Kerr 1974).
D Social Significance	The bridge has been an important factor in the pattern of growth of metropolitan Sydney, particularly in residential development in post-World War II years. In the 1960s and 1970s the Central Business District had extended to the northern side of the bridge at North Sydney which has been due in part to the easy access provided by the bridge and also to the increasing traffic problems associated with the bridge (Walker and Kerr 1974).
E Research Potential	BRADFIELD PARK NORTH (SANDSTONE WALLS): "The archaeological remains have some potential to yield information about the previous residential and commercial occupation of Milsons Point prior to the construction of the Sydney Harbour Bridge transport link" [Statement of Heritage Impact - Sandstone Walls: Bradfield Park North, Milsons Point (2003: 8), McFadyen and Stuart, HLA Envirosciences].
F Rarity	The bridge is a uniquely important development in Sydney's transportation network. As it introduced a main road and rail connection across Sydney Harbour, the bridge was the single most important factor in the expansion of metropolitan Sydney north of the harbour.

Criterion	Comment
	The Sydney Harbour Bridge Movable Heritage Collection is a collection of rare surviving relics relating to the construction methodology, technology and materials of the bridge, assembled as part of the overall construction program, the first time in Australia that the construction of a bridge had been approached in this manner. The Sydney Harbour Bridge Movable Heritage Collection comprises original relics of the ceremonies and celebrations for the Opening Day of the Bridge and represents a rare record of Sydney society in the period during the construction of the Bridge. It also contains rare surviving relics of the fiftieth birthday celebrations of the Bridge and of the Bicentennial celebrations in 1988.
G Representative	The bridge is representative of a significant stage in the development of Sydney and associated changes in modes of transport, including the growing reliance on private motor vehicles. The Sydney Harbour Bridge Movable Heritage Collection comprises components, materials, original memorabilia of the ceremonies and celebrations for the Opening Day of the Bridge. These items are representative of the technologies in use at the time and utilised for the construction of the bridge and is representative of the aesthetic and cultural context during the construction of the bridge.

Table 6-5 Grades of significance – Sydney Harbour Bridge arch components

Component	Description	Grading
Existing unobstructed views of the bridge and approach spans including: • Views of the bridge end-on from the northern and southern approach roads. • Views of the bridge from ground level nearby and from the water. • Views of the steel structure and pylons.	The views of the bridge from vantage points from ground level in surrounding areas along the Sydney Harbour foreshore, i.e. Kirribilli, Bradfield Park, Dawes Point, Bennelong Point and from the water. From these views, the existing AMUs on the arches are a distinguishable visual element of the Sydney Harbour Bridge. The approaches afford impressive views of the Sydney Harbour Bridge end-on, including distant views of the steel structure and pylons from deck level. These views include the existing AMUs on the arches, which are distinguishable against the silhouette of the steel structure. The views of the steel structure of the SHB from deck level offer opportunity of appreciation of the construction of the Sydney Harbour Bridge and its significant arches. From this perspective, the existing AMUs are difficult to distinguish given the oblique viewing angle and are a less noticeable visual element on the bridge.	Exceptional
Overall form of the arch and pylons, including the pattern of steel structural members.	The main arch structure of the Sydney Harbour Bridge is an integral element and one of the main recognisable components of the bridge. The arch directly contributes to the significance of the Sydney Harbour Bridge. The pattern made by the structural members of the steelwork is a tangible aspect of the bridge's significance, expressing the	Exceptional

Component	Description	Grading
	aesthetic principles underpinning its design and construction methodology.	
All steelwork of the trusses, lateral bracing and hangers, portal frames at end posts, floor laterals, cross girders, stringers, joists and bearings.	The project area encompasses the steelwork of the Sydney Harbour Bridge main arch structure including trusses, lateral bracing and hangers, portal frames at end posts, floor laterals, cross girders, stringers, joists and bearings. The existing 1997 AMUs do not provide access to lateral members of the steelwork.	High
All original access equipment, painting cranes, gantries, stairs, ladders and handrails.	The original Sydney Harbour Bridge gantries and painting cranes are no longer extant, having been removed and replaced in 1997. The walkways feature steel treads and handrails designed to fold down flat across each other over the stairway to allow the original maintenance cranes to pass across. Commencement of commercial bridge climbing activities in 1988 necessitated replacement of the walkways in some locations.	High
Replacement painting cranes and gantries installed in 1997, and associated infrastructure	The project area comprises four 1997 AMUs that replaced original gantries and painting cranes. While the AMUs retain a similar form and appearance to the original cranes, they do not constitute significant fabric and are therefore graded as being of little significance. Associated bridge maintenance infrastructure associated with the 1997 AMUs, including the electrical bus bar, cable anchorages and angles, do not constitute original fabric and are therefore graded as being of little significance.	Little

Nearby heritage items

There are several heritage items in the locality around the Sydney Harbour Bridge. Those identified as most relevant for consideration of indirect impacts are identified in Table 6-6.

Table 6-6 Nearby heritage items and areas

ID	Item/area	Location	Listing
01682	Millers Point and Dawes Point Village Precinct	Millers Point and Dawes Point	State Heritage Register
I876	Millers Point Conservation Area	Refer to Figure 6-1	Sydney LEP
-	Sydney Opera House Buffer Zone	Refer to Figure 6-2	Relates to World Heritage listed Sydney Opera House
I0538	Bradfield Park (including northern section)	Refer to Figure 6-1	North Sydney LEP
I0537	North Sydney Olympic Pool	Refer to Figure 6-1	North Sydney LEP

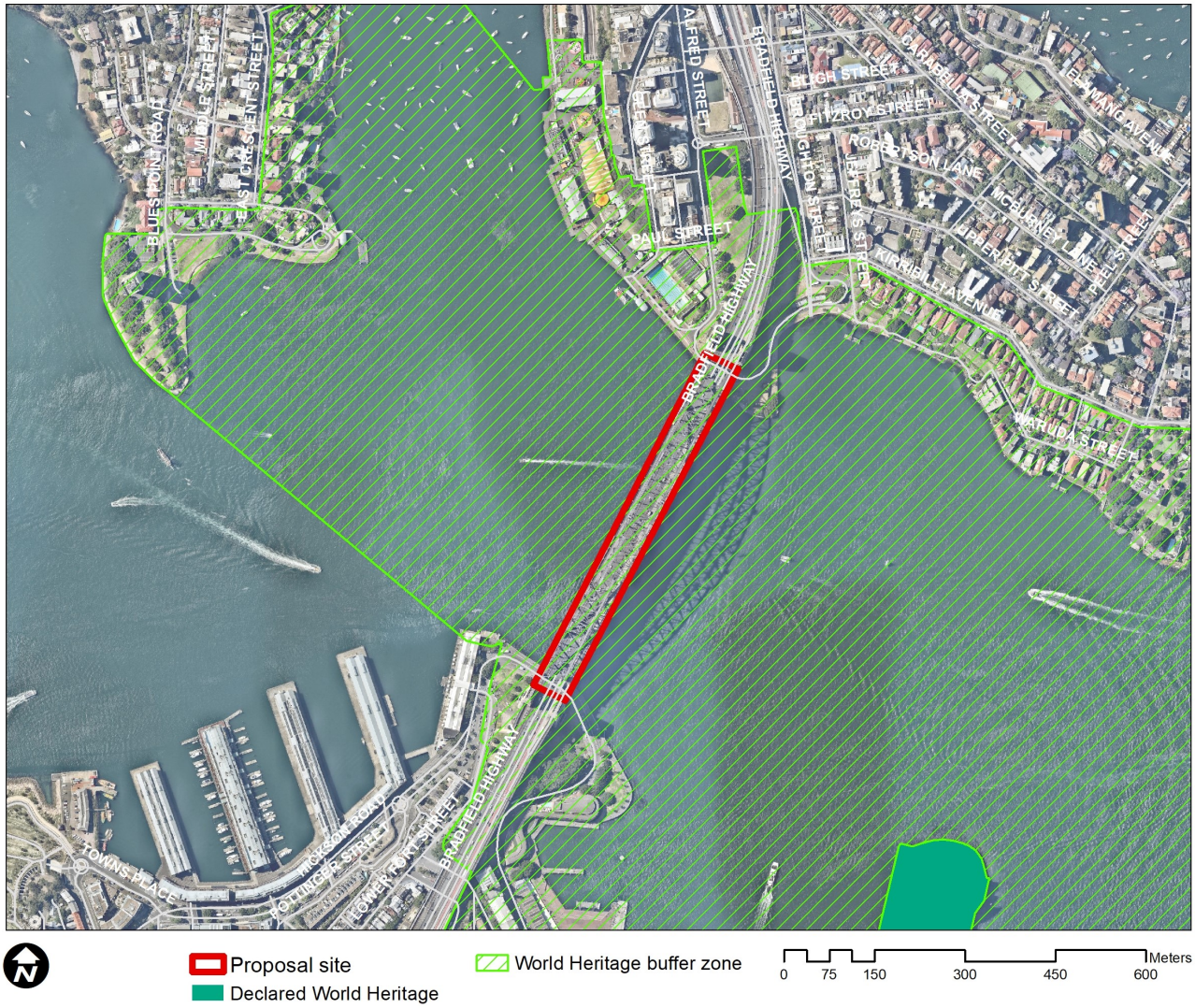


Figure 6-2 Sydney Opera House World Heritage listing and buffer zone

6.1.5 Potential impacts

Construction

The installation of the AMUs would have direct impacts on the fabric of the Sydney Harbour Bridge. The potential impacts on fabric associated with key element of construction is discussed below.

Removal of existing 1997 AMUs

The 1997 AMUs (including electrical bus bar and cable anchorages) are not original fabric of the Sydney Harbour Bridge and have been identified as being of little significance.

However, the proposed removal of the 1997 AMUs would occur near significant fabric including the steelwork elements of the main arch structure. There is potential for a minor physical impact on these significant elements.

Removal of metal walkways

The proposal involves total removal of the existing metal walkways that extend along the centre line of each top chord. These components are identified as being of high significance.

The proposed removal of existing metal walkways would have a major physical impact on the heritage significant fabric of the Sydney Harbour Bridge main arch structure.

Installation of new rail for AMUs

The proposal involves installation of new rail on the Sydney Harbour Bridge main arch structure to allow new AMUs to move along the length of the top chord members and access all required areas of the bridge. The staged construction of the rail, which would first involve installation of a 30 metre section of rail, would result in the removal not only of existing metal walkways but also a series of external rivets along a proposed path on the centre line of the top chords.

The significance grading for the original rivets of the Sydney Harbour Bridge main arch structure is not identified in the *Sydney Harbour Bridge Conservation Management Plan* (Godden Mackay Logan, 2007). These elements, however, are an intrinsic element of the bridge and an important part of its physical character as a riveted structure. The rivets are therefore considered a highly significant aspect of the bridge's aesthetic and technical significance, and also retain significant social values for the workers involved in the bridge's construction.

Given the relative scale of the proposal area compared to the overall bridge structure, which contains about 6 million rivets, the impact to rivets is considered minor. It is also noted that samples of original steel rivets are currently contained in the Sydney Harbour Bridge Movable Heritage Collection. This collection, containing original fabric elements, provides future opportunity for materials testing and analysis.

Overall, the proposed installation of new rail for the AMUs a would have a moderate physical impact on the heritage significant fabric of the Sydney Harbour Bridge main arch structure.

Installation of new AMUs

The proposal involves installation of two new AMUs consisting of two movable gantries each with two movable BMUs on the Sydney Harbour Bridge main arch structure.

While there is a possibility of the proposed works requiring modification to the cable supports of the air navigation beacon located at the bridge's apex, the proposal would not directly impact on this element of the bridge. Installation of the new AMUs would result in modification of walkways crossing the top chords, while the summit crossing would not be impacted.

The proposed installation of new AMUs would have a minor physical impact on the heritage significant fabric of the Sydney Harbour Bridge main arch structure.

Installation of new walkways

The proposal involves removal of the existing metal walkways and replacement with new walkways on the outer edges of each top chord of the bridge arches. Installation of the walkways would utilise existing rivet holes where possible, and appropriate materials and colour palette to minimise indirect impacts. Additional holes would potentially be drilled to facilitate installation of new walkways.

The proposed installation of new walkways would have a moderate physical impact on the heritage significant fabric of the Sydney Harbour Bridge main arch structure.

Operation

Following installation of the AMUs there would be improvements to effectiveness, efficiency, accessibility and safety of critical maintenance activities. This would support ongoing use and longevity of the Sydney Harbour Bridge as an item of national and state heritage significance.

There would be the potential for ongoing visual impacts both on the Sydney Harbour Bridge and on other nearby heritage items and areas.

Visual impact - Sydney Harbour Bridge

Existing unobstructed views of the Sydney Harbour Bridge and the overall visual form and pattern of the steel structural members comprising the main arch structure, are of exceptional significance. The proposal would involve permanent new elements with corresponding visual changes to the silhouette and form of the main arch structure. This particularly relates to the installation of the two new movable gantries with platforms and each with two BMUs, and the removal and replacement

of the walkways on the top chords of the arches. Visual impacts are considered from a non-Aboriginal heritage perspective below, with further detail provided in section 6.5.3 and the Visual Impact Assessment in Appendix D.

Visual impact of AMUs

The proposed 'knuckle jib' BMUs and truss gantry designs represent a departure from the 'double jib' design of the earlier AMUs on the bridge. While in operation, the new BMUs would have an increased visual impact, extending to reach a required length of 10.7 metres. The proposed AMUs, featuring platforms that span between the two top chords, would introduce prominent new visual elements that would potentially obscure the legibility of the main arch structure. This particularly applies to close angle views from deck level, end on views along the approaches, and from ground level vantage points around the Sydney Harbour foreshore, which capture the pattern of the steel structural members of the bridge.

While in 'park' mode and non-operational, the BMUs would be compact in appearance and have been designed to not exceed the visual envelope of the existing 1997 AMUs. New elements would be painted 'bridge grey' to visually match to the existing material palette and significant character of the surrounding steelwork and associated infrastructure. The truss design of the proposed gantries and utilisation of perforated mesh on the platforms would maximise the transparency of new structures, thereby minimising the visual 'bulk' and discernibility of the proposed AMUs within the context of the bridge and its broader setting.

It is noted that potential visual impacts of the new AMUs vary depending on the location, timing and frequency of maintenance activities carried out on the main arch structure and therefore visual impacts would be temporary for any given viewpoint. Moreover, the form of cranes carrying out maintenance activities has been a lasting element on the silhouette of the Sydney Harbour Bridge since its construction and is an intrinsic aspect of the bridge's visual character. The changed design of the new AMUs does not seek to mimic or replicate the original painting cranes but does honestly reflect updates and advancements in bridge maintenance technology.

This aspect of the proposal would have a moderate visual impact on the setting and character of the main arch structure.

Visual impact of walkways

The proposed replacement of walkways on the main arch structure would result in discrete visual changes to the main arch structure, in particular the relocation of the walkways to the outer edges of the top chords and adjustments to the configuration of the railings. Changes to the walkways would alter the visual appearance of the main arch structure, particularly for people accessing the top chords including maintenance workers and climbers. They would also be more visible from end on vantage points along the bridge approaches.

The design of the walkways would visually match and respond to the existing colour palette and character of the surrounding steelwork and associated infrastructure. While the proposed use of fibreglass for the new stair treads would depart from the traditional material palette of the bridge, this material would allow for ease of maintenance and ongoing longevity of the walkways, as many of the original steel treads exhibit signs of corrosion and ongoing deterioration.

The proposed replacement and relocation of walkways would not impact on the overall form and visual character of the bridge, or its setting. Importantly, replacement walkways and adjustments to the railings would not be distinguishable visually from distant views and from vantage points that capture the main arch structure in elevation.

This aspect of the proposal would have a moderate visual impact on the setting and character of the main arch structure.

Visual impact – Sydney Opera House

While the existing 1997 AMUs, comprising two on each chord, are vaguely discernible on the silhouette of the Sydney Harbour Bridge, the distance from the bridge and the percentage of the

view that is occupied by the relatively small spatial envelopes of the cranes means that their visual presence in relation to the harbour and the Sydney Opera House would be minimal.

Visual impact – nearby heritage items and areas

The potential visual impact on nearby heritage items and areas is summarised in Table 6-7.

Table 6-7 Nearby heritage items and areas

Item/area	Physical impact	Visual impact	Comment
Millers Point and Dawes Point Village Precinct	No impact	Negligible	Direct sightlines exist between the top chords of the main arch and all the items. The proposed removal and upgrading of the AMUs would be visible, but the presence of cranes is considered an intrinsic part of the silhouette of the SHB since its construction. The relative scale and form of the proposed AMUs is considered to 'blend' with the surrounding character and form of the bridge. During operation, the new AMUs would have an increased temporary visual impact.
Millers Point Conservation Area	No impact	Negligible	
Bradfield Park (including northern section)	No impact	Negligible	
North Sydney Olympic Pool	No impact	Negligible	

6.1.6 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Non-Aboriginal heritage	The materials used in new works will be compatible with the visual character of the Sydney Harbour Bridge. This includes selection of modern and lightweight materials that are, where appropriate, coloured to match the existing fabric of the bridge including existing steelwork tones. The material palette of the proposal will be consistent with other Sydney Harbour Bridge projects.	Transport for NSW Project Manager	Detailed design	Additional safeguard
Non-Aboriginal heritage	Where feasible, works will be designed to reduce the visual prominence of new elements along the top of the main arch structure.	Transport for NSW Project Manager	Detailed design	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Non-Aboriginal heritage	A photographic archival recording of the affected areas will be prepared prior to the start of works and following completion of works, in accordance with the NSW Heritage Division publications *How to prepare archival records of heritage items* and *Photographic Recording of Heritage Items using Film or Digital Capture*. The original copy of the archival record will be deposited with the Heritage Division, Office of Environment and Heritage, and an additional copy will be provided to the City of Sydney and North Sydney Council.	Transport for NSW Project Manager	Pre-construction Construction	Additional safeguard (s.60 approval)
Non-Aboriginal heritage	All work will be carried out by suitably qualified tradespersons with demonstrated experience in conservation of similar heritage structures, methods and materials. All tradesmen are to be inducted on the significance of the heritage item prior to works commencing.	Contractor	Construction	Additional safeguard (s.60 approval)
Non-Aboriginal heritage	A suitably qualified and experienced heritage consultant will be nominated. The nominated heritage consultant will provide input into the detailed design and supervise the works to minimise impacts to heritage values. The nominated heritage practitioner will be consulted prior to the selection of appropriate tradespersons and must be satisfied that all work	Transport for NSW Project Manager	Detailed design Pre-construction Construction	Additional safeguard (s.60 approval)

Impact	Environmental safeguards	Responsibility	Timing	Reference
	has been carried out in accordance with the conditions of the Heritage Act s.60 approval.			
Non-Aboriginal heritage	Significant elements will be adequately protected during the works from potential damage. Protection systems will ensure historic fabric is not damaged or removed.	Transport for NSW Project Manager	Construction	Additional safeguard (s.60 approval)
Non-Aboriginal heritage	A heritage induction will be provided for all workers prior to works commencing. The induction will cover all heritage related safeguards and management measures.	Transport for NSW Project Manager	Pre-construction	Additional safeguard

6.2 Noise and vibration

6.2.1 Methodology

The *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) and associated Construction Noise Estimator were used to determine the potential for construction noise impacts at the nearest noise sensitive receivers to the Sydney Harbour Bridge main span. The Estimator was also used to determine the distance beyond which noise management levels (levels that guide the need to apply work practices to minimise noise impacts) would not be exceeded for each of the following periods:

- Day – Monday to Friday (7am to 6pm), Saturday (8am to 1pm)
- Day (outside standard hours) – Saturday (7am to 8am and 1pm to 6pm)
- Evening – 6pm to 10pm
- Night – 10pm to 7am

Construction noise calculations have assumed a use of a mobile crane, trucks, generators, hand tools, light vehicles and the presence of workers.

Calculations were made using the Estimator (Individual Plant) worksheet, which allows the selection of individual plant and the calculation of noise levels at varying distances. Background noise levels previously recorded near the proposal site (Cardno, 2017) were considered representative and were used for the purposes of assessment.

Most of the locations were not identified as having existing barriers that would reduce the propagation of noise. Barrier attenuation was therefore not assumed in the calculations for most receivers.

6.2.2 Existing environment

The dominant noise sources at the subject site are road and rail traffic on the bridge and maritime traffic (ferries, private boats, cruise liners and fuel ships) using the harbour below. The nearest noise sensitive receivers include residences, active recreation areas and hotels / serviced apartments are shown by Figure 6-3 and listed below:

- Residential receiver – Residences on Lower Fort Street. Approximately 170 metres (horizontal distance) from main arch with line of sight
- Residential receiver – Residences on Cumberland Street. Approximately 340 metres (horizontal distance) from main arch with line of sight
- Commercial Receiver – Pier One Hotel. Approximately 90 metres (horizontal distance) from main arch with line of sight
- Commercial receiver – Park Hyatt. Approximately 145 metres (horizontal distance) from main arch with line of sight
- Passive recreation – Dawes Point. Directly beneath and adjacent to bridge (horizontal distance of 10 metres assumed)
- Active recreation – North Sydney Olympic Pool. Approximately 60 metres (horizontal distance) from main arch with line of sight
- Residential receiver – Residences on Alfred Street. Approximately 200 metres (horizontal distance) from main arch with line of sight obscured by commercial buildings
- Residential receiver – Residences on Broughton Street and Kirribilli Avenue. Approximately 200 metres (horizontal distance) from main arch with line of sight
- Residential receiver – Residences on Waruda Street and Kirribilli Avenue. Approximately 360 metres (horizontal distance) from main arch with line of sight
- Passive recreation – Bradfield Park. Directly beneath and adjacent to bridge (horizontal distance of 10 metres assumed)

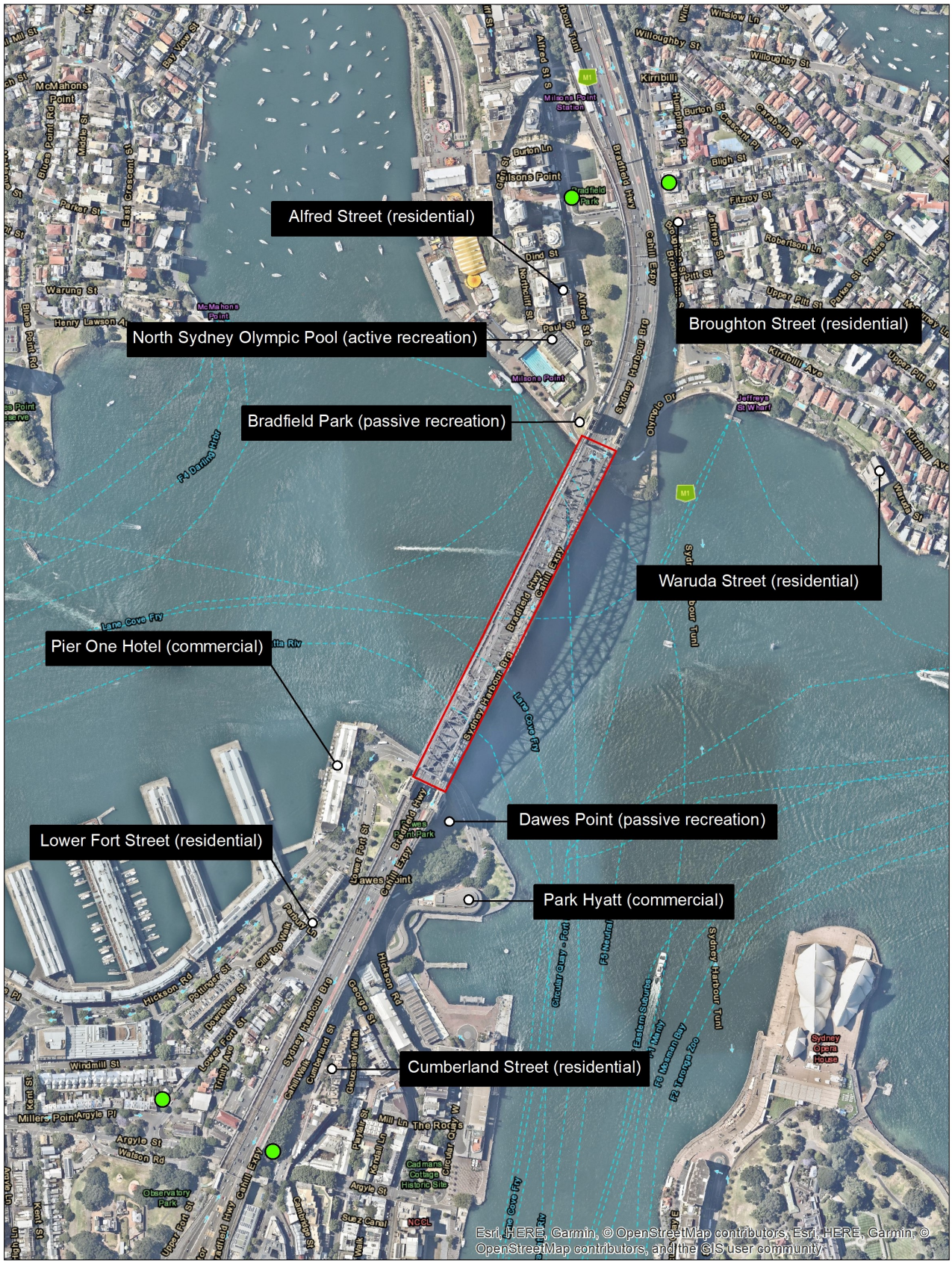


Figure 6-3 Location of noise sensitive receivers

Table 6-8 shows measured background noise levels adopted for the purposes of assessment, while Figure 6-3 shows monitoring locations.

Table 6-8 Background noise levels - RBL dB(A)

Location	7am – 6pm	6pm – 10pm	10pm – 7am
87 Lower Fort Street	49	48	43
Cumberland Street (Council depot)	59	58	49
Residential towers, Alfred Street near Bradfield Park	57	55	46
3a-9b Broughton Street Kirribilli	59	59	42

Source: Noise Impact Assessment – Sydney Harbour Bridge Step-free Access (Cardno, 2017)

6.2.3 Criteria

Noise management goals for construction are given in the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009).

For residential receivers, the guideline provides that construction noise should not exceed the background noise levels by more than 10 dB(A) during standard hours, and by more than 5 dB(A) out-of-hours (that is, for night-time work). The level of 75 dB(A) is identified as the point above which there may be a strong community reaction to construction noise.

The project specific construction noise management levels for residential receivers have been set based on the nearest recorded Rating Background Levels (RBLs) (see *Table 6-9*).

Table 6-9 Project specific construction noise management levels – residential receivers

Receiver	Standard hours[2]	Out-of-hours Day[3]	Out-of-hours Evening[4]	Out-of-hours Night[5]
Residences on Lower Fort Street	59 dB(A)	54 dB(A)	53 dB(A)	48 dB(A)
Residences on Cumberland Street	69 dB(A)	64 dB(A)	63 dB(A)	54 dB(A)
Residences on Alfred Street	67 dB(A)	62 dB(A)	60 dB(A)	51 dB(A)
Residences on Broughton Street	68 dB(A)	64 dB(A)	64 dB(A)	47 dB(A)
Residences on Waruda Street	68 dB(A)	64 dB(A)	64 dB(A)	47 dB(A)

1. Daytime construction noise criteria calculated as $L_{eq,15min}$ = RBL+ 10 dB; evening and night-time construction noise criteria calculated as $L_{eq,15min}$ = RBL + 5 dB
2. Standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm
3. Out-of-hours daytime: Saturday 1 pm to 6 pm Saturday, 7 am to 6 pm Sunday
4. Out-of-hours evening: Monday to Sunday 6 pm to 10 pm
5. Out-of-hours night-time: Monday to Saturday 10 pm to 7 am Sunday and Public Holidays 10 pm to 8 am.

The *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009) provides the following noise management goals for other non-residential noise sensitive receivers:

- Active recreation areas: external $L_{Aeq,\ 15min}$ 65 dB(A) (when in use)
- Passive recreation areas: external $L_{Aeq,\ 15min}$ 60 dB(A) (when in use)
- Industrial premises: $L_{Aeq,\ 15min}$ 75 dB(A) (external)
- Offices, retail outlets: $L_{Aeq,\ 15min}$ 70 dB(A) (external)
- Places of worship $L_{Aeq,\ 15min}$ 45 dB(A) (internal) (when in use)
- Classrooms at schools $L_{Aeq,\ 15min}$ 45 dB(A) (internal) (when in use).

6.2.4 Potential impacts

Construction noise

The results of the construction noise assessment are summarised in Table 6-10, while further details are provided in Appendix C. The results show when works are occurring at the nearest point to residential and recreation receivers, noise management levels would be exceeded during standard hours and out-of-hours periods. The largest predicted exceedances are for Dawes Point and Bradfield Park, largely due to their close proximity.

The predicted exceedances are considered worst case because in many cases works would be occurring at substantially greater distances from these receivers (such as when they are occurring on the main bridge span).

Table 6-10 Predicted noise management level exceedances

Receiver	**Total SPL $L_{Aeq(15minute)}$ (dBA)**	**Noise management level exceedance (dBA)**			
		Standard	Day (OOH)	Evening	Night
Residences on Lower Fort Street	61	2	7	8	13
Residences on Cumberland Street	53	0	0	0	0
Pier One Hotel	69	0	-	-	-
Park Hyatt	63	0	-	-	-
Dawes Point	90	30	30	30	-
North Sydney Olympic Pool	72	7	7	7	-
Residences on Alfred Street	59	0	0	2	8
Residences on Broughton Street	59	1	6	6	12
Residences on Waruda Street	56	0	0	0	9
Bradfield Park	90	30	30	30	-

Figure 6-4 shows the distance beyond which noise management levels are not likely not be exceeded for each of the following periods (adopting the lowest noise management levels based on daytime and evening background noise levels at 87 Lower Fort Street and night-time background noise levels at 3a-9b Broughton Street Kirribilli):

- Day – Monday to Friday (7am to 6pm), Saturday (8am to 1pm)
- Day (outside standard hours) – Saturday (7am to 8am and 1pm to 6pm)
- Evening – 6pm to 10pm
- Night – 10pm to 7am.

The *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) (in Appendix E of the *Construction Noise and Vibration Guideline*) identifies a sleep disturbance level of L_{Amax} 65 dB(A) external and for bridge works an associated sleep disturbance distance of 200 metres (in urban areas). This distance in the context of the proposal site is shown on Figure 6-4.

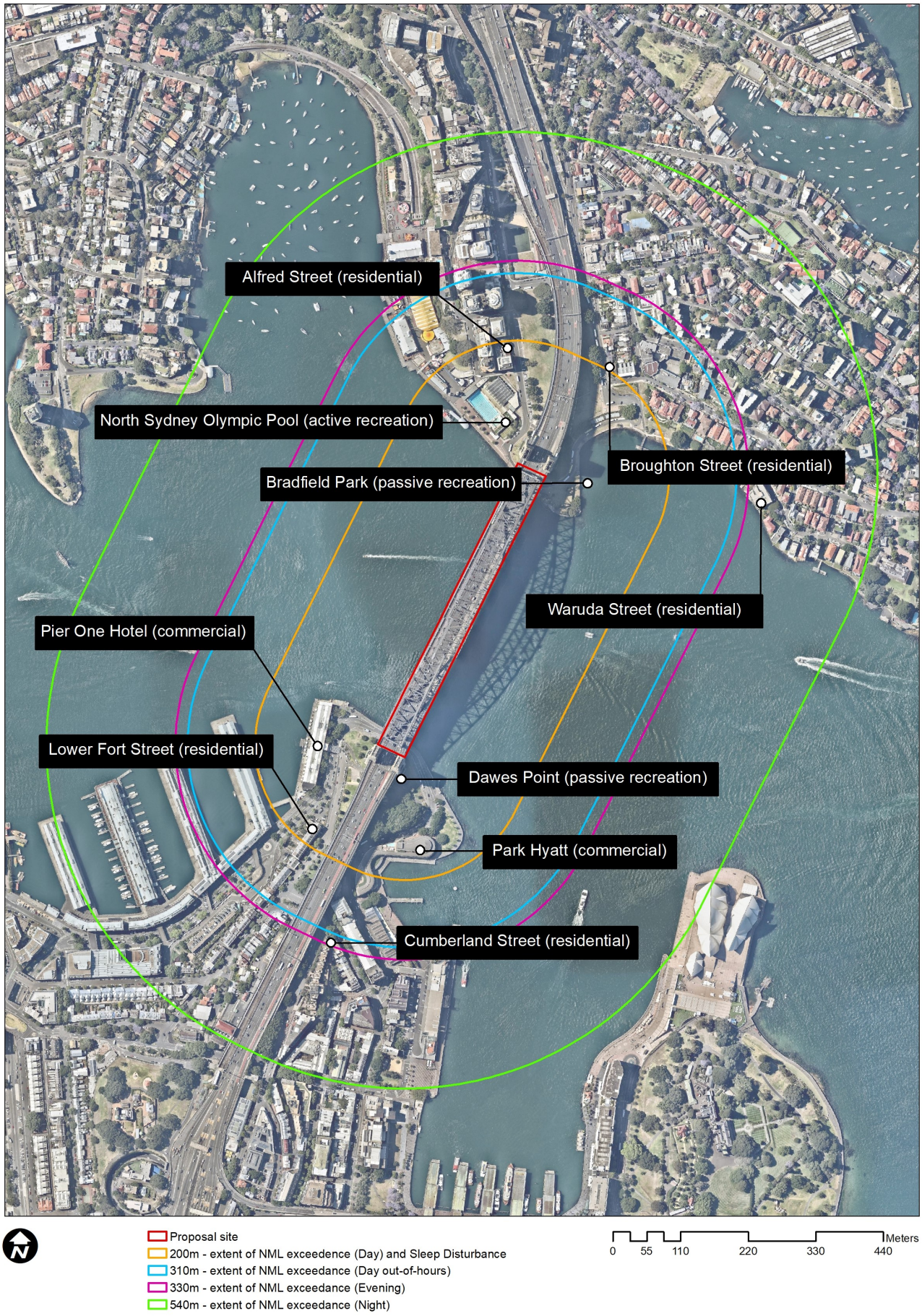


Figure 6-4 Predicted extent of noise management level exceedances

Construction road traffic noise

During most evening and night works, the proposal would be unlikely to generate more than five vehicle movements per hour. This is not likely to result in an increase in road traffic noise of more than 2 dB(A), which is the screening criteria for consideration of reasonable and feasible road traffic noise mitigation.

Review of potential construction mitigation measures

On the basis of the construction noise calculations, the Construction Noise Estimator has identified potential mitigation measures from Appendix C of the *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016). These are reviewed in Table 6-11.

Table 6-11 Review of potential construction noise mitigation measures

Code	Measure	Description	Comment
N	Notification	Letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification occurs a minimum of five working days prior to the start of works.	There is the potential for exceedance of noise management levels for some activities. Notification is proposed. The notification area would be determined by reference to the specific types of activities proposed and the general distances identified in Figure 6-4.
SN	Specific notification	Letterbox drop (or equivalent) to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. The specific notification provides additional information when relevant and informative to more highly affected receivers than covered by the standard notification.	Not proposed. It is not expected that the proposal would result in exceedance of the 75 dB(A) 'highly noise affected level.
PC	Phone calls	Phone calls detailing relevant information made to identified / affected stakeholders within seven calendar days of proposed work.	Not considered practical in this case due to high density of receivers, which includes apartment buildings.
IB	Individual briefings	Project representatives visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities.	Not considered practical in this case due to high density of receivers, which includes apartment buildings.

Code	Measure	Description	Comment
RO	Respite offer	Proposes that works should be carried out in continuous blocks that do not exceed three hours each, with a minimum respite period of one hour between each block. The purpose of such offer is to provide residents with respite from an ongoing impact.	Not required for works during standard hours. Not proposed during evening and night works as the stopping and restarting of work may be a nuisance to residents during those periods. R1 and R2 to apply to evening and night works.
R1	Respite period 1	Evening works limited to no more than three consecutive evenings per week, separated by not less than one week and no more than six evenings per month.	Not proposed as evening works would be followed by night works subject to R2. Refer below.
R2	Respite period 2	Night works limited to two consecutive nights separated by not less than one week and no more than six nights per month.	Proposed for works on approach spans.
DR	Duration respite	Used where respite periods cannot be implemented. Involves increase in the work duration (number of evenings or nights worked) so that the project can be completed more quickly.	Not required. Respite periods have been proposed.
V	Verification	Measurement of the background noise level and construction noise. Followed by consideration of further mitigation.	Proposed in response to construction noise related complaints.
AA	Alternative accommodation	Offer of alternative accommodation to residents living near construction works.	Not considered practical in this case due to high density of receivers, which includes apartment buildings.

Operational noise

The proposal is not expected to generate ongoing noise requiring assessment under the *Noise Policy for Industry* (Environment Protection Authority, 2017). The proposal would not change operational road traffic volumes or composition, or road geometry, and would therefore not have any operational road traffic noise impacts.

6.2.5 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Construction noise	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • All project specific and relevant standard noise and vibration mitigation measures • Relevant licence and approval conditions • Permissible hours of work • Any limitations on high noise generating activities • Location of nearest sensitive receivers • Construction employee parking areas • Designated loading/unloading areas and procedures • Site opening / closing times (including deliveries) • Environmental incident procedures	Transport for NSW Project Manager	Pre-construction Construction	Construction Noise and Vibration Guideline Appendix B
Construction noise	The following would be raised in inductions and avoided during works: • Swearing or unnecessary shouting • Loud stereos/radios • Dropping of materials from height, throwing of	Transport for NSW Project Manager	Construction	Construction Noise and Vibration Guideline Appendix B

Impact	Environmental safeguards	Responsibility	Timing	Reference
	metal items and slamming of doors • Use of equipment which generates impulsive noise, where possible • Metal-to-metal contact on equipment, where possible.			
Construction noise	A letterbox drop notification for residential receivers will occur at least five days prior to works on approach spans that are likely to exceed noise management levels. The extent of the notification will be determined with reference to the noise assessment and the specific types of activities proposed. The notification will detail work activities, dates and hours, impacts and mitigation measures. It will also include a contact number for enquiries and complaints.	Transport for NSW Project Manager	Construction	Construction Noise and Vibration Guideline Appendix C
Construction noise	Works likely to exceed construction noise management levels during evening and night periods will be managed in accordance with the Transport for NSW Construction Noise and Vibration Guideline.	Transport for NSW Project Manager	Construction	Construction Noise and Vibration Guideline Appendix C

Impact	Environmental safeguards	Responsibility	Timing	Reference
Construction noise	Verification of background noise and construction noise levels will occur in response to noise related complaints. Verification will be in accordance with Appendix F of the Construction Noise and Vibration Guideline. The results of the noise measurements will be used to inform consideration of any necessary changes to work practices or additional mitigation measures.	Transport for NSW Project Manager	Construction	Construction Noise and Vibration Guideline Appendix C
Construction	The noisiest works will be scheduled to occur before 11 pm where possible.	Transport for NSW	Construction	Construction Noise and Vibration Guideline Appendix C

6.3 Water quality

6.3.1 Existing environment

The proposal is located within the Sydney Harbour catchment. Sydney Harbour, and to a lesser extent its tributaries, provide for a range of commercial and recreational activities including, but not limited to, pleasure craft, passenger ferries and commercial shipping.

Water quality in the harbour is influenced by pollution from a range of sources including boating/shipping, stormwater runoff and sewer overflows. Previous industrial uses are also a factor.

6.3.2 Potential impacts

The proposal has the potential to discharge lead contaminated dust (associated with removal of paint around rivets prior to removal) paint overspray into the surrounding environment during any rivet removal and minor paint repair activities. Additionally, the spillage of oil, fuel and other liquids associated with the AMU installation have the potential, if not properly managed, to discharge into Sydney Harbour.

6.3.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Water quality impacts associated with paint repair	Removal of all materials identified as being coated with paint containing lead (or other hazardous metallic pigments) will be conducted in accordance with guidance as set out in AS/NZS 4361.1:2017 *Guide to hazardous paint management Part 1 Lead and other hazardous metallic pigments in industrial applications.* This will include conducting a Lead Risk Assessment for each work location[1].	Transport for NSW Project Manager	Construction	Additional safeguard
Water quality impacts	There is to be no release of dirty or contaminated water into Sydney Harbour.	Transport for NSW Project Manager	Construction	Additional safeguard
Spills	Plant and equipment will be inspected regularly to ensure there are no leakages of fuel, oil and hydraulic fluid.	Transport for NSW Project Manager	Construction	Additional safeguard
Spills	Work practices will be structured to minimise the risk of spills on-site.	Transport for NSW Project Manager	Construction	Additional safeguard
Spills	An emergency spill kit is to be kept on site at all times and maintained throughout the construction work. The spill kit must be appropriately sized for the volume of substances at the work site.	Transport for NSW Project Manager	Construction	Additional safeguard
Spills	Storage of chemicals and fuels and refuelling of plant and equipment is to occur on impervious surfaces with spill containment available.	Transport for NSW Project Manager	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Spills / incidents	If a spill or incident occurs, the *Environmental Incident Classification and Reporting Procedure* (Roads and Maritime Services, 2017) is to be followed and the Transport for NSW Regional Environment Manager notified immediately.	Transport for NSW Project Manager	Construction	Additional safeguard
Spills / incidents	In the event of a maritime spill, the an incident emergency plan would be implemented in accordance with Sydney Ports Corporation's response to shipping incidents and emergencies outlined in the NSW State Waters Marine Oil and Chemical Spill Contingency Plan (Roads and Maritime Services, 2016). The plan would be part of the Construction Environmental Management Plan and would include relevant emergency contacts.	Transport for NSW Project Manager	Construction	Additional safeguard

Refer also to section 6.4.3 (air quality) which requires containment areas to be established and appropriately managed. Containment areas would also prevent paint and other materials entering the harbour.

6.4 Air quality

6.4.1 Existing environment

The subject site is in a highly urbanised area. The main sources of air pollution are motor vehicles and maritime traffic. There are no Office of Environment and Heritage air quality monitoring stations near the subject site.

6.4.2 Potential impacts

Potential impacts associated with the proposal include dust generated as a result of the requirement to repair any damage to painted surfaces (primarily in areas where rivet removal is to occur).

Dust would be the main by-product of the paint removal process and would consist primarily of existing lead-based protective coatings and rust. During application of any new paint, overspray and the release of associated fumes represent a potential environmental risk.

There would be some emissions associated with the operation of plant and equipment (including trucks, light vehicles and mobile cranes).

6.4.3 Safeguards and management measures

Impact	Environmental safeguards[1]	Responsibility	Timing	Reference
Air quality impacts associated with paint repair	Paint dust and flakes would be contained during paint removal or repair works. The methodology adopted would be dependent on the location, expected wind loads and form of access and would be informed by the risk assessment carried out in accordance with AS/NZS 4361.1:2017.	Transport for NSW	Construction	Additional safeguard
Air quality impacts associated with paint removal	Works (including the spraying of paint and other materials) are not to be carried out during strong winds or in weather conditions where high levels of dust or air borne particulates are likely.	Transport for NSW Project Manager	Construction	Additional safeguard
Air quality impacts associated with paint removal	Works must cease when air borne dust cannot be controlled.	Transport for NSW Project Manager	Construction	Additional safeguard
Air quality impacts associated with paint removal	Paints containing fast drying solvents will be used to minimise the impact of air sprayed paint emissions.	Transport for NSW Project Manager	Construction	Additional safeguard
Air quality impacts associated with paint removal	Air quality monitoring will be undertaken in accordance with AS/NZS 4361.1:2017 *Guide to hazardous paint management Part 1 Lead and other hazardous metallic pigments in industrial applications.*	Transport for NSW Project Manager	Construction	Additional safeguard

Note 1: Section 6.3.3 requires works to be carried out in accordance with AS/NZS 4361.1:2017 Guide to hazardous paint management Part 1 Lead and other hazardous metallic pigments in industrial applications. This is also relevant to air quality.

6.5 Visual amenity

6.5.1 Methodology

A Landscape Character and Visual Impact Assessment Landscape has been prepared for the proposal by Design Inc (Appendix E).character and visual assessment is considered in accordance with the *Guidelines for landscape character and visual impact assessment* (Roads and Maritime Services, 2013).

The guidelines establish an assessment process by reference to the sensitivity of the area and magnitude of the proposal in that area. Figure 6-5 illustrates this process.

SENSITIVITY	MAGNITUDE: HIGH	MODERATE	LOW	NEGLIGIBLE
HIGH	HIGH	HIGH - MODERATE	MODERATE	NEGLIGIBLE
MODERATE	HIGH - MODERATE	MODERATE	MODERATE - LOW	NEGLIGIBLE
LOW	MODERATE	MODERATE -LOW	LOW	NEGLIGIBLE
NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE

Figure 6-5 Landscape Character / Visual impact grading matrix

Landscape character

Landscape character assessment sums up an area's sense of place including all built, natural and cultural aspects, covering towns, countryside and all shades between (Roads and Maritime Services, 2013).

Visual impact

Visual impact assessment considers the effect on specific viewpoints.

6.5.2 Existing environment

Landscape Character

Only one landscape character zone was identified for the purposes of assessment. This zone is primarily characterised by the monumental landmark structure of the Sydney Harbour Bridge which dominates the view. The bridge spans the equally significant waterbody of Sydney Harbour and lands on the northern foreshore at Milson Point and the southern foreshore at The Rocks. Both foreshores comprise parkland and walking/ cycling paths providing panoramic views of the Harbour, SHB and the Opera House. There is minimal vegetation with man-made structures dominating the view. The bridge itself is a skeletal weblike steel arch structure painted dark grey. Two existing cranes are located on each of the top chords of the arches. Walkways are also located along each top chord.

The Sydney is 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, Sydney Harbour and its foreshores and the city skyline. It is highly visible from all these vantage points. Landscape character sensitivity is therefore considered to be high.

Visual envelop and viewpoints

The visual envelope illustrates the likely visual catchment of the proposal. It generally describes the extent of the views possible from any given place within the proposal site. Based on existing landforms, the visual catchment also takes into account vegetation, land uses and structures.

Key viewpoints from which potential visual impacts have been assessed are located on the visual envelope map. It is noted that while the Sydney Harbour Bridge is visible from more distant viewpoints, given the scale of the proposed elements, they would not be visible beyond the extents shown.

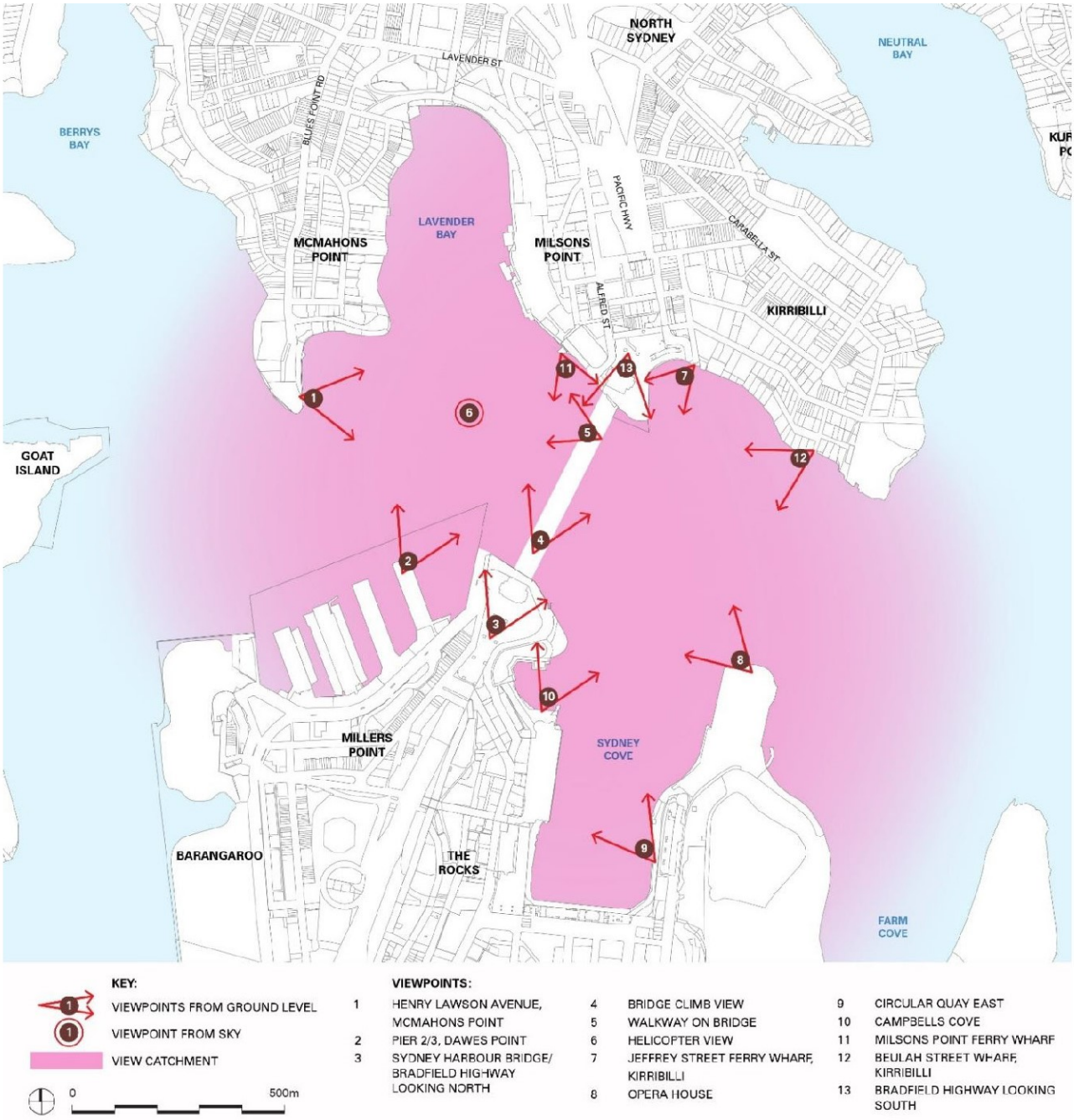


Figure 6-6 Visual envelope and key viewpoints

6.5.3 Potential impacts

Landscape character

The visual magnitude of the proposal was assessed as moderate, primarily due to the introduction of the following elements:

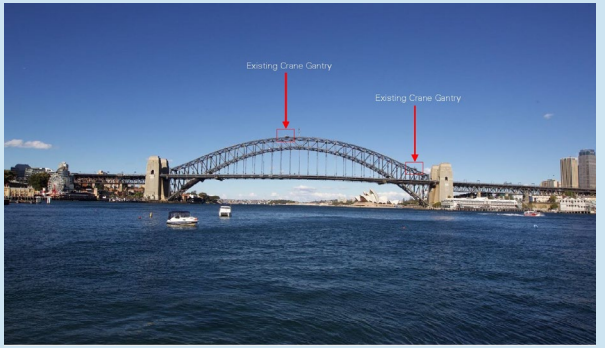
- Replacement of existing cranes.
- New platform structure spanning between arch trusses for the new cranes to be located on.
- Replacement of walkways along arch truss top chords.

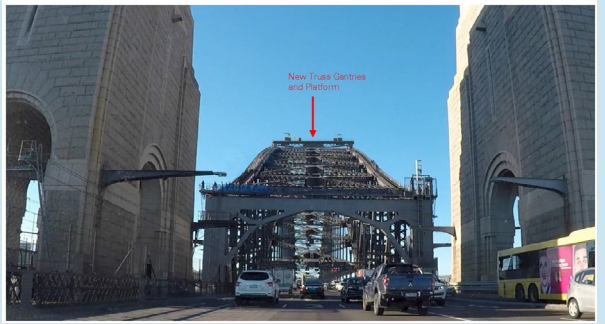
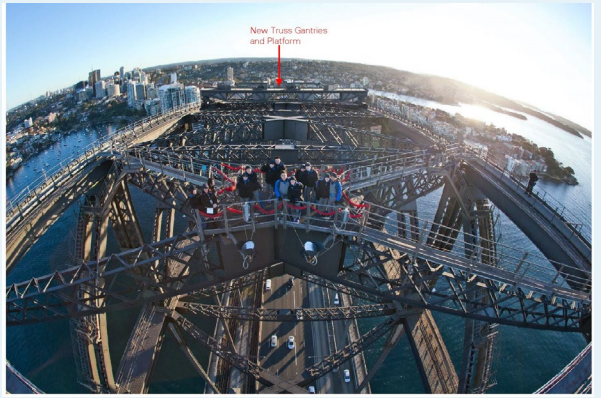
The landscape character impact is moderate to high. While the sensitivity is high the degree of change is moderate as cranes and walkways already exist and it is the platform only that is a new additional element.

Visual impact

The potential visual impact of the proposal was assessed by reference to 13 viewpoints as shown on Figure 6-6. Viewpoints were assessed based on a single AMU position. While AMUs would be in different positions on the bridge at different times, this is not expected to materially affect visual impact ratings. The assessment of visual impacts for each viewpoint is provided in Table 6-12.

Table 6-12 Visual impact assessment outcomes

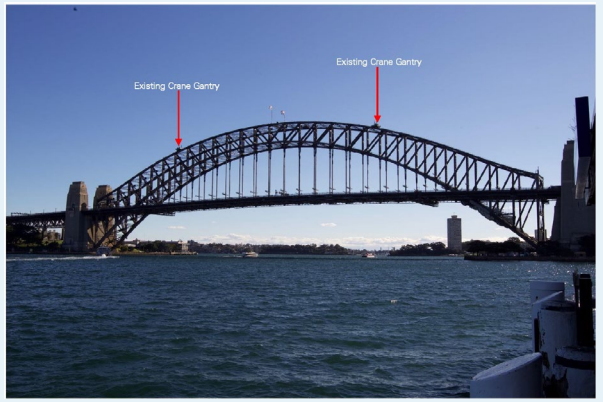
#	Viewpoint / visibility	Sensitivity	Magnitude	Impact	Viewpoint image
1	Henry Lawson Avenue, McMahons Point Only the crane would be visible from this location. The platform and the maintenance/ climber walkway are not distinguishable from this distance.	High	Negligible	Low The visual sensitivity is high but the distance of the viewer from the crane and the percentage of the view the crane occupies in the overall bridge elevation means the magnitude of visual effect is negligible.	
2	Pier 2/3 view, Dawes Point The new crane and platform would be visible from this location. The maintenance/ climber walkway cannot be seen.	High	Low	Moderate The visual sensitivity is high. The magnitude is low as the new crane would be smaller in appearance than the existing cranes and located further inwards from the edge of the truss arch. The platform would add a new element more prominent in this view, but the truss would minimise its bulk through its transparency.	

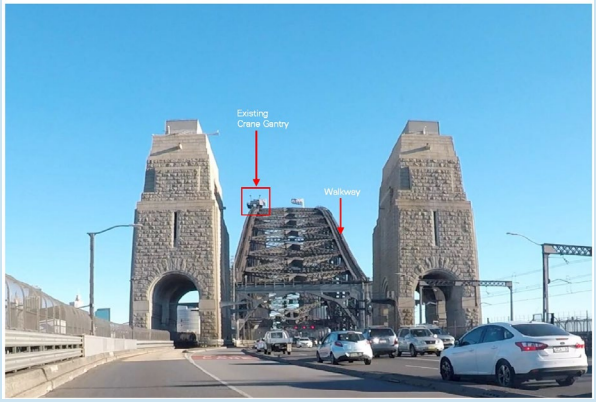
#	Viewpoint / visibility	Sensitivity	Magnitude	Impact	Viewpoint image
3	Sydney Harbour Bridge / Bradfield Highway heading north The new crane, platform and walkway would be visible from this location. The walkway would be less distinguishable visually than the new crane and platform.	High	Moderate	Moderate-High The visual sensitivity is high. The magnitude is moderate as while the new crane would be smaller in appearance than the existing cranes, the platform would add a new more prominent element in this view. The truss would minimise its bulk by providing glimpses through to the skyline as the current bridge weblike structure provides.	
4	Climber / aerial view The new crane, platform and walkway would be highly visible from this location.	High	Moderate	Moderate-High The visual sensitivity is high. The magnitude would be moderate as while the new crane would be smaller in appearance than the existing cranes, the platform would add a new element to the bridge arch horizon that is more prominent in this view. The truss design would help to minimise its overall bulk.	

#	Viewpoint / visibility	Sensitivity	Magnitude	Impact	Viewpoint image
5	Pedestrian Walkway on Sydney Harbour Bridge heading south The new crane, platform and walkway would be visible from this location. The maintenance/ climber walkway would be less distinguishable visually than the new crane and platform in the overall view.	High	Moderate	Moderate-High The visual sensitivity is high. The magnitude would be moderate as while the new crane would be smaller in appearance than the existing crane, the platform would add a new more prominent element in this view. The truss design would minimise its bulk by providing glimpses to the sky. When the platform/crane is at the top of the arch it may partially obscure the view to the flag.	
6	Helicopter view The new crane and platform would be visible from this location. The maintenance / climber walkway is not distinguishable visually from this location.	High	Low	Moderate The visual sensitivity is high. The magnitude is low, as while the new crane would be smaller in appearance, the platform would add a more solid element perpendicular to the arch chord which contrasts the more transparent cross patterning of existing structure between the arch chords. The distance of the view lowers the visual effect from high.	

#	Viewpoint / visibility	Sensitivity	Magnitude	Impact	Viewpoint image
7	Jeffrey St Ferry Wharf, Kirribilli The new crane and some of the platform would be visible from this location. The maintenance / climber walkway is not distinguishable visually from this location.	High	Negligible	Low The visual sensitivity is high. The magnitude would be negligible, as the crane structure from this angle is reduced in size compared to the existing crane. There would be a view of the platform through the existing web of structure, but the truss would maximise the transparency.	
8	Opera House The new crane and platform would be visible from this location. The maintenance/ climber walkway would not be visually distinguishable from this distance.	High	Negligible	Low The visual sensitivity is high. The magnitude would be negligible, as the crane structure from this angle would reduce the visual bulk on the top chord skyline view compared to the existing crane structure. There would be some additional bulk where the platform crosses over the two arches although this will be negligible from this distance.	

#	Viewpoint / visibility	Sensitivity	Magnitude	Impact	Viewpoint image
9	Circular Quay East The new crane and platform would be visible from this location. The maintenance / climber walkway would not be distinguishable visually from this distance.	High	Negligible	Low The visual sensitivity is high. The magnitude would be negligible, as the crane structure from this angle would reduce the visual bulk on the top chord skyline view compared to the existing crane structure. There would be some additional bulk where the platform crosses over, although this would be negligible from this distance.	
10	Campbell's Cove View The new crane, platform would be visible from this location. The maintenance climber walkway would not be visually distinguishable from this location.	High	Low	Moderate The visual sensitivity is high. The magnitude would be low as while the new crane would be smaller in appearance than the existing crane and located further inwards from the edge of the truss arch, the platform would add a new element more prominent in this view with some additional shadow where the platform crosses over. The truss design would however minimise its bulk to some extent.	

#	Viewpoint / visibility	Sensitivity	Magnitude	Impact	Viewpoint image
11	Milsons Point Ferry Wharf The new crane, platform and walkway would be visible from this location. The maintenance / climber walkway would be less distinguishable visually than the new crane and platform.	High	Moderate	Moderate-High The visual sensitivity is high. The magnitude is moderate and while the new crane would be smaller in appearance than the existing crane, the platform would add a new more prominent element in this view. The truss design would minimise its bulk by providing glimpses through to the skyline as the current bridge weblike structure provides.	
12	Beulah Street Wharf, Kirribilli The new crane, platform and walkway would be visible from this location. The maintenance / climber walkway would be less distinguishable visually than the new crane and platform.	High	Low	Moderate The visual sensitivity is high. The magnitude would be low as while the new crane would be smaller in appearance than the existing, the platform would add a new element in this view. The truss design would minimise its bulk to some degree.	

#	Viewpoint / visibility	Sensitivity	Magnitude	Impact	Viewpoint image
13	Sydney Harbour Bridge / Bradfield Highway heading south	High	Moderate	Moderate-High The visual sensitivity is high. The magnitude would be moderate as while the new crane would be smaller in appearance than the existing crane, the platform would add a new element more prominent in this view. The truss design would minimise its bulk to some degree by providing glimpses through to the skyline as the current bridge web-like structure does.	

6.5.4 Design changes to minimise visual impacts

A number of design refinements have been made to the proposal to minimise visual impacts. These include:

- Use of more transparent materials such as expanded or perforated mesh or clear materials on the platform deck where possible and consistent with applicable standards
- Provision of additional voids through the platform (ie the truss structure) to increase visual transparency
- Design of the walkway along the arch so that there is a separation / shadow line expressed between the arch top chord and the supporting structure / beam for the walkway to distinguish the new structure from the old bridge structure
- Design of the walkway railing to minimise width of structural elements and to be in keeping with the steel materials used in the existing structure.

6.5.5 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Visual impacts during works	Works areas will be maintained in a clean and tidy state and visual clutter will be minimised.	Transport for NSW Project Manager	Construction	Additional safeguard
Ongoing visual impacts	All services pipes, wiring or cable trays will be concealed in the structure.	Transport for NSW Project Manager	Detailed design	Additional safeguard
Ongoing visual impacts	Bolt fixings will have domed heads = and will be painted to match existing, subject to structural and maintenance requirements.	Transport for NSW Project Manager	Detailed design	Additional safeguard
Ongoing visual impacts	A preferred parking location for the AMUs will be determined to minimise visual impacts (a position along the arch may be a more appropriate place than at the ends where the line of the arch is interrupted).	Transport for NSW Project Manager	Detailed design	Additional safeguard
Ongoing visual impacts	Works would ensure retention of the “bridge grey” colour scheme.	Transport for NSW Project Manager	Construction	Additional safeguard

6.6 Waste management

Transport for NSW is committed to ensuring the responsible management of unavoidable waste and promotes the reuse of such waste in accordance with the resource management hierarchy principles outlined in the *Waste Avoidance and Resource Recovery Act 2001*. These resource management hierarchy principles, in order of priority are:

- Avoid unnecessary resource consumption as a priority
- Avoidance is followed by resource recovery (including reuse of materials, reprocessing, recycling and energy recovery)
- Disposal is undertaken as a last resort (in accordance with the *Waste Avoidance and Resource Recovery Act 2001*).

By adopting the above principles, Transport for NSW aims to efficiently reduce resource use, reduce costs, and reduce environmental harm in accordance with the principles of ecologically sustainable development (refer section 8.2).

6.6.1 Potential impacts

The proposal would generate only small amounts of waste at any given time. Including paint and removed rivets.

Paint that is removed would likely contain lead and therefore needs to be handled appropriately to minimise the risk to human health. Lead paint waste (arising otherwise than from residential premises or educational or child care institutions) is pre-classified as hazardous waste under the *Waste Classification Guidelines Part 1: Classifying Waste* (Environment Protection Authority, 2014) and will be collected and placed in lined bags in steel drums, then stored in secured area (within the existing maintenance facilities at either the northern or southern pylon) prior to transport to a facility that can legally accept hazardous waste.

6.6.2 Safeguards and mitigation measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Construction waste management	The following resource management hierarchy principles would be followed: • Avoid unnecessary resource consumption as a priority. • Avoidance would be followed by resource recovery (including reuse of materials where possible, reprocessing, and recycling and energy recovery). • Disposal would be undertaken as a last resort (in accordance with the *Waste Avoidance and Resource Recovery Act 2001*).	Transport for NSW Project Manager	Construction	Additional safeguard
Construction waste management	Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day.	Transport for NSW Project Manager	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Construction waste management	All wastes would be collected and disposed of legally in accordance with their classification under the *Waste Classification Guidelines Part 1: Classifying Waste* (Environment Protection Authority, 2014).	Transport for NSW Project Manager	Construction	Additional safeguard

6.7 Other impacts

6.7.1 Existing environment and potential impacts

Environmental factor	Existing environment	Potential impacts
Biodiversity	The proposal is confined to the Sydney Harbour Bridge structure and would not affect vegetation or other habitat on which native fauna (including threatened species) would be reliant.	Potential impacts would be limited to fauna which may be use bridge elements for nesting and/or shelter. Noise, light and vibration impacts are already present within the proposal site and adjacent areas due to existing infrastructure (eg major roads) and development. The proposal is unlikely to exacerbate any potential impacts on biodiversity due to noise, light or vibration.
Traffic and transport	The Sydney Harbour Bridge includes seven general traffic lanes, one bus lane, two railway lanes (part of the T1 North Shore Line), a cycleway on the western side of the bridge deck and a pedestrian path on the eastern side. The Sydney Harbour Bridge carries more than 80,000 vehicles per day as well as large numbers of cyclists and pedestrians.	There is some potential for minor delays (pedestrians, cyclists, motorists) associated with lane closures on the bridge or works adjacent to the pedestrian walkway or cycleway. Full bridge closures would be limited to four nights. During this time access for emergency vehicles would be maintained. No impacts to railway operations would occur as any works within the rail corridor would occur during scheduled rail possession periods.

Environmental factor	Existing environment	Potential impacts
Aboriginal heritage	The Sydney Harbour Bridge structure does not encroach a declared Aboriginal place and does not have Aboriginal archaeological potential. A search of the Aboriginal Heritage Information Management System (AHIMS) conducted on 10 April 2018 returned six Aboriginal sites within the immediate locality (three of which are listed as destroyed). The nearest site to the proposal is 45-6-0030 (Dawes Point Park rock engraving) and is listed as destroyed.	The proposal would have no impacts on Aboriginal heritage. There is no requirement to proceed to Stage 2 of the Transport for NSW PACHCI.
Socio-economic	The proposal is confined to the Sydney Harbour Bridge main and approach spans and would not directly affect any social infrastructure. The only business operating on the structure is the Bridge Concessionaire. The Sydney Harbour Bridge represents an important link between communities and is an important means by which people gain accesses to and from their places of employment.	Potential amenity impacts have been considered as follows: • Noise and vibration (refer Section 6.2) • Air quality (refer Section 6.4) • Visual impacts (refer Section 6.5) Access across the bridge would be maintained, except for the limited periods where a full bridge closure is required. There is some potential for works to affect Bridge Concessionaire climbing routes.

6.7.2 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	Fauna handling must be carried out in accordance with the requirements the *Biodiversity Guidelines* - Guide 9 (Fauna Handling).	Transport for NSW Project Manager	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Traffic and transport	Access for vehicular, cyclist and pedestrian traffic across the bridge will be maintained, except when a full bridge closure is required.	Transport for NSW Project Manage	Construction	Additional safeguard
Traffic and transport	Works within the rail corridor (at deck level) will only occur during scheduled track possession periods.	Transport for NSW Project Manage	Construction	Additional safeguard
Socio-economic	A Communication Plan will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The Communication Plan will include (as a minimum): • Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions • Contact name and number for complaints • Notification requirements for noise generating activities • Procedures for communicating with other projects to determine the potential for concurrent activities and associated cumulative impacts.	Transport for NSW Project Manage	Pre-construction	Standard safeguard
Socio-economic	The Bridge Concessionaire will be provided with at least 14 days' notice for planned works and at least 24 hours' notice for unplanned repairs and/or maintenance requiring diversion of climbing routes. Notification is to be consistent with any with the applicable agreement between Transport for NSW and the Bridge Concessionaire.	Transport for NSW Project Manage	Construction	Additional safeguard

6.8 Cumulative impacts

6.8.1 Study area

The cumulative impacts assessment has considered the suburbs of Dawes Point, The Rocks, Milsons Point and Kirribilli. Potentially interacting projects were identified by reference to the Transport for NSW website and the Department of Planning, Industry and Environment major projects register.

6.8.2 Other projects and developments

A review of other projects and proposals on or near the Sydney Harbour Bridge and approach spans identified the following whose construction may overlap with painting and maintenance works on the Sydney Harbour Bridge:

Table 6-13 Past, present and future projects

Project	Construction Impact	Operational Impacts
Sydney Harbour Bridge northern toll plaza precinct upgrade. Replacing existing electronic tolling equipment on the Warringah Freeway for southbound traffic. Northern toll plaza construction works currently continuing. Southern toll plaza upgrade construction works complete.	Construction impacts include: • Traffic impacts at night from lane closures • Temporary pedestrian detours • Construction noise generated in the area • Temporary visual impacts	Operational impacts include: • Safer maintenance of tolling equipment • Visual benefit from an unlit gantry during day and night • Visual impact from equipment at new locations
Sydney Harbour Bridge Northern and Southern cycleway.	Construction impacts include: • Traffic impacts at night from lane closures • Temporary cyclist detours • Construction noise generated in the area • Temporary visual impacts	Operational impacts include: • Minor cumulative heritage impacts to fabric and visual aspects of the Sydney Harbour Bridge • Better access to the Sydney Harbour Bridge for the public

Project	Construction Impact	Operational Impacts
Repainting of the South Portal Frame. Works currently continuing.	Construction impacts include: • Temporary pedestrian diversions around work area (Hickson Road) • Construction noise (limited to standard construction hours) • Temporary visual impacts associated with containment structures	Operational impacts include: • Increased longevity of bridge elements • Retention of heritage values
Repainting of the northern approach span. Works currently continuing.	Construction impacts include: • Restricted access to parts of Bradfield Park with establishment of safety zone • Construction noise (limited to standard construction hours) • Temporary visual impacts associated with containment structures • Temporary pedestrian diversions • Temporary narrowing of cycleway	Operational impacts include: • Increased longevity of bridge elements • Retention of heritage values
Northern pylon amenities improvements. Includes removal of the existing first floor of administration building.	Construction impacts include: • No exceedances of noise management levels at residential receivers • Exceedance of noise management levels at outdoor active areas (North Sydney Pool and Bradfield Park) and nearby school (St Aloysius College) • Additional construction traffic	Operational impacts include: • Improved facilities • Minor additional traffic associated with an increased maintenance workforce utilising the building within the northern pylon, along with deliveries and waste removal.

Project	Construction Impact	Operational Impacts
St Aloysius' College Redevelopment – 29 Burton Street, 1-5 Jeffreys Street, 49 Upper Pitt Street (SSD 17_8669). Approved September 2019	Construction impacts include: • Construction noise generated in the area • Additional construction traffic	Operational impacts include: • Improved facilities for students and staff
Other periodic Sydney Harbour Bridge works beyond the scope of this REF (eg barriers, strengthening, deck replacement, parapets, lighting)	Construction impacts include: • Traffic impacts at night from lane closures • Temporary cyclist detours • Construction noise generated in the area • Temporary visual impacts	Operational impacts include: • Improved management of bridge operation

6.8.3 Potential impacts

Cumulative impacts have the potential to arise from the interaction with other projects that may be occurring or planned within the locality or the broader region. Clause 228(2) of the Environmental Planning and Assessment Regulation 2000 requires that potential cumulative impacts be considered during the environmental impact assessment process.

Table 6-14 Potential cumulative impacts

Environmental factor	Construction	Operation
Noise	There is the potential for the proposal to occur concurrently with and in close proximity to construction works associated with other projects on the bridge and nearby (refer to Table 6-13). There is the potential for cumulative noise impacts (ie a higher noise level than for any individual project) where works are carried out at the same time, and both are predicted to exceed noise management levels at the same receivers. Cumulative noise impacts, if they occur, would only be experienced for short periods at a time, with the implementation of respite (refer to section 6.2.5).	No cumulative operation stage impacts are expected as a result of the proposal.

Environmental factor	Construction	Operation
Non-Aboriginal heritage	Multiple projects which introduce new visual elements to the Sydney Harbour Bridge or visible changes to fabric would have potential cumulative impacts on the heritage values of the bridge. The proposal involves interventions to significant fabric of the bridge main arch structure including removal of original rivets and walkways and potential drilling of additional holes into the original steel plates of the top chords. These interventions have been assessed as having minor to major physical localised impacts on the main arch structure, and a moderate impact to the overall significance of the Sydney Harbour Bridge. The potential for cumulative heritage impacts due to the proposal is however considered low because other projects proposed for the bridge would introduce a limited number of new highly visible elements and would in most cases fall within the approval exemptions established under the *Heritage Act 1977*. The *Sydney Harbour Bridge Conservation Management Plan 2007* (Godden Mackay Logan, 2007) assists in limiting cumulative impacts by setting the overall management framework for the bridge.	No additional cumulative heritage impacts beyond those identified for the construction stage are expected.
Visual	Multiple projects which introduce new visual elements to the could result in an overall cumulative increase in visual impacts. The ongoing visual impacts of the proposal have been assessed in Section 6.5.3. Cumulative visual impacts are minimised through the *Sydney Harbour Bridge Conservation Management Plan 2007* (Godden Mackay Logan, 2007). This includes ensuring minimisation of physical impact to	No additional cumulative heritage impacts beyond those identified for the construction stage are expected.

Environmental factor	Construction	Operation
	significant fabric of Sydney Harbour Bridge, consistency in the design, style, aesthetic character and material palette of works relating to the bridge, and a coordinated approach to provision of interpretation.	
Traffic and transport	Multiple projects which generate construction traffic, and / or which involve traffic lane closures or pedestrian / cyclist diversions can combine to result cumulative delays and affect people's ability to access places of employment, services, family and friends. In this case, the potential for cumulative delays is considered very low as most works would not require lane closures or affect pedestrian and cycle paths. Where lane closures and pedestrian diversions are needed, coordination with other projects would reduce the potential for cumulative impacts (ie the number of closure/diversion periods).	The proposal would not increase operational traffic volumes, composition or distribution and is therefore not expected to have operational traffic impacts.

Minimising impacts attributable to the proposal is the best way to address any potential cumulative effects and various measures have been proposed throughout this chapter. These measures are summarised in section 7.1.

A coordinated approach to the management and construction of the proposal and nearby concurrent projects would ensure that cumulative impacts are minimised.

6.8.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Cumulative impacts	Current and upcoming projects with the potential to interact with bridge maintenance activities will be monitored. Where potential cumulative impacts are identified, the scheduling of works will be coordinated with interacting projects to minimise potential impacts. This will include	Transport for NSW Project Manager	Construction	Additional

Impact	Environmental safeguards	Responsibility	Timing	Reference
	• Scheduling works to allow suitable respite periods for construction noise • Coordinating lane closures and pedestrian/cyclist diversions to minimise the overall number of occasions where disruption occurs.			

Other safeguards and management measures that would address cumulative impacts are identified in sections6.1.5, 0 and 6.7.2. The Communications Plan for the project will include procedures for communicating with other projects to determine the potential for concurrent activities and associated cumulative impacts (refer to section 6.7.2).

7 Environmental management

7.1 Environmental management plans (or system)

A number of safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Construction Environmental Management Plan (CEMP) and associated Environmental Work Method Statements (EWMS) will be prepared to describe the safeguards and management measures identified. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The CEMP and EWMS will be prepared prior to construction of the proposal and must be reviewed and certified by the Sydney Region environment staff prior to the commencement of any on-site works. The CEMP and EWMS will be working documents, subject to ongoing change and updated as necessary to respond to specific requirements.

7.2 Summary of safeguards and management measures

Environmental safeguards outlined in this document will be implemented during the proposed works, should they proceed. These safeguards will minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The safeguards and management measures are summarised in Table 7-1.

Table 7-1 Summary of site specific environmental safeguards

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
GEN1	General - minimise environmental impacts during construction	A CEMP (and EWMS) will be prepared and submitted for review and endorsement of the Transport for NSW Environment Manager prior to commencement of the activity. As a minimum, the CEMP will address the following: • any requirements associated with statutory approvals • details of how the project will implement the identified safeguards outlined in the REF • issue-specific environmental management plans • roles and responsibilities • communication requirements • induction and training requirements • procedures for monitoring and evaluating environmental performance, and for corrective action • reporting requirements and record-keeping • procedures for emergency and incident management • procedures for audit and review. The endorsed CEMP will be implemented during the undertaking of the activity.	Transport for NSW Project Manager	Pre-construction	Standard safeguard
GEN2	General - notification	All businesses, residential properties and other key stakeholders (eg schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity.	Transport for NSW Project Manager	Pre-construction	Standard safeguard
GEN3	General – environmental awareness	All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular "toolbox" style briefings.	Transport for NSW Project Manager	Pre-construction	Standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include: • Heritage values and the requirements of Heritage Act 1977 exemptions • Air quality management measures (including encapsulation of work areas) • Location of noise sensitive receivers and noise management measures.			
GEN4	General	Any proposal to substantially modify the design of the proposal, works and boundaries applicable to the project as described in the REF would require additional environmental impact assessment.	Transport for NSW Project Manager	Pre-construction	Additional safeguard
GEN5	General	Greater Sydney Project Office environment staff will be consulted in relation to any proposal to trial new surface preparation, maintenance and/or repair techniques. Any additional safeguards or other requirements will be incorporated into the CEMP prior to proceeding with the trialling of the new activity.	Transport for NSW Project Manager	Pre-construction	Additional safeguard
GEN6	General	Any works resulting from this approval and as covered by the REF may be subject to an environmental audit(s) and/or inspection(s) at any time during their duration.	Transport for NSW Environment Staff	Construction	Additional safeguard
GEN7	General	The Transport for NSW Project Manager is to notify Greater Sydney Project Office environment staff, at least 5 days prior to work commencing.	Transport for NSW Project Manager	Pre-construction	Additional safeguard
NAH1	Non-Aboriginal heritage	The materials used in new works will be compatible with the visual character of the Sydney Harbour Bridge. This includes selection of modern and lightweight materials that are, where appropriate,	Transport for NSW Project Manager	Detailed design	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		coloured to match the existing fabric of the bridge including existing steelwork tones. The material palette of the proposal will be consistent with other Sydney Harbour Bridge projects.			
NAH2	Non-Aboriginal heritage	Where feasible, works will be designed to reduce the visual prominence of new elements along the top of the main arch structure.	Transport for NSW Project Manager	Detailed design	Additional safeguard
NAH3	Non-Aboriginal heritage	A photographic archival recording of the affected areas will be prepared prior to the start of works and following completion of works, in accordance with the NSW Heritage Division publications *How to prepare archival records of heritage items* and *Photographic Recording of Heritage Items using Film or Digital Capture*. The original copy of the archival record will be deposited with the Heritage Division, Office of Environment and Heritage, and an additional copy will be provided to the City of Sydney and North Sydney Council.	Transport for NSW Project Manager	Pre-construction Construction	Additional safeguard (s.60 approval)
NAH4	Non-Aboriginal heritage	All work will be carried out by suitably qualified tradespersons with demonstrated experience in conservation of similar heritage structures, methods and materials. All tradesmen are to be inducted on the significance of the heritage item prior to works commencing.	Contractor	Construction	Additional safeguard (s.60 approval)
NAH5	Non-Aboriginal heritage	A suitably qualified and experienced heritage consultant will be nominated. The nominated heritage consultant will provide input into the detailed design and supervise the works to minimise impacts to heritage values. The nominated heritage practitioner will be consulted prior to the selection of appropriate tradespersons and must be satisfied that all work has been	Transport for NSW Project Manager	Detailed design Pre-construction Construction	Additional safeguard (s.60 approval)

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		carried out in accordance with the conditions of the Heritage Act s.60 approval.			
NAH6	Non-Aboriginal heritage	Significant elements will be adequately protected during the works from potential damage. Protection systems will ensure historic fabric is not damaged or removed.	Transport for NSW Project Manager	Construction	Additional safeguard (s.60 approval)
NAH7	Non-Aboriginal heritage	A heritage induction will be provided for all workers prior to works commencing. The induction will cover all heritage related safeguards and management measures.	Transport for NSW Project Manager	Pre-construction	Additional safeguard
NVI1	Construction noise	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • All project specific and relevant standard noise and vibration mitigation measures • Relevant licence and approval conditions • Permissible hours of work • Any limitations on high noise generating activities • Location of nearest sensitive receivers • Construction employee parking areas • Designated loading/unloading areas and procedures • Site opening / closing times (including deliveries) • Environmental incident procedures	Transport for NSW Project Manager	Pre-construction Construction	Construction Noise and Vibration Guideline Appendix B
NVI2	Construction noise	The following would be raised in inductions and avoided during works: • Swearing or unnecessary shouting	Transport for NSW Project Manager	Construction	Construction Noise and Vibration

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Loud stereos/radios • Dropping of materials from height, throwing of metal items and slamming of doors • Use of equipment which generates impulsive noise, where possible • Metal-to-metal contact on equipment, where possible.			Guideline Appendix B
NVI3	Construction noise	A letterbox drop notification for residential receivers will occur at least five days prior to works on approach spans that are likely to exceed noise management levels. The extent of the notification will be determined with reference to the noise assessment and the specific types of activities proposed. The notification will detail work activities, dates and hours, impacts and mitigation measures. It will also include a contact number for enquiries and complaints.	Transport for NSW Project Manager	Construction	Construction Noise and Vibration Guideline Appendix C
NVI4	Construction noise	Works likely to exceed construction noise management levels during evening and night periods will be managed in accordance with the Transport for NSW Construction Noise and Vibration Guideline.	Transport for NSW Project Manager	Construction	Construction Noise and Vibration Guideline Appendix C
NVI5	Construction noise	Verification of background noise and construction noise levels will occur in response to noise related complaints. Verification will be in accordance with Appendix F of the Construction Noise and Vibration Guideline.	Transport for NSW Project Manager	Construction	Construction Noise and Vibration Guideline Appendix C

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		The results of the noise measurements will be used to inform consideration of any necessary changes to work practices or additional mitigation measures.			
NVI6	Construction	The noisiest works will be scheduled to occur before 11 pm where possible.	Transport for NSW	Construction	Construction Noise and Vibration Guideline Appendix C
WQU1	Water quality impacts associated with paint repair	Removal of all materials identified as being coated with paint containing lead (or other hazardous metallic pigments) will be conducted in accordance with guidance as set out in AS/NZS 4361.1:2017 *Guide to hazardous paint management Part 1 Lead and other hazardous metallic pigments in industrial applications.* This will include conducting a Lead Risk Assessment for each work location[1].	Transport for NSW Project Manager	Construction	Additional safeguard
WQU2	Water quality impacts	There is to be no release of dirty or contaminated water into Sydney Harbour.	Transport for NSW Project Manager	Construction	Additional safeguard
WQU3	Spills	Plant and equipment will be inspected regularly to ensure there are no leakages of fuel, oil and hydraulic fluid.	Transport for NSW Project Manager	Construction	Additional safeguard
WQU4	Spills	Work practices will be structured to minimise the risk of spills on-site.	Transport for NSW Project Manager	Construction	Additional safeguard
WQU5	Spills	An emergency spill kit is to be kept on site at all times and maintained throughout the construction work. The spill kit must be appropriately sized for the volume of substances at the work site.	Transport for NSW Project Manager	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
WQU6	Spills	Storage of chemicals and fuels and refuelling of plant and equipment is to occur on impervious surfaces with spill containment available.	Transport for NSW Project Manager	Construction	Additional safeguard
WQU7	Spills / incidents	If a spill or incident occurs, the *Environmental Incident Classification and Reporting Procedure* (Roads and Maritime Services, 2017) is to be followed and the Transport for NSW Regional Environment Manager notified immediately.	Transport for NSW Project Manager	Construction	Additional safeguard
WQU8	Spills / incidents	In the event of a maritime spill, an incident emergency plan would be implemented in accordance with Sydney Ports Corporation's response to shipping incidents and emergencies outlined in the NSW State Waters Marine Oil and Chemical Spill Contingency Plan (Roads and Maritime Services, 2016). The plan would be part of the Construction Environmental Management Plan and would include relevant emergency contacts.	Transport for NSW Project Manager	Construction	Additional safeguard
AQU1	Air quality impacts associated with paint repair	Paint dust and flakes would be contained during paint removal or repair works. The methodology adopted would be dependent on the location, expected wind loads and form of access and would be informed by the risk assessment carried out in accordance with AS/NZS 4361.1:2017.	Transport for NSW	Construction	Additional safeguard
AQU2	Air quality impacts associated with paint repair	Works (including the spraying of paint and other materials) are not to be carried out during strong winds or in weather conditions where high levels of dust or air borne particulates are likely.	Transport for NSW Project Manager	Construction	Additional safeguard
AQU3	Air quality impacts	Works must cease when air borne dust cannot be controlled.	Transport for NSW Project Manager	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
	associated with paint repair				
AQU4	Air quality impacts associated with paint repair	Paints containing fast drying solvents will be used to minimise the impact of air sprayed paint emissions.	Transport for NSW Project Manager	Construction	Additional safeguard
AQU5	Air quality impacts associated with paint repair	Air quality monitoring will be undertaken in accordance with AS/NZS 4361.1:2017 *Guide to hazardous paint management Part 1 Lead and other hazardous metallic pigments in industrial applications.*	Transport for NSW Project Manager	Construction	Additional safeguard
VIS1	Visual impacts during works	Works areas will be maintained in a clean and tidy state and visual clutter will be minimised.	Transport for NSW Project Manager	Construction	Additional safeguard
VIS2	Ongoing visual impacts	All services pipes, wiring or cable trays will be concealed in the structure.	Transport for NSW Project Manager	Detailed design	Additional safeguard
VIS3	Ongoing visual impacts	Bolt fixings will have domed heads and will be painted to match existing, subject to structural and maintenance requirements.	Transport for NSW Project Manager	Detailed design	Additional safeguard
VIS4	Ongoing visual impacts	A preferred parking location for the AMUs will be determined to minimise visual impacts (a position along the arch may be a more appropriate place than at the ends where the line of the arch is interrupted).	Transport for NSW Project Manager	Detailed design	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
VIS5	Ongoing visual impacts	Works would ensure retention of the “bridge grey” colour scheme.	Transport for NSW Project Manager	Construction	Additional safeguard
WMA1	Construction waste management	The following resource management hierarchy principles would be followed: • Avoid unnecessary resource consumption as a priority. • Avoidance would be followed by resource recovery (including reuse of materials where possible, reprocessing, and recycling and energy recovery). Disposal would be undertaken as a last resort (in accordance with the *Waste Avoidance and Resource Recovery Act 2001*).	Transport for NSW Project Manager	Construction	Additional safeguard
WMA2	Construction waste management	Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day.	Transport for NSW Project Manager	Construction	Additional safeguard
WMA3	Construction waste management	All wastes would be collected and disposed of legally in accordance with their classification under the *Waste Classification Guidelines Part 1: Classifying Waste* (Environment Protection Authority, 2014).	Transport for NSW Project Manager	Construction	Additional safeguard
OTH1	Biodiversity	Fauna handling must be carried out in accordance with the requirements the *Biodiversity Guidelines* - Guide 9 (Fauna Handling).	Transport for NSW Project Manager	Construction	Additional safeguard
OTH2	Traffic and transport	Access for vehicular, cyclist and pedestrian traffic across the bridge will be maintained, except when a full bridge closure is required.	Transport for NSW Project Manager	Construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
OTH3	Traffic and transport	Works within the rail corridor (at deck level) will only occur during scheduled track possession periods.	Transport for NSW Project Manager	Construction	Additional safeguard
OTH4	Socio-economic	A Communication Plan will be prepared and implemented as part of the CEMP to help provide timely and accurate information to the community during construction. The Communication Plan will include (as a minimum): • Mechanisms to provide details and timing of proposed activities to affected residents, including changed traffic and access conditions • Contact name and number for complaints • Notification requirements for noise generating activities • Procedures for communicating with other projects to determine the potential for concurrent activities and associated cumulative impacts.	Transport for NSW Project Manager	Pre-construction	Standard safeguard
OTH6	Socio-economic	The Bridge Concessionaire will be provided with at least 14 days' notice for planned works and at least 24 hours' notice unplanned repairs and/or maintenance requiring diversion of climbing routes. Notification is to be consistent with any with the applicable agreement between Transport for NSW and the Bridge Concessionaire.	Transport for NSW Project Manager	Construction	Additional safeguard
CII1	Cumulative impacts	Current and upcoming projects with the potential to interact with bridge maintenance activities will be monitored. Where potential cumulative impacts are identified, the scheduling of works will be coordinated with interacting projects to minimise potential impacts. This will include • Scheduling works to allow suitable respite periods for construction noise	Transport for NSW Project Manager	Construction	Additional

No.	Impact	Environmental safeguards	Responsibility	Timing	Reference
		• Coordinating lane closures and pedestrian/cyclist diversions to minimise the overall number of occasions where disruption occurs.			

7.3 Licensing and approvals

Table 7-2 provides a summary of the licensing and approval requirements relevant to the proposal.

Table 7-2 Summary of licensing and approval requirements

Instrument	Requirement	Timing
Roads Act 1993 (section 138)	Road occupancy licence for lane closures on the Sydney Harbour Bridge and approaches.	Prior to road occupancy.
Protection of the Environment Operations (Waste) Regulation 2014 (Part 4)	Tracking requirements for hazardous waste (which includes lead paint waste). Obligations for consignor, transporter and receiver of waste.	Prior to transport of hazardous waste.
Heritage Act 1977	Heritage Council approval required in relation to works affecting a State Heritage Register item.	On 6 June 2018, the Heritage Council approved the proposed replacement of the AMUs under section 63 of the Heritage Act, subject to eight conditions (refer to Appendix C).

8 Conclusion

8.1 Justification

The existing AMUs, which were installed in 1997, have limited reach and manoeuvrability and do not provide access to the lateral bridge members. This has resulted in a limited capacity to carry out necessary maintenance works and inspections. The proposal would provide improved accessibility and safety for maintenance workers on the Sydney Harbour Bridge arch and ensure steel bridge members with exceptional heritage significance, are appropriately maintained. In contrast, a 'Do-Nothing' approach would not allow works on the unmaintained top arches of the bridge.

By assisting the ongoing management of the Sydney Harbour Bridge and the retention of heritage values, the proposal is consistent with the policy direction set out in the Sydney Harbour Bridge Conservation Management Plan.

While there would be some temporary environmental impacts as a consequence of the proposal, they will be minimised wherever possible through the site-specific safeguards summarised in Section 7.

The benefits of the proposal are considered to outweigh the mostly temporary adverse impacts and risks associated with the proposal.

8.2 Objects of the EP&A Act

A consideration of the proposal in the context of the objects of the EP&A Act is presented in Table 8-1 below.

Table 8-1 Objects of the EP&A Act review

Object	Comment
1.3 (a) to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources	The proposal would help improve the condition of the transport network and support the conservation of heritage values, while minimising impacts on the natural and built environment through appropriate safeguards and management measures. It is therefore consistent with the objective of promoting the social and economic welfare of the community and a better environment.
1.3 (b) to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment	Ecologically sustainable development is considered in section 8.2.1 below.
1.3 (c) to promote the orderly and economic use and development of land	The proposal would continue to support the orderly economic use of land by providing an important regional transport link.
1.3 (d) to promote the delivery and maintenance of affordable housing	Not relevant to the project.

Object	Comment
1.3 (e) to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats	The proposal would not affect threatened and other species of native animals and plants, ecological communities and their habitats. Measures have been proposed to address the risk of pollution to the marine environment beneath the bridge. Refer to Chapter 6.
1.3 (f) to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage)	The proposal has been developed to minimise potential impacts on the state and nationally significant Sydney Harbour Bridge. The proposal would retain heritage values and extend the useful life of the bridge.
1.3 (g) to promote good design and amenity of the built environment	The proposal would support essential ongoing maintenance of the Sydney Harbour Bridge. Potential amenity impacts during works have been addressed by the safeguards and management measures detailed in section 7.2 (in particular NVI1-NVI6 and VIS1-VIS10).
1.3 (h) to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants	The proposal would support ongoing maintenance of the Sydney Harbour Bridge and will be carried out in accordance with Transport for NSW and SafeWork NSW work health and safety requirements.
1.3 (i) to promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State	Not relevant to the proposal.
1.3 (j) to provide increased opportunity for community participation in environmental planning and assessment.	Updates regarding key Sydney Harbour Bridge activities are generally provided via the Transport for NSW website. Given the distance between most maintenance activities (ie those on the main span) to the nearest sensitive receivers, impacts are expected to be minor and therefore a general pre-work letter box notification is not proposed. Notification of works (via letterbox drop) would however occur in relation to any works proposed outside standard construction hours that are expected to result in exceedance of noise management levels. This would occur in accordance with the Communications Plan for the proposal (refer to measure OTH5).

8.2.1 Ecologically sustainable development

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been a consideration throughout the development of the proposal.

The EP&A Act recognises that ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are considered in the context of the proposal below.

8.2.2 Precautionary principle

The precautionary principle deals with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

The threat of serious or irreversible environmental damage is one of the essential preconditions to the engagement of the precautionary principle. In this case, there is no threat of serious or irreversible environmental damage. Works have been approved under the *Heritage Act 1977* and potential impacts on water and air quality have been addressed through the proposed safeguards and mitigation measures.

8.2.3 Intergenerational equity

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations.

While maintenance works on the Sydney Harbour Bridge are ongoing, the impacts of the proposal have been identified as short term and manageable at individual locations. The ongoing maintenance of the bridge ensures the transport function and heritage values of the Sydney Harbour Bridge are accessible to future generations.

8.2.4 Conservation of biological diversity and ecological integrity

The twin principles of biodiversity conservation and ecological integrity have been a consideration during the course of the design and assessment process with a view to identifying, avoiding, minimising and mitigating impacts.

The proposal is not expected to have biodiversity impacts.

8.2.5 Improved valuation, pricing and incentive mechanisms

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by a project, including air, water, land and living things. While it is often difficult to place a reliable monetary value on the residual, environmental and social effects of the project, the value placed on environmental resources within and around the corridor is evident in the extent of environmental investigations, planning and design of impact mitigation measures to prevent adverse environmental impacts.

Internalisation of environmental costs occurs via EnSite meetings (Environment and Safety Improvement Team meetings) which are held to scope the delivery of project works, document the sequence of work activities and identify critical work health and safety hazards and environmental issues that may result in illness, injury, environmental harm or incident. This process allows risks to be assessed and agreement to be reached on appropriate work health and safety and environmental controls for the project. The costs of those controls represent the allocation of a monetary value to environmental risks.

8.3 Conclusion

The proposed replacement of the four existing Sydney Harbour Bridge AMUs with two new AMUs is subject to assessment under Division 5.1, of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration (where relevant) of conservation agreements and plans of management under the NPW Act, biodiversity stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species and ecological communities and their habitats and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the Federal EPBC Act.

A number of potential environmental impacts from the proposal (energy and resources use) have been reduced during the options assessment. The proposal as described in the REF best meets the project objectives but would still result in some impacts, primarily temporary noise and visual impacts. Safeguards and management measures as detailed in this REF would ameliorate or minimise these and other expected impacts. The proposal would also retain heritage values and extend the useful life of the bridge. On balance the proposal is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Species Impact Statement or Biodiversity Development Assessment Report is not required. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from council(s) is not required.

Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. A referral to the Australian Government Department of the Environment and Energy is not required.

9 Certification

This review of environmental factors provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.

Stuart Hill
Environmental Planner
Hills Environmental
Date: 17 January 2020

I have examined this review of environmental factors and the certification by Stuart Hill (Hills Environmental) and accept the review of environmental factors on behalf of Transport for NSW Services.

Jayanthsiri Hapuwida
Project Manager/Engineer
Greater Sydney Project Office
Transport for NSW
Date:

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Terms and acronyms used in this REF

Term / Acronym	Description
AMU	Arch Maintenance Unit
BC Act	Biodiversity Conservation Act 2016 (NSW)
CEMP	Construction environmental management plan
DoEE	Federal Department of the Environment and Energy
EIA	Environmental impact assessment
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
FM Act	*Fisheries Management Act 1994* (NSW)
Heritage Act	*Heritage Act 1977* (NSW)
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SHR	State Heritage Register
SoHI	Statement of Heritage Impact
Sydney Harbour REP	Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005
QA Specifications	Specifications developed by Transport for NSW Services for use with roadworks and bridgeworks contracts let by Transport for NSW

Appendix A

Consideration of clause 228(2) factors and matters of national environmental significance

Clause 228(2) Checklist

In addition to the requirements of the *Is an EIS required?* guideline as detailed in the REF, the following factors, listed in clause 228(2) of the *Environmental Planning and Assessment Regulation 2000*, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor	Impact
a. Any environmental impact on a community? There is some potential for noise, visual impacts and dust associated with the proposal that could impact on the community. Safeguards and mitigation measures (refer Chapter 6 of this REF) have been proposed to address these issues.	Minor short-term negative
b. Any transformation of a locality? The proposal would not transform a locality.	Nil
c. Any environmental impact on the ecosystems of the locality? The proposal would not affect habitats on which terrestrial native plants and animals (including threatened species) would be reliant. There is identified potential for impacts to aquatic biodiversity through accidental spills (paint products, washing water) or the escape of lead paint residue (which bioaccumulates). Safeguards have been proposed to address these risks.	Minor negative
d. Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? There is some potential for noise and dust associated with the proposal that could impact on the environmental quality or value of the locality. Safeguards and mitigation measures (refer Chapter 6 of this REF) have been proposed to address these issues. Temporary lane closures and pedestrian/cyclist diversions could affect accessibility and recreational value of the locality in the short-term. The proposed painting and maintenance would also result in short-term visual impacts. In the longer term, the proposal would improve the appearance of the bridge by better maintenance access.	Short-term negative Long-term positive
e. Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations? The proposal would have some impact on Sydney Harbour Bridge heritage fabric but has received approval under the *Heritage Act 1977*. The proposal would would assist in preserving the heritage values of the Sydney Harbour Bridge by allowing better maintenance access.	Short-term negative Long-term positive

Factor	Impact
f. Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act* 1974)? Impacts on the habitat of protected terrestrial fauna would be limited to fauna which may use the bridge elements for nesting and/or shelter. There is identified potential for impacts to aquatic species through accidental spills (eg paint products) or the escape of lead paint residue (which bioaccumulates). Safeguards have been proposed to address these risks.	Minor short-term negative
g. Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? The proposal would not endanger any species of animal, plant or other form of life.	Nil
h. Any long-term effects on the environment? Long-term negative effects on the environment are not expected. Benefits would be realised in terms of retention of heritage values.	Positive
i. Any degradation of the quality of the environment? The proposal has some potential to degrade the quality of the environment via the escape of lead paint residue (which bioaccumulates) to air and water. Safeguards have been proposed to address this risk.	Minor long-term negative
j. Any risk to the safety of the environment? There is a risk to the safety of the environment associated with accidental spills (eg paint products) or the escape of lead paint residue to air and/or water. Safeguards have been proposed to address these risks.	Minor long-term negative
k. Any reduction in the range of beneficial uses of the environment? The proposal would not reduce the range of beneficial uses of the environment.	Nil
l. Any pollution of the environment? There is a risk of pollution associated with accidental spills (eg paint products) or the escape of lead paint residue to air and/or water. Hazardous waste (lead paint) would be generated by the proposal and would require disposal. Noise would be generated by maintenance activities and has the potential to affect nearby sensitive receivers. Safeguards have been proposed to address these risks	Minor short-term and long-term negative
m. Any environmental problems associated with the disposal of waste? Waste generated during construction (including lead paint which is pre-classified as hazardous waste) would need to be removed from site, tracked and disposed of legally.	Minor long-term negative

Factor	Impact
n. Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? The proposed works would not increase demand for resources, which are, or are likely to become, in short supply.	Nil
o. Any cumulative environmental effect with other existing or likely future activities? There is some potential for the proposal to interact with other projects to generate cumulative impacts (such as noise and traffic / transport disruption). A coordinated approach to the management and construction of the proposal and nearby concurrent projects would ensure that cumulative impacts are minimised. Cumulative impacts and proposed mitigation measures are discussed in section 6.8.3 and 6.8.4 of this REF respectively.	Minor short-term negative
p. Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? The works would not influence coastal processes and/or coastal hazards.	Minor short-term negative

Matters of National Environmental Significance

Under the environmental assessment provisions of the *Environment Protection and Biodiversity Conservation Act 1999*, the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of the Environment and Energy.

A referral is not required for proposed actions that may affect nationally listed threatened species, populations, endangered ecological communities and migratory species. Impacts on these matters are still assessed as part of the REF in accordance with Australian Government significant impact criteria and taking into account relevant guidelines and policies.

Factor	Impact
a. Any impact on a World Heritage property? The Sydney Opera House is a declared World Heritage property and the Sydney Harbour Bridge is located within the declared buffer zone. With reference to the significant impact criteria *in Matters of National Environmental Significance - Significant impact guidelines 1.1* (Department of the Environment, 2013) it is noted that: • one or more of the World Heritage values would not be lost • one or more of the World Heritage values would not be degraded or damaged, and • one or more of the World Heritage values would not be notably altered, modified, obscured or diminished. There would be no direct impacts on the Sydney Opera House, no noticeable changes to its setting and no obscuring of views (either to or from the item). The visual impacts of the proposal are discussed in section 6.5 of this REF.	Nil
b. Any impact on a National Heritage place? The Sydney Harbour Bridge is on the National Heritage List. With reference to the significant impact criteria *in Matters of National Environmental Significance - Significant impact guidelines 1.1* (Department of the Environment, 2013) it is noted that: • one or more of the National Heritage values would not be lost • one or more of the National Heritage values would not be degraded or damaged, and • one or more of the National Heritage values would not be notably altered, modified, obscured or diminished. The Statement of Heritage Impact concludes that the cumulative impact of the proposal is not currently considered to require referral under the EPBC Act. Potential heritage impacts are discussed in section 6.1 of this REF.	Minor negative Not significant
c. Any impact on a wetland of international importance? The proposal would not affect a wetland of international importance.	Nil

Factor	Impact
d. Any impact on a listed threatened species or communities? A number of Commonwealth listed threatened species have the potential to occur in the local area. The nature, scale and location of the proposal are such that impacts on these species or their habitats are not expected. Indirect impacts are also not expected	Nil
e. Any impacts on listed migratory species? A number of Commonwealth listed migratory species have the potential to occur in the local area. The nature, scale and location of the proposal is such that impacts on these species or their habitats are not expected. Indirect impacts are also not expected.	Nil
f. Any impact on a Commonwealth marine area? Due to lack of proximity, there would be no environmental impact on a Commonwealth Marine area.	Nil
g. Does the proposal involve a nuclear action (including uranium mining)? The proposed works do not constitute a nuclear action.	Nil
h. Any impact on a water resource, in relation to coal seam gas development and large coal mining development? The proposal is not for coal seam gas development and large coal mining development.	Nil
Additionally, any impact (direct or indirect) on Commonwealth land?	Nil

Appendix B

ISEPP consultation checklists

Council related infrastructure or services

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Stormwater	Are the works likely to have a *substantial* impact on the stormwater management services which are provided by council?	No		ISEPP cl.13(1)(a)
Traffic	Are the works likely to generate traffic to an extent that will *strain* the existing road system in a local government area?	No		ISEPP cl.13(1)(b)
Sewerage system	Will the works involve connection to a council owned sewerage system? If so, will this connection have a *substantial* impact on the capacity of any part of the system?	No		ISEPP cl.13(1)(c)
Water usage	Will the works involve connection to a council owned water supply system? If so, will this require the use of a *substantial* volume of water?	No		ISEPP cl.13(1)(d)
Temporary structures	Will the works involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, will this cause more than a *minor* or *inconsequential* disruption to pedestrian or vehicular flow?	No		ISEPP cl.13(1)(e)
Road & footpath excavation	Will the works involve more than *minor* or *inconsequential* excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	No		ISEPP cl.13(1)(f)

Local heritage items

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Local heritage	Is there a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the works? If yes, does a heritage assessment indicate that the potential impacts to the item/area are more than *minor* or *inconsequential*?	No. Item also on SHR		ISEPP cl.14

Flood liable land

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Flood liable land	Are the works located on flood liable land? If so, will the works change flood patterns to more than a *minor* extent?	No		ISEPP cl.15

Public authorities other than councils

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
National parks and reserves	Are the works adjacent to a national park or nature reserve, or other area reserved under the *National Parks and Wildlife Act 1974*?	No	Office of Environment and Heritage	ISEPP cl.16(2)(a)
Marine parks	Are the works adjacent to a declared marine park under the *Marine Parks Act 1997*?	No	Department of Planning and Environment	ISEPP cl.16(2)(b)
Aquatic reserves	Are the works adjacent to a declared aquatic reserve under the *Fisheries Management Act 1994*?	No	Office of Environment and Heritage	ISEPP cl.16(2)(c)

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Sydney Harbour foreshore	Are the works in the Sydney Harbour Foreshore Area as defined by the *Sydney Harbour Foreshore Authority Act 1998*?	No The subject site adjoins the *Sydney Harbour Foreshore Authority Act 1998* foreshore area at Dawes Point. Given that the proposal would be confined to the bridge and land at Dawes Point would not be affected, specific consultation with the Property NSW (which now has the functions of the Sydney Harbour Foreshore Authority) is not considered necessary. Consultation occurs periodically with Property NSW regarding works on the Sydney Harbour Bridge.	Department of Planning and Environment	ISEPP cl.16(2)(d)

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Bush fire prone land	Are the works for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?	No		ISEPP cl.16(2)(f)

Appendix C

Heritage Act 1977 approval

Appendix D

Statement of Heritage Impact

Appendix E

Landscape Character and Visual Impact Assessment

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