Appendix B - Additional heritage investigations

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Windsor Bridge Replacement Project
Addendum to the Historic Heritage Assessment and Statement of Heritage Impact

Addendum B

Report for Roads and Maritime Services NSW

March 2013

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ABBREVIATIONS

CHL	Commonwealth Heritage List
DGRs	Director General's environmental assessment requirements
DUAP	Department of Urban Affairs and Planning (former); now Department of Planning and Infrastructure
EIS	Environmental Impact Statement
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
ICOMOS	International Council on Monuments and Sites
km	Kilometre
LEP	Local Environmental Plan – for the purposes of this report, also refers to the *Hawkesbury LEP 2012*
LGA	Local Government Area
MGA	Map Grid of Australia – unless otherwise specified all coordinates are in MGA
m	Metre
mm	Millimetre
NLA	National Library of Australia
NHL	National Heritage List
NT	National Trust of Australia (NSW)
OEH	NSW Office of Environment and Heritage, Department of Premier and Cabinet
RMS	Roads and Maritime Services NSW
RTA	Roads and Traffic Authority (former) – now Roads and Maritime Services
SHI	State Heritage Inventory
SHR	State Heritage Register
SL NSW	State Library of NSW

SL VIC	State Library of Victoria
SoHI	Statement of Heritage Impact
SPF	Small Pictures File, Mitchell Library (State Library of NSW)

DOCUMENT CONTROL SHEET

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EXECUTIVE SUMMARY

Roads and Maritime Services NSW (RMS) is proposing to replace the existing bridge over the Hawkesbury River at Windsor with a new bridge about 35 metres downstream. The existing Windsor Bridge would be demolished as part of the proposal and new approach roads and intersections would be constructed.

Archaeological and historic heritage impacts of the project were assessed in the working paper *Windsor Bridge Replacement Project Historic Heritage Assessment & Statement of Heritage Impact (Biosis Research Pty Ltd and Cultural Resources Management Pty Ltd) November 2012* (Working Paper 1), which was exhibited in November-December 2012.The assessment identified impacts associated with the removal of the existing Windsor Bridge, removal of relics, impacts to views and vistas and the cultural landscape as a result of the construction of the replacement bridge and other associated works.

RMS also proposes a number of changes to the design exhibited in the EIS, which are addressed in this report. The proposed design changes are:

- increase in bridge clearance height over The Terrace from 3.6 metres to 4.6 metres
- reconfiguring of the form and position of the bridge piers
- installation of additional noise mitigation works to some heritage properties.

The need for these design changes and an assessment of the heritage impacts can be found in Section 2 of this addendum.

Further assessment has also been undertaken to more thoroughly address the following issues:

- Assessment of impacts of the proposed urban design and landscaping components of the project, including consolidation of the two parkland areas on the heritage values of the Thompson Square
- Consideration of visual impacts on heritage items from the proposed lighting on the bridge (both for traffic and the shared user pathway)

RMS also undertook additional archaeological investigations near the George Street / Bridge Street intersection to understand the potential archaeological impact of signalising the intersection. This further archaeological investigation was undertaken in February 2013. The results of this excavation are included in Attachment 1 of this document.

Additional noise mitigation measures have been considered in a separate report to SKM. The advice was prepared by City Plan Heritage and is included in the submissions report. The sites were not physically accessed and advice was general in nature but appropriate for items of high significance. In summary, noise mitigation measures are proposed for an additional three buildings, which are the Doctor House at 1-3 Thompson Square, the former Hawkesbury Stores at 64 – 68 George Street and the former School of Arts at 14 Bridge Street, Windsor. The assessment concluded that as the buildings were rare and of high significance, two options should be considered: custom made individual glazed timber framed panels and; magnetic double glazing, which should first be assessed for suitability when a site inspection is possible.

This Statement of Heritage Impact found that there will be minimal additional impact resulting from the design changes to the replacement bridge to that which was assessed in the technical working paper. The impact of the replacement bridge, approach road and associated other works will have a major negative impact on the archaeological resource, the views and vistas, setting and cultural landscape in which Thompson Square sits. The overall statement of heritage impact remains unchanged from the original heritage working paper.

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1 INTRODUCTION

1.1 Background to this addendum

Roads and Maritime Services NSW (RMS) is proposing to replace the existing bridge over the Hawkesbury River at Windsor with a new bridge about 35 metres downstream. The existing Windsor Bridge would be demolished as part of the proposal and new approach roads and intersections would be constructed.

Archaeological and historic heritage impacts of the project were assessed in the working paper *Windsor Bridge Replacement Project Historic Heritage Assessment & Statement of Heritage Impact (Biosis Research Pty Ltd and Cultural Resources Management Pty Ltd) November 2012* (Working Paper 1).The assessment identified impacts associated with the removal of the existing Windsor Bridge, removal of relics, impacts to views and vistas and the cultural landscape as a result of the construction of the replacement bridge and other associated works. The working paper formed part of the EIS for project.

Having reviewed the EIS and working papers as submitted, and considered RMS' responses to various matters on which the Department of Planning and Infrastructure required further information, the Department placed the EIS on public exhibition on 14 November 2012. The Department also requested further archaeological investigations to be undertaken, as documented in this report. A number of design changes to the project are also proposed, which are assessed in this report.

The archaeological investigations were required to better understand potential archaeological impacts associated with the signalised intersection proposed at Bridge and George streets (replacing the existing roundabout at that location). While a research design was approved by the Heritage Branch, OEH and the Department of Planning and Infrastructure in April 2012 and informed the archaeological investigations described in the EIS the treatment of the intersection was not fully detailed at that time. With this information, the need for additional investigations was identified and a S60 application for additional archaeological work was submitted to Heritage Branch for approval in December 2012.

The additional archaeological investigations and key findings are discussed in detail in Attachment 1 of this addendum. Attachment 1 also provides more detailed consideration of other potential impacts of the project, including compressive impacts on archaeology.

The proposed design changes are:

- increase in bridge clearance height over The Terrace from 3.6 metres to 4.6 metres
- reconfiguring of the form and position of the bridge piers
- installation of additional noise mitigation works to some heritage properties.

The need for these design changes and an assessment of the heritage impacts can be found in Section 2 of this report.

Advice pertaining to the installation of additional noise mitigation works has been addressed by City Plan Heritage and is appended to the Submissions Report.

Further assessment has also been undertaken to more thoroughly address the following issues:

- Assessment of heritage impacts of the proposed urban design and landscaping components of the project, including consolidation of two parkland areas into one space;
- Consideration of visual impacts on heritage items from the proposed lighting on the bridge (both for traffic and the shared user pathway).

This addendum updates the findings of the *Windsor Bridge Replacement Project Historic Heritage Assessment & Statement of Heritage Impact* (Working Paper 1) report and should be read in conjunction with that report. It also forms an appendix to the Submissions Report for the Windsor Bridge replacement project.

1.2 Objectives of this Report

The objectives of this report are:

1. Assess the heritage impact of the proposed design changes;
2. Assess the heritage impacts of the landscape design and landscaping concept including consolidation of two parkland areas into one space;
3. Assess the heritage impacts of the proposed lighting on the bridge for traffic and pedestrian use;
4. Present the findings of the additional test excavations (Heritage Act Permit approval 2013/S6/006, issued 12/2/2013).

1.3 The Focus of the current investigations

The current areas of investigation lie within the Project Area (Figure 1). Archaeological test excavations were conducted at the intersection of George Street and Bridge Street. The replacement bridge design modification is concerned with the area along the alignment of the proposed bridge.

The archaeological test excavation results are appended to this document. The SoHI in response to the modification of the bridge design is presented from Section 2.

1.4 Study Team

This report was prepared by Pamela Kottaras and Wendy Thorp. It utilises information presented in the Working Paper 1 and the associated research design (Biosis and CRM December 2012). The report was reviewed by Braith Gilchrist (SMEC) and Denis Gojak (RMS) and Roy Surace (RMS).

Biosis and Cultural Resources Management would like to acknowledge the assistance of the design team for providing plans and elevations for the additional statement of heritage impact and the archaeological options paper.

Figure 1: The Project Area

2 STATEMENT OF HERITAGE IMPACT

2.1 Introduction

The following section assesses the predicted impacts associated with the design changes proposed for the project. Refer to the *Windsor Bridge Archaeological Options Paper* appended to this report for a detailed discussion on the predicted impacts of the two southern abutment options.

As discussed in Section1.1, design changes include:

- Increased clearance over The Terrace
- Changes to the location and form of the bridge piers
- Noise mitigation treatments to heritage properties.

In addition to the design changes discussed in this report, the effect of compressive impacts exerted by plant and stockpiles on the archaeological resource are also considered. Recommendations have been formulated to reduce the risk of inadvertent damage to relics during the site preparation and construction process.

Noise mitigation treatments to three additional properties will be required. The properties are The Doctors House at 1-3 Thompson Square, the former Hawkesbury Stores at 64-68 George Street and the former School of Arts building at 14 Bridge Street, Windsor. These buildings were assessed by City Plan Heritage using photographs of each building; Biosis did not undertake a separate assessment and makes reference to the report advising of the most appropriate noise mitigation measures for the buildings as assessed by City Plan Heritage.[1]

This statement of heritage impact has been assessed in accordance with the guiding document published by the NSW Heritage Office & Department of Urban Affairs & Planning (2002) *NSW Heritage Manual – Statements of Heritage Impact.*

2.2 Description of the changes

2.2.1 Change 1 – Increase in the clearance of the new bridge over The Terrace

During the development of the project, the vertical alignment of the new bridge and approach road through Thompson Square was lowered substantially to minimise impacts on heritage views and vistas. The alignment was lowered while maintaining a 3.6 metre clearance over The Terrace to allow small coaches, service vehicles and emergency vehicles to access Windsor Wharf.

In consultation with Hawkesbury City Council and in response to submissions received during the exhibition of the EIS, RMS has now increased the proposed clearance of the new bridge over The Terrace from a minimum of 3.6 metres to a maximum of 4.6 metres to allow large coaches to directly access Windsor Wharf. Large coach access along The Terrace is required to allow the patrons of the Hawkesbury Paddle Wheeler to have easy access to Windsor Wharf.

Many of the patrons of the Hawkesbury Paddle Wheeler are elderly, disabled and/or have limited mobility and would find it difficult or impossible to access the wharf if large coaches were forced to park in Thompson Square road or Baker Street. The Windsor Paddle Steamer business has been operating for 14 years, with the main source of income being the provision of leisure cruises for the elderly and disabled. The viability of the Hawkesbury Paddle Wheeler business is reliant on large coaches being able to transport patrons to Windsor Wharf.

To provide the additional clearance over The Terrace, the height of the southern end of the bridge would be increased. This would result in a one metre higher bridge and abutment at the southern end, and a marginally higher 45 metre long section of the southern approach road through Thompson Square between the driveway of No. 4 Bridge Street to the southern abutment. South of the driveway of No. 4 Bridge Street and in front of the heritage listed properties of No. 6 and No. 10

[1] City Plan Heritage March 2013.

Bridge Street, the height of the southern approach road would remain the same as that presented in the EIS. The grade of the bridge would also increase slightly from 1.6 to 1.9 per cent.

2.2.2 Change 2 – Change in bridge pier location

The location of the bridge piers in the Hawkesbury River would change slightly from those presented in the EIS to accommodate the specific type of incrementally launched bridge. The modified location of the bridge piers in comparison to in the exhibited design are presented in Plate 1 to 4 of this document. The southernmost pier will now be 9 metres from the bank, and approximately 2 metres from the position of the original Pier 1.

The modified location of the bridge pier closest to the southern bank may result in a minor reduction in direct impacts to the early wharf site and may reduce scour of the southern bank during flood events. Other environmental impacts would be similar to those presented in the EIS.

2.2.3 Additional property requiring noise mitigation

Four residential properties that were incorrectly identified as commercial properties in the EIS have now been re-assessed as residential properties to determine the need for impact mitigation in accordance with the RMS Road Noise Policy. The properties that have been re-classified as residential receivers since completion of the EIS are:

- Thompson Square – Doctors House – two residences
- 64-68 George Street – three first-floor residences
- 14 Bridge Street – one residence.

The results of the revised noise assessment are presented in Section 4.1.2 of the submissions report. The Doctors House currently experiences "acute" noise levels from the existing alignment and while the noise levels would be reduced slightly as a result of the project, noise levels would still exceed the RNP criteria and therefore would qualify for architectural treatment of reduce noise levels inside the premises.

In selecting appropriate architectural treatment options, the type, condition and fabric of the building needs to be considered to provide the optimum internal noise benefit. For heritage buildings generally, the implementation of architectural treatments is not straightforward due to the need to determine the significance of fabric, finishes and appearance, and consider a range of options that are non-impacting and reversible but also acceptable for residential amenity. Any architectural treatment options must be sympathetic to the character, style and heritage value of the building.

A qualified heritage architect, Kerime Danis of City Plan Heritage, was engaged to recommend potential architectural treatments for the three additional buildings. Appropriate architectural noise environmental management measures for heritage listed buildings will be developed based on these recommendations and in agreement with property owners. In summary, the report advised that two types of noise mitigation measures for buildings as significant as the three subject items. The first is custom made individual glazed timber framed panels. These types of frames would create an air cavity sealed and fitted to reduce noise and will not damage existing original glazing panels.[2] The second type that has been suggested in magnetic double glazing systems that require suitability assessments prior to installation.[3]

The treatments will be installed by qualified professionals. The assessment of appropriate architectural treatments included in the Submissions Report.

[2] City Plan Heritage March 2013: 15.
[3] City Plan Heritage March 2013: 15.

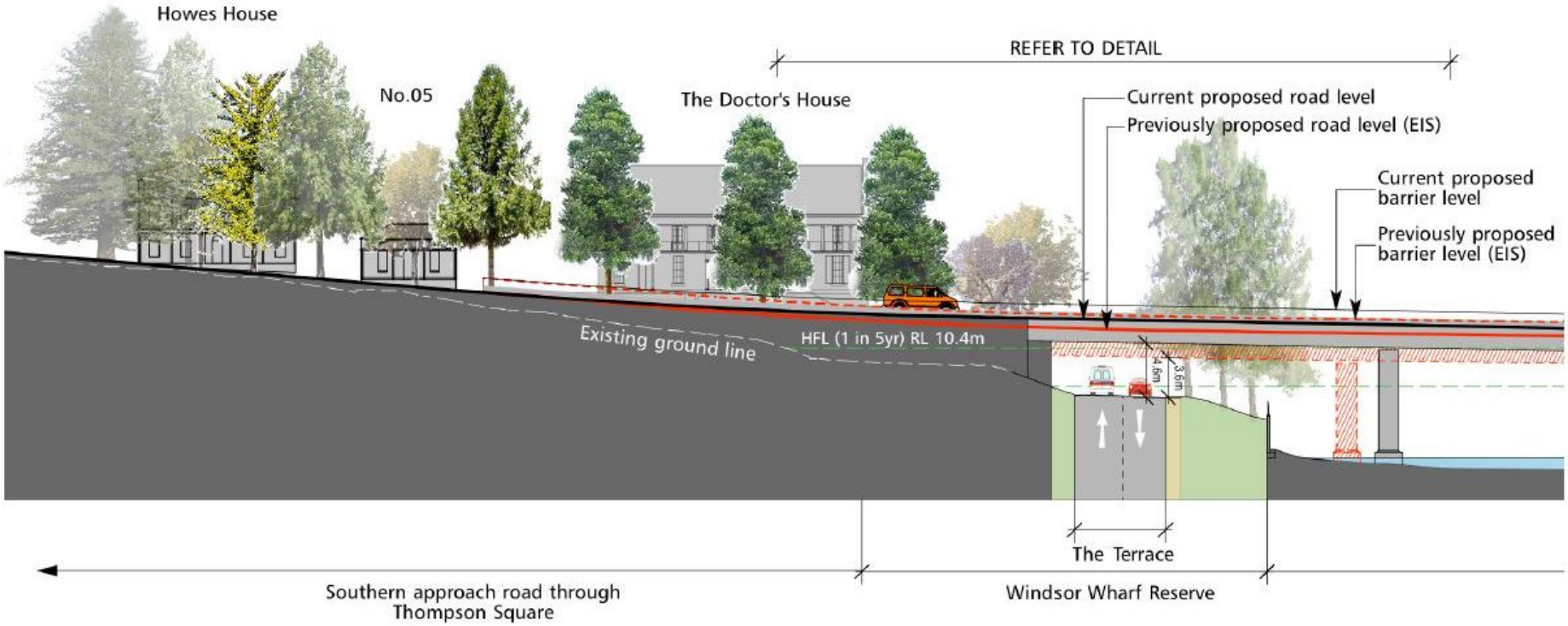

Plate 1: Longitudinal section of the proposed changes to the replacement bridge deck height (and barriers) and the proposed new location of the piers (in grey). View north- west from the Windsor bank. Source: Spackman Mossop and Michaels.

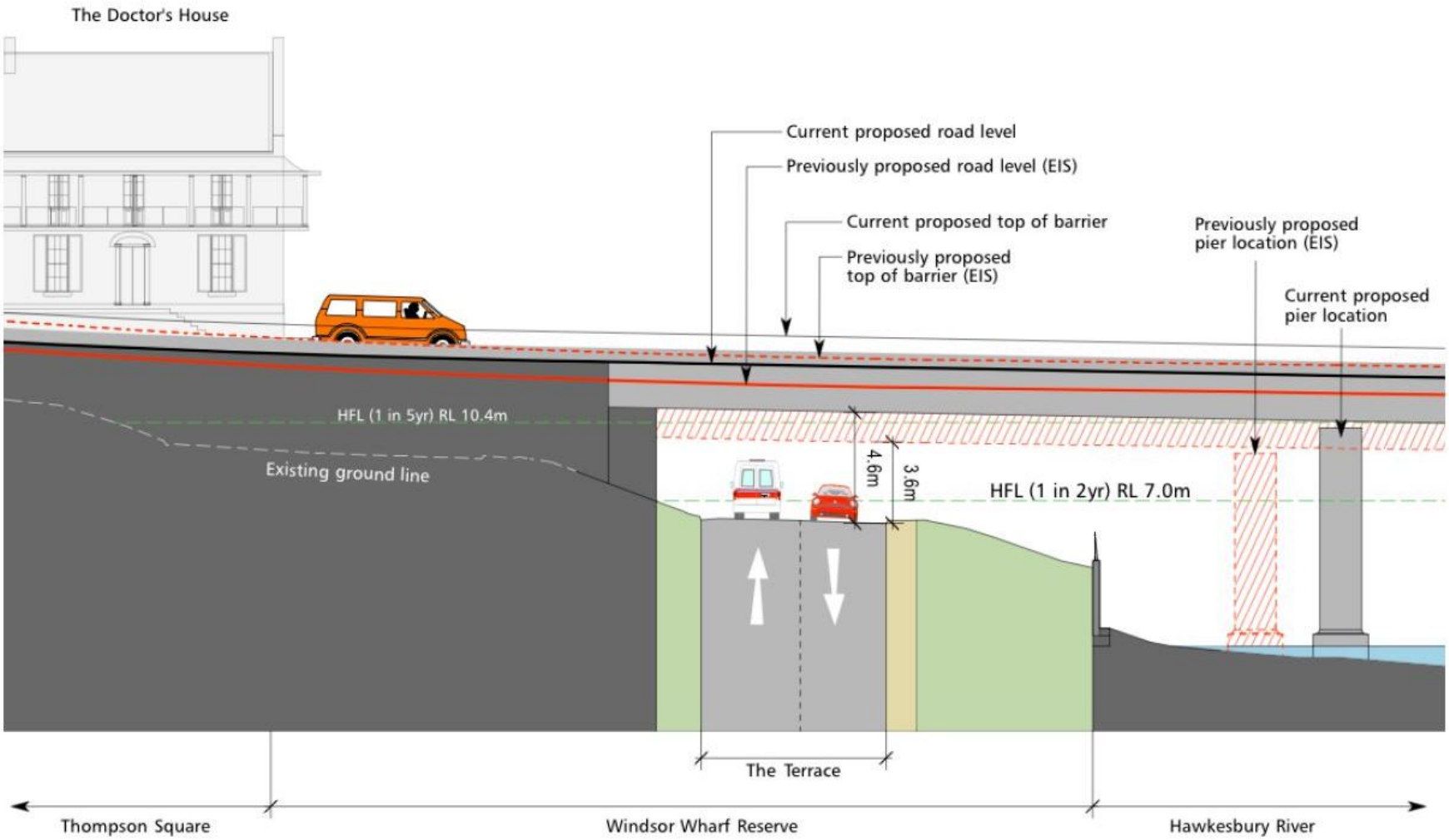

Plate 2: Detail of the longitudinal section illustrating the proposed changes. Note that trees are not shown in this diagram. Source: Spackman Mossop and Michaels.

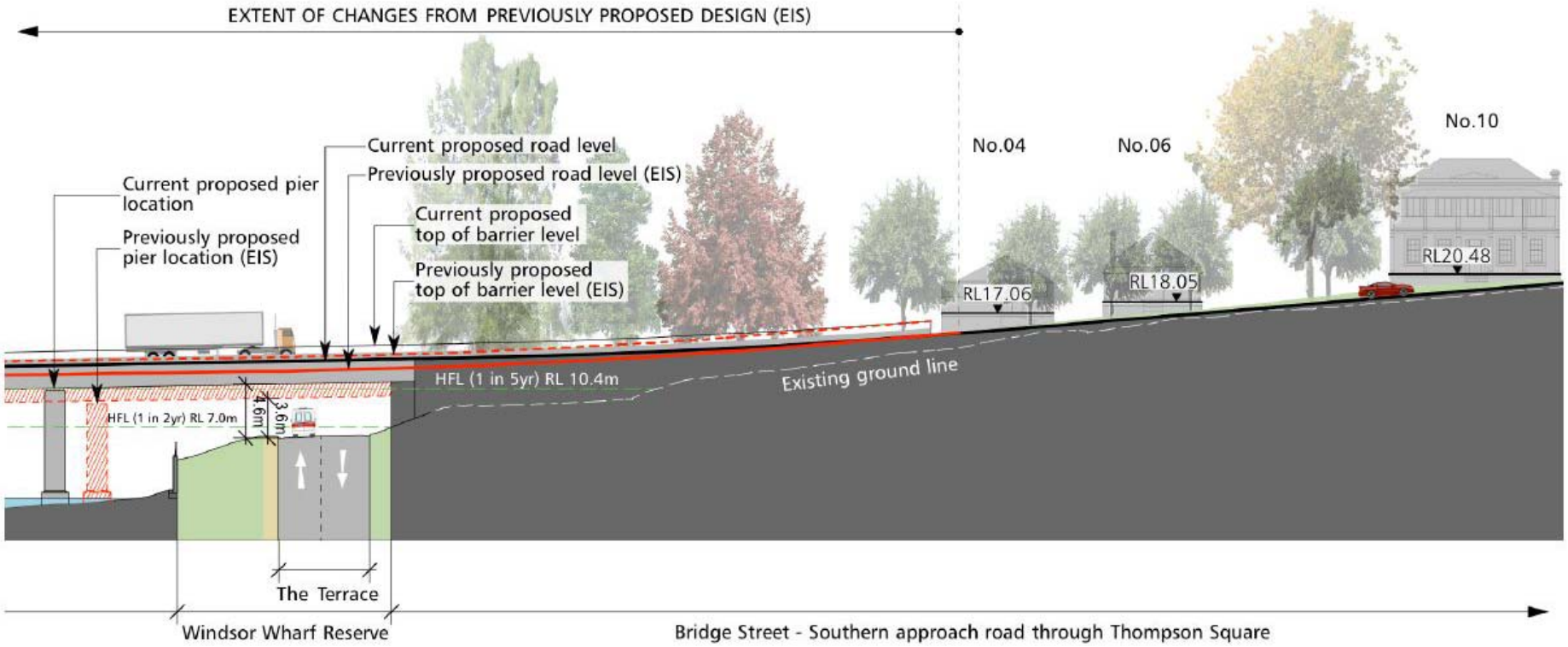

Plate 3: Longitudinal view to the east from Thompson Square of the proposed changes. Source: Spackman Mossop and Michaels.

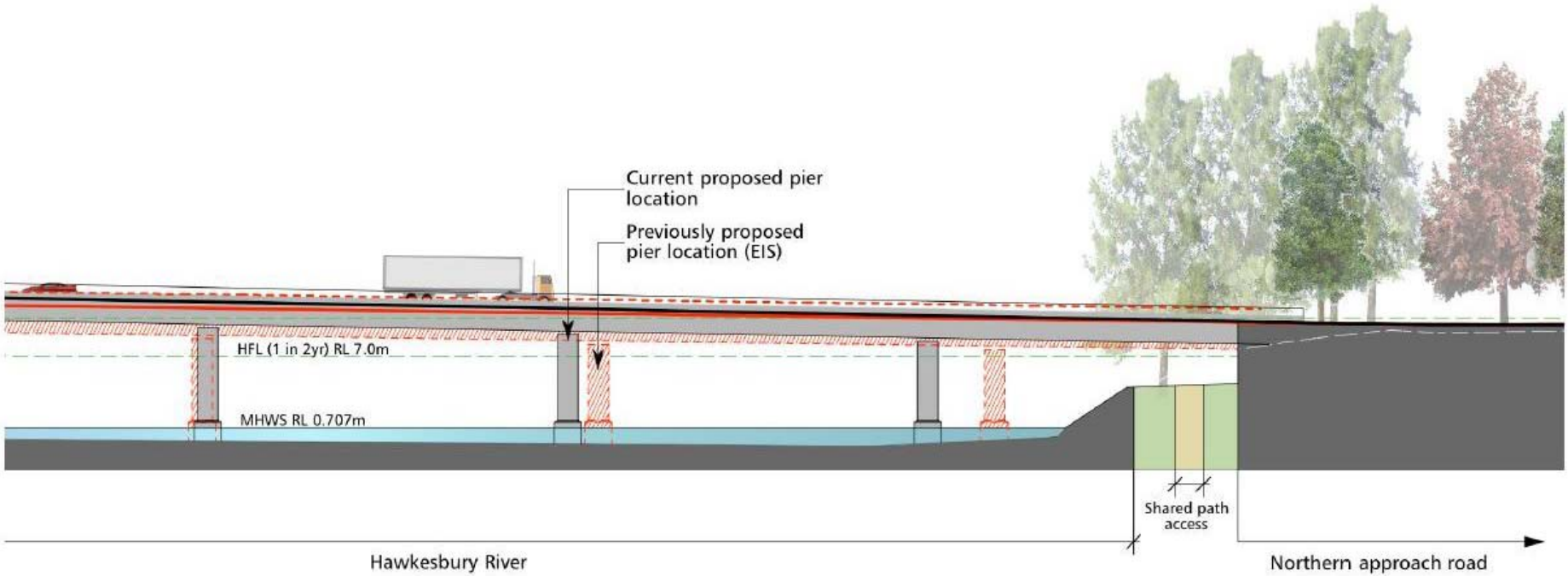

Plate 4: Longitudinal section of the replacement bridge showing the elements that have been redesigned. The level of the replacement bridge and barriers is minor on this side of the bridge. The amended locations of the proposed piers are shown in grey.

2.3 Description of the Urban Design and Landscape Concept

2.3.1 Landscaping the parkland areas

The concept design envisages the two parkland areas joined to form one cohesive space by relocating the current bridge access road and infilling the alignment as part of the landscaping for the project. In order for this to be achieved the road pavement would be milled to create traction and erosion barriers that would be covered by the infill material. The purpose of the erosion barriers is to halt slippage of the fill.

The assessment of heritage impacts associated with landscaping of the parkland areas is general in nature. An urban design and landscaping concept (UDLC) design prepared by Spackman Mossop and Michaels (Nov 2012) provides visual examples of possible finishes and is intended to illustrate the potential for landscaping the public spaces at the completion of the project. The final elevation of the fill and its treatment as part of the consolidated park has not yet been decided but it will have had an appropriate level of consultation with the relevant authorities (refer to Section 11.8.5 Heritage Working Paper).

The example used is of terracing at Bradley's Head (Mosman) NSW. However, it is unlikely that terracing will be incorporated into the final urban design and landscape plan. The parkland is proposed to be graded down from the upper parkland area to the foreshore, consistent with the changing height of the proposed stairs to the bridge.

2.3.2 Lighting

The proposed approach road, replacement bridge and shared path will require lighting in accordance with relevant road safety standards (AS: 1158). The project has not progressed to a stage where the bridge design has been finalised but it is acknowledged that the outcome of the detail design must continue to respond to the heritage sensitivity of the project area. The new light sources would be designed to strike a balance between illumination for safety and the historic context of the parkland and its adjoining areas. It is proposed to achieve this by using specialist light diffusers such as "aeroscreen", which are designed to reduce glare.

2.4 SoHI

2.4.1 Identification of impacts

All heritage impacts resulting from the Project are discussed in the heritage working paper and the EIS (November 2012). The discussion in this section is in terms of a comparison of the current design with the design exhibited for the EIS.

Impacts associated with the design change would be visual impacts associated with operation of the replacement bridge. They are:

- The visual impact of the project and its constituent elements including:
  - The proposed southern approach to the replacement bridge as a new element
  - The height of the southern approach
  - Compression of the archaeological resource by plant and stockpiles

The design changes assessed in this report include two elements; they are bridge deck height and the re-location of the bridge piers.

The location of impacts within the riverbed has also changed with the re-positioning of piers; however, the statement of heritage impact for maritime archaeological resources (Cosmos Archaeology 2012), assessed the corridor within the river. The assessment found that impacts to significant heritage would be anticipated with the original location of Pier 1. With its re-location two metres to the north of the original position, impacts to the wharf remnant

from the placement of Pier 1 have been removed, although scour protection on the southern bank will remove this relic.

2.4.2 Bridge Deck Height

The height of the current design rises incrementally gradually starting at the driveway of 4 Bridge Street, and reaching a maximum height of 1 metre higher over The Terrace than the exhibited design. Once over The Terrace, the deck height gradually slopes down to meet the exhibited deck height between Pier 3 and Pier 4.

The previously unassessed impacts associated with this particular design change are solely visual.

2.4.3 Replacement Bridge Piers

Physical impacts on the shore are generally unchanged. The position of the proposed piers have been moved with the most substantial changed being that Pier 1 has moved 2 metres to the north. Impacts to potential maritime archaeological resources along the entire corridor of the replacement bridge were assessed in the maritime heritage report (Cosmos Archaeology November 2012). Substantial physical impacts to the river bed are anticipated; maritime relics will be managed through an archaeological salvage program, therefore further assessment of the changed location of Pier 1 has not been undertaken in this report.

2.4.4 Soil Compression and Archaeological Sites

Section 2.4.4 was prepared by Denis Gojak (RMS) and reviewed by Gary Vines and Pamela Kottaras (Biosis). Additional text was added by Gary Vines and Pamela Kottaras

Compression of soil through work activities has been proposed as a potential threat to archaeological deposits and particularly to artefacts. Possible risks arising from the use of heavy machinery, placement of stockpiles or other load pressures on land surfaces could potentially include the compression of soils, the deformation of strata, the movement of artefacts between depositional layers, and potentially artefact breakage.[4]

A review of international literature on the subject plus RMS sponsored test excavation however suggests that such effects are limited in extent. In the context of an actively used urban environment that has been a major movement corridor for more than two centuries, and has been subject to major landscape modifications, the impacts from soil compression are likely to be relatively minor contributors to disturbance.

The key result of examinations of the effects of loading on archaeological sites is that compression will occur, and artefacts within the matrix will tend to move down with the deposits as they are compacted.[5] However, this mechanism does not result in them moving differentially to surrounding sediment, regardless of particle size, meaning they normally do not relocate from one stratigraphic unit to another. The one clear exception to this is that artefacts will tend through time to achieve a horizontal position within the deposit, regardless of their initial orientation.[6]

Some risk of displacement has also been suggested where layers with very different characteristics overlie each other, and where the archaeological item, in this case structural timber, had sufficient inertia to withstand movement.[7] Site processes that are known to relocate artefacts between deposits include bioturbation such as plant roots, from small shrubs to tree-size, plant clearance through grubbing out or tree-throws and faunal disturbance by burrowing animals, for instance worms, cicadas, reptiles, small mammals.[8] The impacts of flooding on Aboriginal deposits and potentially many post-European settlement deposits are also likely to have resulted in disturbance of the relationship between

[4] For example Wood and Johnson 1978; Wildesen 1982; Schiffer 1987.
[5] Nickens 1999; Andrews 2006
[6] Andrews 2006.
[7] Huisman 2012.
[8] For example Darwin 1882; Morin 2006.

artefacts and the deposits in which they were originally buried.[9] Trampling and surface movement also contribute to mixing artefacts and strata, although mainly in looser deposits.[10]

Soil deposits compress primarily by reducing the volume of air cavities and voids within the sediment. Direct pressure will lower soil by compressing the sediment, which will contain less air. In an experiment aimed at determining effectiveness of 'hardstand' surfaces a site was prepared with a barrier material, 10 cm of sand and then clay and gravel, all sealed by bitumen. The effects of this covering, once removed were to note that compression of the upper deposit was clearly evident. This resulted in denser, more compact deposit. No impact was observed on artefacts or the soil morphology. The research suggested that the main impact would be following the removal of hardstand, where the compacted surface would shed rather than absorb rainfall, and be slow to return to normal structure.[11]

While the study above did not observe any impacts on artefact materials, other studies have observed potential breakages for different materials at a range of ground pressures from moving machines, although the use of hard-stand covering significantly reduced the eventual ground pressure. Ardito stresses the need to have sufficient coverage to ensure the dispersal of pressure over a wide area.[12]

Another important consideration is the depth of the archaeological resource where it is not covered by hardstand or where the hardstand has failed; ground surfaces will become heavily disturbed. Tracked vehicles and tight manoeuvring can also damage sub-surface deposits and accelerate erosion.

Heavy machinery will also be required for the archaeological excavation program. In this instance, care will need to be taken with movement on uneven surfaces such as in the lower reserve. An archaeologist will be monitoring the bucket scrapes and the effect the machinery has on the ground surface during the archaeological work. Heavy machinery is regularly used on archaeological sites beyond the depth of paving and road base without noticeable compressive impacts prior to the removal of deposits and artefacts. If disturbance to the ground occurs through the movement of machine wheels/tracks or due to muddy ground, the ground will require preparation to distribute the load. Material such as timber slats or steel plates may need to be laid down for the machine or work may need to be re-located to a less vulnerable area of the site until a solution is found or the ground dries.

Substantial portions of the Windsor Bridge Replacement construction area consist of paved roadways or car parking. These are also likely to have borne the brunt of much previous heavy machinery movement, and should be considered as offering the best locations where loads can be carried on the site, whether static such as stockpiles or vehicles. Recommendations to reduce the risk of compression impacts to the archaeological resource prior to its archaeological excavation or to resources that are not proposed for removal, refer to Section 3 of this report.

2.4.5 Consolidation of the two parkland areas

The impact of re-joining the two parkland areas on the familiar character of Thompson Square as it exists today is included in the Heritage Working Paper and is expanded upon here. Either retaining the current configuration or consolidating the two separate parks can be argued on heritage grounds with each presenting its own positive and negative heritage impacts.

The *ad hoc* development of Thompson Square has resulted in its current informal character. Additions such as picnic tables and the Pioneer's Memorial in the upper parkland area and the yacht club (now removed) in the lower parkland area, which also now includes picnic tables and the lower car park, are all superficial changes to the historic entity. Mature trees in both parks are a mixture of deliberate plantings and self-seeded individuals.

[9] Hofman 1986; Petraglia and Nash 1987
[10] Gifford-Gonzalez et al 1985
[11] Player and Kelleher 2012
[12] Ardito 1994; Dain-Owens et al 2012; McBride and Mercer 2012

The single-most, recent substantial impact to the historic character of Thompson Square was the excavation, in 1934, of Bridge Street from George Street to the existing bridge, the approach road. When initially constructed, the current approach road to the existing bridge was excavated through the historic landscape of Thompson Square and what was once the Green Hills public space. Although carefully constructed for practical purposes, the approach road is another element of the *ad hoc* nature of the development of the modern Thompson Square. It is also an integral part of the development of the modern Thompson Square. Constructed in 1934 during the Great Depression, it is very possible that the program was unemployment relief aimed at replacing the existing winding access to the bridge. The increase in motor vehicle use, the development in motor vehicle technology and greater settlement west of the Hawkesbury River demanded a safer and more efficient approach road to the bridge. It is an important part of the story of Windsor and the Hawkesbury.

Construction of the current alignment to the bridge was a substantial change to the square. It divided the open park into two smaller areas and removed a large area of usable land. The road separates one side of the conservation area from the other. There is no evidence to suggest that, when the road was being built, attention was paid to the detrimental impact that the construction of the road would have had on the archaeological resources, or on the character of square as one open space.

The approach road carries heavy, loud traffic that disrupts the historical connection between the two parkland areas when viewed from certain locations. It creates a physical barrier between the upper and lower parklands and restricts pedestrian access from one to the other as crossing the approach road can be dangerous. As a result, the lower parkland area is less used than the upper parkland area due to its poor accessibility. It was also noted during community consultation that the traffic noise can be distressing and interferes with the quiet enjoyment of both parks.

The dominant heritage impacts of infilling the current bridge approach that cuts through the historical entity of Thompson Square would be that evidence of a significant event will be obscured. The road cutting is part of the events that formed Thompson Square as it is today. A positive aspect of infilling the existing cutting would be that the potential to reconnect the two grassed spaces could provide a platform for clearer interpretation of phases of Thompson Square that are more significant that the creation of the road in 1934.

2.4.6 Parkland landscaping

This section further considers the concept landscape design of the consolidated park in the context of what could be considered an informal character of the existing parkland.

Through time there has been a fluctuating level of formality within the park, expressed by deliberately planted trees, provision of fencing on all road boundaries, declaration of status as a ‘square’ within the townscape, uses such as picnics, The concept design in the UDLC Working Paper is not "formal" in the sense that Hyde Park, for instance, demonstrates a formal landscape scheme, although it is less *ad hoc* than the development of the square that exists now. A final design for the space will be the subject a subsequent process involving extensive consultation between Hawkesbury Council, the Heritage Council and the Department of Planning and Infrastructure.

There is potential for landscaping within the two parkland areas to impact on significant archaeological resources; this issue is discussed in detail in the Archaeology Options Report (Biosis and CRM Feb 2013).

The lower parkland area would be negatively impacted to a large degree through the construction of the proposed approach road. A small portion of the western side of the lower park is also likely to be impacted by heavy machinery/plant during the construction excavation process.

Improving access to The Terrace will require modification of the existing park surface levels. It may require removal of deposit. As a general principle, all design options that do not result in impact to archaeologically sensitive areas should be thoroughly investigated first. How this will be achieved is yet to be determined and will necessarily be the topic of a detailed statement of heritage impact.

2.4.7 Consideration of the visual impacts to heritage items from the proposed lighting on the bridge

The detailed design of the all project elements has not been finalised thus it is difficult to assess the impact of lighting furniture and light spill. Light standards on the bridge approaches will be relocated so there is likely to be a change. New lighting technology has the potential to meet required levels of safe lighting without additional light spill for residents and, as discussed above, will be required to meet to strike a balance between illumination for safety and the context of the parkland and its adjoining areas. As discussed, RMS is also proposing specialist light diffusers such as “aeroscreen” which reduce glare. Both the lighting furniture and levels of change to existing conditions will require assessment during the design phase and prior to the design's finalisation.

2.4.8 SoHI Questions

Questions relevant to the project have been applied to the modified bridge design. Relevant questions are as follow:

- *Will the additions tend to visually dominate the heritage item?*
- *Are the additions sited on any known, or potentially significant archaeological deposits? If so, have alternative positions for the additions been considered?*
- *How has the impact of the new work on the heritage significance of the existing landscape been minimised?*
- *How does the work impact on views to, and from, adjacent heritage items?*
- *What are the potential effects of heavy machinery of an archaeological site?*

2.5 Alternative to the Current Bridge Design

2.5.1 Southern Bridge Abutment

Construction of the replacement bridge has been assessed to have major, moderate and minor impacts to heritage resources within the Project Area. Impacts would be most noticeable in Thompson Square in Windsor and would include the removal of significant archaeological evidence, disruption to significant views and vistas, and the current setting of Thompson Square, as well as a cultural landscape that has evolved gradually since Green Hills was established.

The design process has considered the issues surrounding construction of the bridge abutment in Thompson Square. Two types of construction were considered and the decision to build a land bridge over piers was made because of the archaeological implications and consequent remediation works that would be required.

In considering the issues, including heritage, surrounding construction of the southern bridge abutment, the design team prepared two construction methods:

1. A land bridge comprising piers at 8 metre centres inserted into the ground around the perimeter of the wall; then from that, building a bridge structure over the void;
2. A concrete abutment comprising of two "L-shaped" walls facing inwards, then infilling with material upon which the road is built.

The finished appearance of the two options would be similar. The L-Shaped retaining wall has a lower initial construction cost and ongoing routine maintenance cost and will require less maintenance intervention after a large flood event when the structure becomes partially or fully submerged in the flood waters. The land bridge was proposed as alternative to the L-shape wall option due to the potential to minimise the excavation in Thompson Square. The extent of this advantage is dependent on the extent of archaeological excavation required to clear the site for the piling. The land bridge also has some construction program advantages and avoids the need for the engineered backfill material to be brought to site and be compacted between the walls.

The implication of impact to archaeological resources influenced the decision to choose the "L-shaped wall design. These two options are discussed in more detail in the *Windsor Bridge*

Replacement Project Archaeological Options Paper (Biosis and Cultural Resources Management, 2013) which is appended. In summary, two options were considered: a land bridge that comprises piers and solid cast in situ walls with infill. The additional excavation, vibration and movement of machinery required for each construction option was included in the considerations by RMS.

The conclusion of the SoHI with respect to the assessed impact to the archaeological resource was that it is complex but fragmented and would require an open area archaeological excavation to collect meaningful data and adequately address research questions.

Constructing the southern approach using the land bridge option with the piled foundations would avoid disturbing/excavating the area between the walls, but would impact relics to a high degree where the piles would be built without the opportunity for archaeological data extraction, further fragmenting, isolating and destroying it permanently. For health and safety as well as logistical reasons it is not feasible to undertake localised archaeological excavation at each of the pile locations. Excavation at this depth would require substantial stepped benching around each pier location, resulting in a larger excavation footprint that would negate any advantage that this approach had to localising impact;

The land bridge option is only commercially viable if the extent of archaeological excavation could have been limited to shallow localised excavation. As a result of the high degree of impact from the proposed archaeological excavation program for both options, the L-shaped wall option was adopted for the abutment.

The L-shaped wall would be constructed in the following sequence: open area archaeological excavation, protection and stabilisation of any archaeological material to remain in situ (either for permanent conservation or for later recovery), further mechanical excavation to bedrock, levelling with approximately 50 mm of concrete base. The L-shaped wall footings would be cast, followed by the walls themselves. The area between the walls would then be backfilled and the pavement built. Both options would result in the removal of archaeological resources in the immediate area; these options and their implications are discussed in more detail in the Archaeological Options Report (Biosis and Cultural Resources Management).

2.5.2 Change in Bridge Height

With respect to the change in bridge deck level, alternatives considered to increase the clearance over The Terrace other than raising the height of the bridge included lowering the road along The Terrace. This was investigated but was not favoured due to:

- The presence of services in the area that would require relocation;
- The requirement to extend road modifications into the upper car park at Windsor Wharf to provide a road grade suitable for buses and other vehicles.

To provide additional clearance over The Terrace, the height of the southern end of the replacement bridge will be increased. This will result in a marginal increase in road deck height of the southern approach road through a small section of Thompson Square; however for the majority of the southern approach road through Thompson Square (that is, south of the driveway of No. 4 Bridge Street), the vertical alignment and height of the road would remain unchanged from that presented in the EIS (refer to Plate 1 of this document). Visually, the scale of change in the overall form of the bridge will not be noticeable.

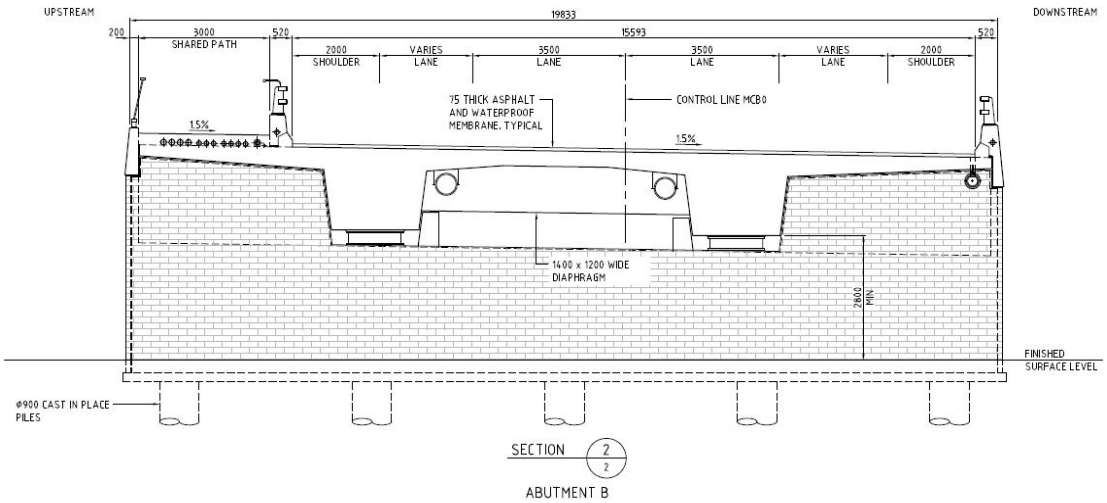

Plate 5: Cross section of the replacement bridge in Thompson Square with the Land Bridge option showing the piles across the structure. An additional six piles along each side also formed part of this design. Source: SKM Plan DS2012/000155 Sheet 3.

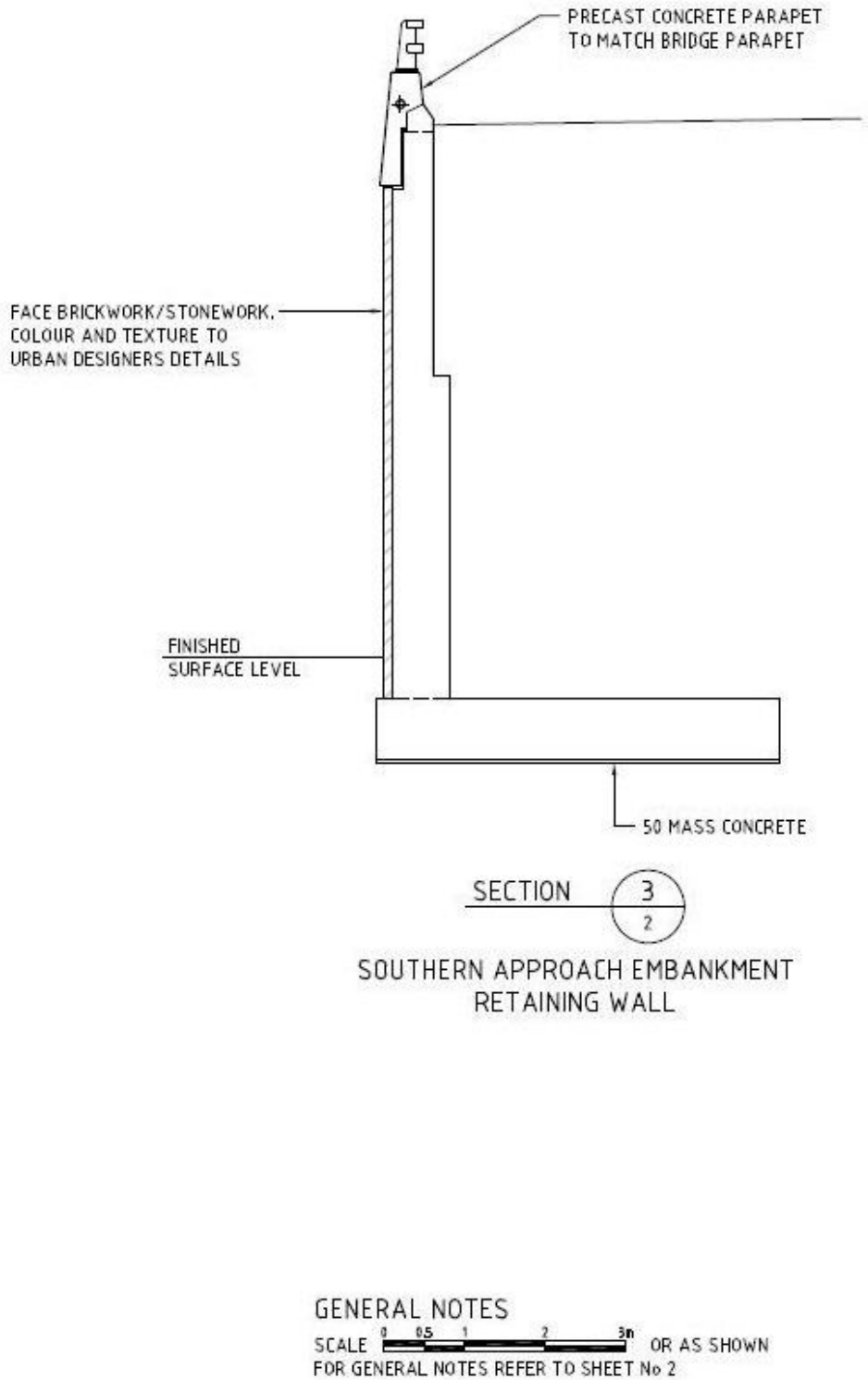

Plate 6: Diagram of one side of the L-shaped retaining walls proposed for the bridge abutments in Thompson Square. This design will be constructed if the project is approved. Source SKM Plan DS2012/000155 Sheet 3.

2.6 Impacts of the design-change on Thompson Square, Bridge Street and The Terrace

2.6.1 Setting and Views

The location and horizontal alignment of the proposed replacement bridge remains the same as described in the EIS and Working Paper 1.

However, the level of the bridge deck would increase by one metre over The Terrace. The level of the approach road would rise gradually from the northern side of the driveway at 4 Bridge Street until a high point at the southern bridge abutment and over The Terrace, after which the level drops again gradually until it reaches the same design level as described in the EIS and Working Paper at a location between Pier 3 and Pier 4.

The effect of proposed design change when compared to the exhibited design is to gently continue the fall from the approach as it travels across the river but with a maximum height increase of one metre for part of the alignment.

The difference between the exhibited bridge design and the modified bridge design is minimal with respect to the overall impact to the existing cultural landscape, archaeological resources and views, vistas and setting. Some advantages are gained with the new design with the placement of Pier 1 approximately 2 metres from the bank allowing views from The Terrace that are slightly more open than those shown in the exhibited design. However, the overall visual impact of the modified replacement bridge design remains substantial.

A visual assessment from an urban design perspective has been undertaken by Spackman Mossop + Michaels (February 2013).

2.6.2 Physical impacts

The physical impacts associated with the modified replacement bridge design that were identified in Working Paper 1 are unchanged. The increase in bridge deck level would not introduce any new physical impacts to the Project Area.

On the western side of the southern approach road, the height of the road (and therefore the retaining wall to the parkland) would be about 3.5 m from 2.5 metres at its highest level. This increase in height is not considered to be any more noticeable that the original height of the proposed retaining wall.

During the design development process, the vertical alignment was lowered along the southern approach to the bridge. The height of the bridge was also lowered to match the level of flood immunity of the northern side. While the proposed design change will increase the vertical alignment by up to one metre above The Terrace, the bridge will decrease in height from there until it reaches its original design level between Piers 3 and 4 approximately halfway across the bridge.

The benefits that were achieved by minimising the height of the bridge deck slightly reduced. The visual impact of the replacement bridge remains substantial and in combination with the other elements of the Project, the overall assessment remains the same.

Table 1: Impact minimisation measure undertaken through the iterative design process

Project Element	Impact Minimisation Measures Through Iterative Design	SoHI After Minimisation Measures
Raising the height of the replacement bridge deck from 3.6 metres to 4.6 metres	The benefits achieved by lowering the height of the bridge and approach roads during design development have been slightly reduced by the increase in bridge clearance over The Terrace. The design development process aims to design a structure that conforms to safety standards, while achieving overall the highest engineering and aesthetic standards. The increase in proposed bridge deck height has allowed the opportunity to re-locate the bridge piers away from the Windsor bank. This will modify the viewing experience from The Terrace by opening up those views to some degree and making opportunities for a land-river connection. The design of the piers will remain curved, giving them a more refined appearance than piers with straight edges. The design of the replacement bridge has considered the heritage sensitivity of the surrounding cultural landscape. An incrementally launched bridge has been selected to achieve: • Pier design that would be curved, giving them a more refined appearance than piers with straight edges. • A 50 km/hr speed limit on the approach roads and replacement bridge, which has also enabled the design of a lower approach roads and replacement bridge and a lower southern approach road.	The impact of the replacement bridge to the existing significant cultural landscape is anticipated to be high. Physical impacts associated with the construction of the replacement bridge are anticipated to be very high. The choice of an incrementally launched bridge and lowering of the design speed limit would be a visual and physical improvement compared to a plank bridge, which would necessarily be higher and less aesthetically refined.
Thompson Square The existing character of Thompson Square will be affected by the introduction of the southern approach road affecting archaeological resources and the setting.	The height of the southern approach road was lowered by between 1 to 2 metres (in the exhibited design it was 2 – 3 metres lower) through the reduced design speed in the exhibited project design. Responses to the project design have initiated a re-design of a section of the replacement bridge to increase clearance on The Terrace. The justification for increased clearance is to allow coaches and garbage trucks to reach the Windsor Wharf for access to the Windsor paddle steamer once access down Bridge Street ceases.	The visual impact of the project on Thompson Square is anticipated to be very high. The physical impact on relics within Thompson Square is anticipated to be very high. The predicted impact of the southern approach road would

Project Element	Impact Minimisation Measures Through Iterative Design	SoHI After Minimisation Measures
	For most of the alignment, the southern approach road remains level with the pedestrian path adjacent. The increase in road level commences gradually from the driveway of 4 Bridge Street and reaches the maximum height increase of one additional metre over The Terrace. The predicted views directly across Thompson Square and the overall impact of the replacement bridge, associated with the demolition of the existing bridge, will change negligibly from the exhibited design.	be high; however, it has been reduced by the lowering of the level by approximately 1 - 2 metres (one metre higher above The Terrace than the exhibited design. This modification is an improvement on the original road design, which would have obscured views across Thompson Square significantly more.

Table 2: Inadvertent impacts to relics through compression by plant and stockpiles

Project Element	Impacts	SoHI After Minimisation Measures
Plant and stockpiles	Impacts to the archaeological resource are a risk during site preparation and construction. Vehicles with tracks on unprotected ground will churn the topsoil and will have a detrimental effect on archaeological deposits, with an even greater effect on archaeological fabric such as the Macquarie-era drain. The effects on the archaeological resource beneath existing hardstand are predicted to be minimal as paved areas within the project boundary are underlain by road base, which distributes the loads above. Archaeological resources have survived in good condition beneath existing roads as demonstrated by the test excavations for the project. As comprehensive test excavation has not been undertaken in parkland areas where the deposit is not protected by paving, it must be assumed that stockpiles and plant will damage the ground surface. The known impact to the archaeological resource will be archaeological excavation that will be conducted in compliance with project conditions.	The risk of inadvertent impacts to the archaeological resource will be reduced by implementing the management measures in Section 3. Ensuring that stockpiles and heavy plant utilise hardstand areas, and the only heavy machinery to utilise unpaved areas will be those that are part of the archaeological excavation should ensure that impacts to the archaeological resource, that are not part of the approved excavation program, will be minimised.

2.7 Impacts of a proposed landscape design

The project would have a significant detrimental impact on the physical, aesthetic and archaeological values of Thompson Square and thus on the significance of the square. The landscape design needs to be considered within this context.

Within the context of the approved project however, the most noticeable impact of the proposed landscape design will be the consolidation of the two parkland areas. The existing 1934 approach road would be obscured by traffic being relocated and the cutting being infilled. The form of the remaining segment of the lower parkland area would need to be shaped so that it would be incorporated into the landscape of the proposed park.

Consolidation of the two park areas would be achieved by infilling the existing approach road by milling the pavement and installing erosion barriers by placing them within small excavations within the road base. The footings of the erosion barriers would be between 300 and 400 mm deep and therefore it is not anticipated that they would exceed the depth of the of the existing road base.

The infilled road will be shaped to connect the currently separated parkland areas with each other and is considered to be a minor negative impact to the significance of Thompson Square as it will remove an element that provides another layer of the development of the square as well of the development of the region. The greater impact of infilling the existing cutting, will however, be positive as it will remove what has been and still is, considered to be an intrusive element to the historic character of Thompson Square, which has managed to retain its legible connection to the early history of Windsor.

Other potential negative impacts associated with the UDLC design are limited to the effects of new plantings on the archaeological resource but these are not considered to be major impacts..

The two key impacts to Thompson Square will result from consolidating and landscaping the surviving parkland area. The project will impact on the archaeological resources within the lower parkland area and the south east corner of the upper parkland area. Subsequent landscaping is also likely to impact on archaeological resources to a lesser degree.

The approach to managing the loss of archaeological information is detailed in a separate document.[13] Three options for archaeological excavation have been discussed, which outlines the advantages and disadvantages of archaeological programs that propose varying degrees of archaeological intervention. RMS is awaiting comment from the Heritage Branch and DP&I on the preferred archaeological option; however Option 3 is not proposed by RMS.[14]

Firstly consolidation has the very real potential of completely obscuring the 1934 approach road, which in itself is a problematic "heritage item". The road is an element of the modern Thompson Square[15] and is recognised as having an adverse impact on the historical integrity of Thompson Square, which *is spoilt by a main road which slices diagonally through it and into a cutting, destroying the visual integrity of the space as was originally intended.*[16] Conversely it represents another stage in reconfiguring access to the bridge to account for different types of vehicles. It may[17] demonstrate the government's intervention in reducing or poverty by providing employment during the Great Depression. The road is also an intrusive element into Thompson Square.

The 1934 bridge approach is undoubtedly part of the historical story, but it is also an intrusive element within the square that has managed to retain elements of the "Macquarie-era character". Infilling may be achieved without obliterating the alignment, and it could be interpreted by incorporating its location into the landform of the final design.

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[14] EIS, Section 3.2.
[15] Although not of the Thompson Square Conservation Area as defined by the SHR.
[16] David Sheedy, 1975 in SHR listing 00126.
[17] "May" because although a substantial amount of time was spent reviewing the annual reports of the Public Works Department, no entries about this road being unemployment relief were found.

Any landscaping design should firstly consider arrangements that do not result in impacts to archaeologically sensitive areas.

2.8 Impacts of the proposed lighting on the approach road

As discussed, the final design of the approach road elements, including lighting, has not been determined. In general however, existing upright light poles would be removed from the current road and change the appearance of lit area on the approaches. Lights on the replacement bridge will be higher and more visible than those on the current bridge. As discussed above, specialist lighting would be proposed which minimises glare and light spill while meeting the relevant Australian standard.

Light spill can also be controlled and directed away from or towards heritage items while lighting furniture may be obscured by plantings as they mature to the extent that they meet minimum safety and functionality requirements. These aspects would be subject to further detailed discussion and consultation with the relevant stakeholders when the details are being formed.

Table 3 is a summary of the impacts arising from a future landscape design in Thompson Square.

Table 3: Impacts of future landscaping and lighting

Project Element	Identified impacts	Magnitude of negative heritage impacts
Future landscaping	Alteration of the current topography of the two parkland areas.	Major (lower park) Minor (upper park)
	Obscuring the 1934 alignment from George Street to the existing bridge.	Moderate to minor
	Consolidating the upper and lower parks.	Moderate
	Removal of archaeological resources.	Major
Lighting furniture	The presence of upright lamp posts on the view lines across the park and in front of heritage items. Lighting fixtures within the road and footpaths or pedestrian barriers would remove the need to light poles.	Minor to none

2.9 Summary Assessment of Heritage Impact

2.9.1 Introduction

The summary assessment of heritage impacts in this section is a response to the modified replacement bridge design and an assessment of effects of compression on archaeological resources. For the summary assessment of all other aspects of the Project on historic period cultural heritage, reference should be made to the heritage working paper and the EIS.

2.9.2 Major Negative Impacts

(*Affects fabric or values of State significance*)

- Impacts to the significant historical view from the northern bank from Bridgeview
- The re-location of the piers from the banks of Thompson Square will remove them from the immediate location of the early wharf; however other project-associated works are likely to impact on the archaeological site

- Impact to archaeological resources surviving in and around the lower reserve
- Impact to archaeological resources surviving in the George and Bridge Street intersection
- Inadvertent impacts to the archaeological resource through compression and ground damage by plant and stockpiles
- Impacts to the cultural landscape through:
    - Substantial modification to the setting of Thompson Square as well as significant views and vistas to and from it
    - Visual intrusion of the replacement bridge and roads into the historic landscape, increased with the increase in replacement bridge deck height

2.9.3 Moderate Negative Impacts

(*Irreversible loss of fabric or values of local significance*)

- Views and vistas to Bridgeview
- Change to the current layout of Thompson Square, which is identified by many in the Windsor community as an authentic representation of historical Windsor.

2.9.4 Minor Negative Impacts

(*Reversible loss of local significance or fabric where mitigation retrieves some value of significance; loss of fabric not of significance but which contributes to local significance values*)

- Lighting furniture on the proposed approach road and replacement bridge
- New tree plantings on the archaeological resource
- Impact to archaeological resources in the south east corner of the upper reserve

2.9.5 Negligible or Neutral Impacts

(*Does not affect heritage values either negatively or positively*)

- Slightly opens up views beneath the bridge from The Terrace.

2.9.6 Minor Positive Impacts

(*Enhances access to, understanding or conservation of fabric or values of local significance*)

- None

2.9.7 Moderate Positive Impacts

(*Enhances access to, understanding or conservation of fabric or values of State significance*)

- None.

2.9.8 Residual Impacts

(Impacts that cannot be mitigated against or ameliorated through avoidance, design changes or alternative methods prior to development approval)

- Physical modification of the current cultural landscape - replacement of the existing bridge with another larger bridge in a different position
- Visual impacts of the project within the current cultural landscape - presence of a larger bridge, new bridge in an old setting, larger footprint for traffic on northern side

2.10 Statement of heritage impact

SoHI for design changes since exhibition of the EIS

The overall statement of heritage impact related to the increase in bridge height remains unchanged from the original heritage working paper.

The modified design of the replacement bridge over the Hawkesbury River at Windsor diverges from the exhibited design in that it incorporates an increase in deck height of 1 metre starting in the location in line with The Terrace to approximately the location of Pier 1. The rise from the driveway of 4 Bridge Street to Pier 1 is gradual as is the fall to the north. The difference in height and therefore the heritage impact of the modification is considered to be minor with respect to the overall impact that a replacement bridge would have on the existing and significant cultural landscape, views, vistas and setting.

Negative impacts on the archaeological resource in the location of the proposed southern abutment are predicted to be major. The two abutment construction options provide the opportunity to archaeologically excavate the resource prior to construction commencing. The land bridge option, which initially appears to result in the least impact, would either destroy relics without the opportunity for archaeological excavation, or require a larger area than the footprint of the piers would require archaeological excavation for work health and safety reasons.

The potential to damage archaeological resources poses a risk to areas that are not protected by hardstand on road base. Compression impacts on the archaeological resource are possible in areas away from the existing paved roads and would be a negative result if not managed. Resources such as the Macquarie-era brick drain are particularly vulnerable to damage by uncontrolled plant and stockpiles and any more inadvertent damage to this item would be a major negative impact.

SoHI considering further assessment of the project

The area of the reserve that will not be physically impacted by the proposal will be separated from its historic context and a significant landscape will be irreversibly impacted. Moreover, as archaeological excavation of the entire upper parkland area is one of the archaeological options considered[18] (although not favoured by RMS) the final design of the upper parkland area will require careful consideration if excavation goes ahead.

The negative impact of the project on the built environment of Thompson Square, the aesthetic values of the surrounding cultural landscape, including the Thompson Square Conservation Area, and the removal of a significant archaeological resource will change a familiar and valued space irreversibly. The Heritage Working Paper concluded that the project would negatively impact the heritage values of the project area and surrounding landscape to a high degree. It is difficult to see how leaving the remaining space untouched will enhance or even retain significance.[19] In the overall context of the project, which will result in the loss of much of a significant and valued landscape, the landscape of the final park will have to be carefully and thoughtfully designed to interpret the significance of remaining elements and illustrate those elements that have been removed.

It is also considered that the impacts associated with the fundamental elements of the project cannot be mitigated to retain the strong sense of the past that is currently evident there. Furthermore, the opportunity to remove through traffic entirely and enhance the significance of Thompson Square and the existing bridge by creating a more usable and pedestrian-friendly community space will be lost permanently.

[18] Windsor Bridge Replacement Project Archaeology Options Paper, Biosis and CRM 2013.
[19] Discussed in the Archaeology Options Paper

3 CONCLUSIONS & RECOMMENDATIONS

The design of the replacement bridge has evolved through a collaborative process between the designers, engineers, urban design team and the heritage specialists. The assessment and discussion presented in the heritage working paper has not changed significantly and therefore the overall conclusions and recommendations remain the same:

While the potential impact has been tempered through iterative design and input from heritage specialists, predicted impacts on the heritage significance of Thompson Square, Windsor Bridge and the northern bank of the project area will be too great to completely mitigate or ameliorate resulting in a residual impact that is discussed below.

However, the changes in the replacement bridge design that have been assessed in this document do not justify a modification of the conclusion and recommendations of the original historic period heritage Working Paper (Biosis November 2012).

By proceeding with the project in this form RMS will reconfigure Thompson Square, removing the current bridge approach road through the cutting, which will be backfilled, and placing it on the eastern margin of the square. The existing low level bridge would be demolished and a new higher structure built. This will be a major heritage impact as it will irreversibly affect the significance of Thompson Square and Windsor Bridge as State significant heritage places, and the State significant vista from the northern bank looking back towards the town. It is also likely to have a major impact on the surviving archaeological resource, particularly that component that reflects the earliest phase/period of European occupation.

The project would have unavoidable impacts on the significance of Thompson Square. The changes to the space that are proposed and necessary to achieve the project would adversely impact the heritage significance of Thompson Square without effectively mitigating that impact. Mitigation measures proposed in the Heritage Working Paper are for the purpose of collecting and interpreting data, and avoiding inadvertent impacts would not retain significance.

The primary recommendation is for all components of Thompson Square to be retained; this recommendation includes retaining the existing bridge.

Reference should be made to the Heritage Working Paper 1 (Biosis 2012) for the conclusions and recommendations arising from the heritage impacts of the project.

To minimise the impact of compression, ground loading needs to be minimised through the following measures:

Recommendation B1

Make use of existing sealed roads and car park areas to place stockpiles or stand machinery.

Recommendation B2

Enforce the large grassed areas within the construction area as exclusion zones for heavy machinery until they are required. Include areas close to the edges of hardstand areas in the exclusions zones.

Recommendation B3

When not on hard-stand (paved roads) use machinery that exerts the least ground pressure such as pneumatic tyres and smaller vehicle size.

Recommendation B4

Where work off the current roads and car parks cannot be avoided, protect it with hardstand or a prepared surface to minimise and dissipate ground pressure. Separate the newly constructed hardstand from the existing surface using geofabric in addition to road base material and asphalt.

Recommendation B5

Where work of the current roads and car parks is proposed and the measures in Recommendation B4 have been implemented, where practicable[20], ensure that the effects of the vehicle on the ground are monitored and work ceases as soon as ground disturbance is observed. An alternative must be sought prior to re-commencing work.

Recommendation B6

Ensure that the noise mitigation advice prepared by City Plan Heritage is included in all considerations of noise mitigation measures for the three additional heritage items. All additions to heritage items are to be undertaken by qualified professional with demonstrated experience in their field and supervised by a suitably qualified heritage consultant. Reference must be made to the report prepared by City Plan Heritage.

Recommendation B7

Interpret the 1934 alignment of Bridge Street (the approach road) so that its location and value is clearly understood within the altered landscape. Include this recommendation in any future landscape designs.

Recommendation B8

Minimise visual impacts associated with light poles (furniture) through judicious selection of appropriate materials in consultation with relevant stakeholders.

[20] In the event that the machine is being used in the archaeological program, preparing a hardstand area is not practicable.

4 REFERENCES

Andrews, B.N. 2006 'Sediment consolidation and archaeological site formation', *Geoarchaeology*, 21, pp. 461–478.

Ardito, A.J. 1994 'Reducing the effects of heavy equipment compaction through in situ archaeological site preservation', *Antiquity*, 68, pp. 816-820.

Biosis Research Pty Ltd with Cultural Resources Management, 2012, *Windsor Bridge Replacement Project Historic Heritage Assessment & Statement of Heritage Impact*. Report for Roads and Maritime Services NSW, November 2012.

Cosmos Archaeology Pty Ltd, *Proposed Windsor Bridge Replacement Windsor, NSW Maritime Archaeological Statement of Heritage Impact Final Working Paper Report*. Report prepared for Roads and Maritime Services NSW, October 2012.

Dain-Owens, A., M. Kibblewhite, M. Hann and R. Godwin 'The risk of harm to archaeological artefacts in soil from dynamic subsurface pressures generated by agricultural operations: experimental studies', *Archaeometry*, accepted for publication – pre-release manuscript.

Darwin, C.1881 *The formation of vegetable mould through the action of worms, with observations on their habit*, D. Appleton and Company, New York.

Gifford-Gonzales, D., D.B. Damrosch, D.R. Damrosch, J.Pryor, and R. Thunen 1985 'The third dimension in site structure: an experiment in trampling and vertical dispersion', *American Antiquity*, 50, pp. 803–818.

Hofman, J.L. 1986 'Vertical movement of artifacts in alluvial and stratigraphic deposits', *Current Anthropology*, 27, pp. 163–171.

Huisman, D. J. 2012 'Deep impact: what happens when archaeological sites are built on?', *Conservation and management of archaeological sites*, 14 pp. 60–71.

Kelleher Nightingale Consulting Pty Ltd, *Windsor Bridge Replacement Project Aboriginal Cultural Heritage Cultural Heritage Assessment Report*. Report prepared for Roads and Maritime Services, September 2012.

McBride, R.A. and G.D. Mercer 2012 'Assessing damage to archaeological artefacts in compacted soil using microcomputed tomography scanning', *Archaeological Prospection*, 19, pp. 7–19.

Morin, E. 2006 'Beyond stratigraphic noise: unravelling the evolution of stratified assemblages in faunalturbated sites', *Geoarchaeology*, 21, pp. 541–565.

Nickens, P.R. 1999 'Technologies for in-place protection and long-term conservation of archaeological sites', *Archives and Museum Informatics*, 13, pp. 383–405.

Petraglia, D. and D. Nash 1987 'The impact of fluvial processes on experimental sites', in D. Nash and D. Petraglia (eds.), *Natural formation processes and the archaeological record*, British Archaeological Reports International Series 352, Oxford, pp 108–130.

Player, S. and M. Kelleher 2012 'Does covering an archaeological site protect the objects?: Physical effects of a storage compound on an archaeological site', Paper to Australian Archaeological Association conference, Wollongong.

Schiffer, M. (1987) *Formation processes of the archaeological record*, University of New Mexico Press, Albuquerque.

Spennemann, Dirk HR. 1989 Of wheels and tracks: experiences with heavy excavating equipment, *Australian Archaeology*, 29, pp. 69-73.

Thorne, R.M. 1991 *Intentional site burial: a technique to protect against natural or mechanical loss*, US Department of the Interior: National Parks Service, Archaeological assistance Program Technical Brief 5, revised edition.

Wildesen, L. 1982 'The study of impacts on archaeological sites', in M. Schiffer (ed.), *Advances in archaeological method and theory*, Academic Press, New York, 5, pp. 51–96.

Wood, W.R. and D.L. Johnson, 1978 'A survey of disturbance processes in archaeological site formation' M. Schiffer (ed.), *Advances in archaeological method and theory*, Academic Press, New York, vol. 1, pp. 315–381.