



Transport  
Roads & Maritime  
Services

# CoA B8 Design Compliance Report

Windsor Bridge Replacement

April 2018

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# 1 Introduction

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## 1.1 Background

The Windsor Bridge Replacement Project involves construction of a new road bridge over the Hawkesbury River at Windsor (the Project). The Project is being delivered by Roads and Maritime Service of NSW (Roads and Maritime) on behalf of the New South Wales (NSW) government.

The Project has been assessed as State Significant Infrastructure (SSI) under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

An Environmental Impact Statement (EIS) *Windsor Bridge Replacement Project Environmental Impact Statement* (EIS) was prepared by Sinclair Knight Merz (now Jacobs) in November 2012 for Roads and Maritime. The EIS was on public exhibition until December 17th 2012. A submissions report (and preferred infrastructure report) was finalised in May 2013 which addressed stakeholder submissions received during the EIS exhibition period. Following this, in December 2013, the Project was approved by the then Minister for Planning and Infrastructure.

Currently the Project is at the end of the detailed design phase with Jacobs providing design and engineering services for the Project on behalf of Roads and Maritime.

## 1.2 Purpose of report

The purpose of this report is to satisfy the requirements of Conditions of Approval (CoA) B8 for the Project which is detailed below:

*“The project is to be revised to incorporate the following amendments. The new design of the SSI shall be provided to the Director-General for approval prior to the commencement of pre-construction and construction activities in the southern side of the Hawkesbury River:*

*(a) the raising of the southern approach road by approximately 1 metre is not approved. The height/clearance of the southern approach road shall be designed ensure consistency with the EIS;*

*(b) public access to the existing wharf is to be maintained and alternative coach access, arrangements for pedestrians/cyclists and consultation undertaken are to be detailed;*

*(c) access to numbers 4 and 6 Bridge Street is to be maintained at all times. Alternative access arrangements to those proposed shall be investigated to the satisfaction of the Director-General;*

*(d) the northern roundabout shall be designed to ensure consistency with the Austroads Guide to Road Design: Part 4B, particularly in relation to geometry and lane designations.*

*In the event that further design amendments are required as a consequence of compliance with conditions B1 to B7, any such revised designs must be approved by the Director-General.”*

The detailed design needs to be approved by the Department of Planning and Environment (DP&E).

## 1.3 Report structure

This report has been structured into the following sections:

- **Section 1 Introduction** - Provides background to the Project and purpose of the report.
- **Section 2 Design Compliance Summary** - Provides an overview of compliance with condition B8.
- **Section 3 Consultation** – Provides a summary of the consultation on the design changes associated with interpretation and the brick barrel drain.
- **Attachments** - Provides supporting evidence to demonstrate design compliance.

## 2 Design compliance

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### 2.1 Required design amendments

Condition B8 requires four specific design amendments to be incorporated into the detailed design. A summary of these amendments and how design compliance has been achieved is outlined in Table 2-1.

**Table 2-1 Summary of compliance with CoA B8**

CoA No.	Requirement	Design Compliance (Yes No)	Comment	Reference
B8	a) the raising of the southern approach road by approximately 1 metre is not approved. The height/clearance of the southern approach road shall be designed ensure consistency with the EIS;	Yes	The proposed road surface level at this location on the detailed design drawings ( <i>Reference 3</i> ) has been lowered below that level shown in the EIS (the level is now 12.045m AHD down from 12.257m AHD ( <i>Reference 2</i> ). This change required the lowering of The Terrace to achieve sufficient clearance under the bridge to provide adequate vehicular access (in particular large coaches and service vehicles) to Windsor Wharf (See below B8b). As a result, the proposed final height/clearance of the southern approach road has been designed to be consistent with the EIS.	2. 100% Concept design drawing No. DS2012/000289 – Sheet 121 - Issue B.  3. Detailed design drawing No. NB98005-ECC-DG-0241 – IFT rev 2 Dated 3/11/2017
	b) public access to the existing wharf is to be maintained and alternative coach access, arrangements for pedestrians/cyclists and consultation undertaken are to be detailed;	Yes	Public access to the existing wharf including consultation with Council has been addressed in detail in a report titled “ <i>Windsor Bridge Replacement Project Options Assessment for Access to Windsor Wharf and Urban and Landscape Design of Thompson Square</i> ” 6 June 2016 ( <i>Reference 4</i> ). See also design changes B8 (a) above.  The options report assesses options for access to the existing wharf and urban design and landscaping within Thompson Square. The preferred option selected for access to Windsor Wharf has progressed through to the end of detailed design.	4. Windsor Bridge Replacement Project Options Assessment for Access to Windsor Wharf and Urban and Landscape Design of Thompson Square. 6 June 2016.
	c) access to numbers 4 and 6 Bridge Street is to be maintained at all times. Alternative access arrangements to those proposed shall be investigated to the satisfaction of the Director-General;	Yes	Permanent and temporary access to 4 and 6 Bridge Street has been maintained during operation ( <i>Reference 5</i> ) and construction ( <i>Reference 6</i> ). The contractor will be required to maintain access to all properties (including No 4 and 6 Bridge Street) at all times during construction. This requirement is documented in Clause 2.1.3 and Annexure A2.5 of the construction specifications G10 of the tender documentation ( <i>Reference 7</i> ).	5. Detailed design drawings Volume 2 - Roadworks - Drawing No. NB98005-ECC-DG-0212 – IFT rev 2 Dated 3/11/2017  6. Detailed design (Construction Staging) drawings No. NB98005-ECS-DG-0320, 0222 and 0322, – FIO rev 2 Dated 3/11/2017  7. RMS QA Specification G10 – Traffic Management (Version for Windsor Bridge Replacement - Oct 2017)
	d) the northern roundabout shall be designed to ensure consistency with the Austroads	Yes	The northern roundabout ( <i>Reference 8</i> ) has been designed in accordance with the <i>Austroads Guide to Road Design (AGRD): Part 4B - Roundabouts</i> .	8. Detailed design drawings Volume 6 – Pavement marking, signs, barriers and street furniture - Drawing No. NB98005-

CoA No.	Requirement	Design Compliance (Yes No)	Comment	Reference
	<p>Guide to Road Design: Part 4B, particularly in relation to geometry and lane designations.</p>		<p>The design of the roundabout has been verified by Jacobs and Roads and Maritime during the detailed design process.</p> <p>Table 4.1 of the AGRD has been adopted for the minimum central island radius and Table 4.2 for entry path radius. Table 4.4 has been adopted for a dual turn being a 25m B-double truck plus a standard vehicle checked with turning paths. An encroachment area or annulus from Figure 4.11 has been provided on the inside of the roundabout. Figure 5.3 has been adopted for shared path crossing locations.</p> <p>In addition, lane designation on approach to the roundabout also complies with AGRD Part 4.</p>	<p><i>ECC-DG-0614 – IFT rev 2 Dated 3/11/2017</i>  <i>9 Detailed Design Report – Roadworks (Jacobs, dated 8 December 2017)</i></p>
	<p>In the event that further design amendments are required as a consequence of compliance with conditions B1 to B7, any such revised designs must be approved by the Director-General</p>	<p>Yes</p>	<p>Refer to Table 2-2 below.</p>	

## 2.2 Design amendments undertaken to avoid and minimise heritage impacts

Condition B8 requires that design amendments, as a consequence of compliance with conditions B1 to B7, are to be documented and approved by the DP&E. Design amendments to avoid and/or minimise heritage impacts are summarised below, (including which condition generated the change):

- Key design amendment 1 (B1, B3): The redesign of the footings for the retaining wall at the bridge southern abutment to incorporate a piled footing instead of a L-shaped retaining wall. This design change resulted in a significant reduction of material to be excavated during construction thus minimising the impact on the sand body and minimising the risk of finding unexpected heritage items.
- Key design amendment 2 (B1, B3): The provision of a shallow pavement (Type 5 – Rehabilitation) along George Street, the intersection of George Street and Bridge Street and along Bridge Street for approximately 20m south of the intersection. The maximum depth of pavement in these areas will be 180mm. This design change has resulted in a reduced depth of excavation required for the proposed pavement thus avoiding the risk of finding unexpected heritage items such as the Telford pavements. The minimum Telford pavement depth is approximately 200mm in depth thus construction is not expected to impact the pavement.
- Key design amendment 3 (B1, B3): The provision of specific design and pavement details to partially salvage and protect the brick fence footing found in archaeological test pit SA25. These pavement details are shown in the engineering drawings (*Reference 14*) and provide requirements to the contractor to locate and expose the brick fence footing prior to construction of the pavement and (in accordance with instructions from the principal's heritage manager):
  - partially salvage the top section of the heritage item
  - protect the remaining portion of the heritage item by providing a 100mm layer of natural granular road material over the item (as recommended by the AAJV archaeologist) using hand tools, and
  - Reconstruct the pavement above the natural material as required.
- Key design amendment 4 (B1, B3): The relocation of proposed underground utility services (water main, telecommunications, and electrical) on the southern side of the Hawkesbury River to be aligned with the existing Bridge Street. The utilities will be placed in an area that will be filled with spoil material during construction, thus removing the need for excavation and avoiding the risk of finding unexpected heritage items.
- Key design amendment 5 (B1, B3): The reduction of the proposed drainage system along The Terrace. An section along The Terrace was identified as having a high archaeological potential (referred to Area 5 in the Detailed Salvage Strategy). This design change has resulted in no additional deep excavation required to lay drainage pipes thus avoiding the risk of finding unexpected heritage items.
- Key design amendment 6 (B1, B3): The proposed scour protection on the southern bank of the Hawkesbury River was designed to avoid the removal or damage of maritime heritage items. . Engineering detail for the scour protection is provided as *Reference 18*. The report outlines the detailed design of the proposed scour protection on the southern river bank foreshore. The proposed design includes placement of gravel, geotextile and rock fill directly over the river bed and bank and any existing items that are not recovered or salvaged as part of the maritime salvage strategy. The scour protection will capsule the maritime heritage and protect it for future generations. The scour protection can also be removed if required to access the maritime heritage items. Modified construction methodologies have been used on the southern side of the river to avoid any impacts to heritage. No excavation of the river bank or sediments would occur, which is specified in the design criteria and drawings.



- Key design amendment 7 (B1): Cladding on the southern abutment has been redesigned to include heritage interpretation. The southern abutment of the new bridge will be utilised to interpret the flood history of the Hawkesbury River and its impact on Thompson Square. The southern abutment will also display 4 different brown coloured bricks to represent the local soil layers, geology and sand body within the area. The different layers of coloured brick will be interspersed with random bricks to represent historical artefacts discovered within the soil profile.
- Key design amendment 8 (B1): Should Hawkesbury City Council (Council) accept the asset and its maintenance, the first span of the existing bridge and the southern bridge abutment on the southern side of the river is to be preserved for interpretation purposes. Refer to Section 3.2 for further information on consultation with Council.
- Key design amendment 9 (B3): Re-design of the western retaining wall to preserve the recently discovered circa 1814 brick barrel drain in-situ. The proposed design (*Reference 24*) includes a redesigned foundation for the retaining wall which has piles either side of the barrel drain and a pile cap (a structural slab positioned atop the piles) to straddle the brick barrel drain. A range of advice has been received from technical specialists regarding preservation of the brick barrel drain (*Reference 25*). Further details are provided in Section 3
- The detailed design documentation includes the provision of Archaeological Salvage & Heritage Management drawings to give the contractor a summary of heritage constraints and management requirement (*Reference 1*). The archaeological salvage and heritage management drawings have been based on findings during the archaeological investigations and the Detailed Salvage Strategy for terrestrial and maritime works. The drawings will be updated as required to include any further finds during the archaeological works. These constraint drawings are provided as *Reference 1*.

Further information on these design changes are provided in Table 2-2, along with the specific design references to demonstrate how design compliance has been achieved.

The purpose of these design changes is to avoid or reduce the impacts on the heritage items on the southern side of the river. The AAJV has reviewed these design changes are supportive of measures which will avoid or reduce heritage impacts. The AAJV has used this design information to inform the Detailed Salvage Strategy which includes management zones for the construction footprint. The AAJV has prepared a *Heritage Mitigation and Options Review Report* which documents the proposed measures to protect the brick barrel drain in-situ. This report includes the supporting technical advice provided as *Reference 25*.

Table 2-2 provides a summary of design amendments as a consequence of compliance with CoAs-B1 to B7 which forms a sub-set requirement of CoA-B8.

**Table 2-2 Summary of compliance with CoA B1 to B7**

CoA No.	Requirement	Design amendments required?	Comment	Reference
B1	<p><i>The Applicant shall submit a Strategic Conservation Management Plan (CMP) to the Director-General for the project area on the southern side of the Hawkesbury River as shown in Appendix 2 Strategic Conservation Management Plan study area. The CMP shall be prepared by appropriately qualified and/or experienced heritage consultants. The nominated heritage consultant(s) is to have appropriate experience and skills including land and maritime archaeology, landscape, engineering and built heritage expertise and documented experience in the preparation and implementation of CMPs.</i></p> <p><i>The Applicant shall not carry out any pre-construction or construction activities on the southern side of the Hawkesbury River for the SSI before the CMP has been approved by the Director-General. The CMP is to provide for the heritage conservation of the Thompson Square Conservation Area. The CMP shall be prepared in consultation with the Heritage Branch, OEH and in accordance with the relevant guidelines of the NSW Heritage Council and include, but not be limited to:</i></p>	N/A	The development of the detail design was undertaken in collaboration with the engaged heritage consultants for the project.	N/A
	<i>(a) identification of the heritage value of the Thompson Square Conservation Area, including statements of significance for the Thompson Square Conservation Area and any individual listings within the conservation area of any local, state or national heritage items;</i>	N/A	This aspect is addressed in Section 3 of the Strategic Conservation Management Plan (SCMP) Volume 1 (Reference 10) and Section 3 of the SCMP Volume 2 (Reference 11)	<p><i>10. Thompson Square Windsor NSW Strategic Conservation Management Plan Volume 1: Site Identification, Historical Background and Heritage Status (AAJV, Dated January 2018)</i></p> <p><i>11. Thompson Square Windsor NSW Strategic Conservation Management Plan Volume 2: Physical Analysis, Assessment of Significance, Constraints and Opportunities, Policies and Implementation (AAJV Dated January 2018).</i></p>
	<i>(b) the development of heritage design principles for the project to retain the heritage significance of the Thompson Square</i>	N/A	This aspect is addressed in Section 4.3 (conservation principles) and Section 5	<i>11. Thompson Square Windsor NSW Strategic Conservation Management</i>

CoA No.	Requirement	Design amendments required?	Comment	Reference
	<p><i>Conservation Area and any individually listed item within the conservation area or in proximity to the site, with the exception of Item 3 (the Thompson Square lower parkland area) and Item 20 (Windsor Bridge) in Table 1 of Appendix 1;</i></p>		<p>(policies) of the SCMP Volume 2 (<i>Reference 11</i>)</p> <p>The specific implementation of the principles and policies is set out in Section 5 of Volume 3 (<i>Reference 12</i>).</p>	<p><i>Plan Volume 2: Physical Analysis, Assessment of Significance, Constraints and Opportunities, Policies and Implementation (AAJV Dated January 2018).</i></p> <p><i>12. Thompson Square Windsor NSW Strategic Conservation Management Plan Volume 3: Windsor Bridge Replacement Project specific information (AAJV, Dated January 2018).</i></p>
	<p><i>(c) specific mitigation measures for the Thompson Square Conservation Area and individually listed items to minimise impact and to ensure that final measures selected are appropriate and the least intrusive option; and</i></p>	<p>Yes</p>	<p>This aspect is addressed in Section 4 of the SCMP Volume 2 (<i>Reference 11</i>).</p> <p>As a result of the outcome of the SCMP minor adjustments have been made to the detailed design to incorporate the relevant design management measures as detailed in Section 5 of the SCMP Volume 3 (<i>Reference 12</i>).</p> <p>Archaeology Aboriginal</p> <ul style="list-style-type: none"> <li>• Key design amendment 1: Re-design of the retaining wall at the southern abutment to incorporate a piled footing (<i>Reference 13</i>).</li> </ul> <p>Historical</p> <ul style="list-style-type: none"> <li>• Key design amendment 2: provision of shallow pavement to avoid heritage items in particular the Telford pavement (<i>Reference 14</i>).</li> <li>• Key design amendment 3: pavement details to partially salvage and protect</li> </ul>	<p><i>11. Thompson Square Windsor NSW Strategic Conservation Management Plan Volume 2: Physical Analysis, Assessment of Significance, Constraints and Opportunities, Policies and Implementation (AAJV Dated January 2018).</i></p> <p><i>12 Thompson Square Windsor NSW Strategic Conservation Management Plan Volume 3: Windsor Bridge Replacement Project specific information (AAJV, Dated January 2018).</i></p> <p><i>13. Retaining Wall Arrangement Drawings DS2012/000155 Sheets 102 and 103 – IFT Issue 2, Dated 3/11/2017</i></p> <p><i>14. Detailed design drawings Volume 5 – Pavement and kerbs - Drawings No. NB98005-ECC-DG-0521 and 0543 – IFT rev 2 Dated 3/11/2017.</i></p>

CoA No.	Requirement	Design amendments required?	Comment	Reference
			<p>the brick fence footing found in archaeological test pit SA25 (<i>Reference 14</i>).</p> <ul style="list-style-type: none"> <li>• Key design amendment 4: Relocation of the proposed underground utilities (<i>Reference 15</i>).</li> <li>• Key design amendment 5: Reduction in the proposed drainage system along The Terrace (<i>Reference 16</i>).</li> </ul> <p>Maritime</p> <ul style="list-style-type: none"> <li>• Key design amendment 6: scour protection details to protect maritime heritage items on the southern river bank (<i>Reference 17 and Reference 18</i>).</li> </ul> <p>Landscape</p> <p>The draft Urban Design and Landscape Plan (UDLP) (<i>Reference 19</i>) has been developed to be sympathetic to the exiting heritage values of Thompson Square including:</p> <ul style="list-style-type: none"> <li>• maintaining historical views</li> <li>• unification of Thompson Square</li> <li>• selected removal of ornamental trees</li> <li>• use of similar trees species that existed prior</li> <li>• simplistic material selection in urban design elements</li> <li>• informal structuring of Thompson Square</li> <li>• framing vistas within the square.</li> </ul>	<p><i>15. Utility Co-ordination Drawing DS2012/000289 Drawing No. NB98005-EEC-DG-0422 – IFT Rev 2, Dated 3/11/2017</i></p> <p><i>16. Drainage and Water Quality Drawing DS2012/000289 Drawing No. NB98005-EEC-DG-0322 – IFT Rev 2, Dated 3/11/2017</i></p> <p><i>17. Scour Protection Detailed design drawings Volume 9 – Scour protection - Drawings No. NB98005-ECC-DG-0903, 0911 and 0921 – IFT rev 2 Dated 3/11/2017</i></p> <p><i>18. Southern River Bank Stability and Scour Protection Detailed Design Report (Jacobs, dated 1 September 2017)</i></p> <p><i>19. Windsor Bridge replacement project - Urban Design &amp; Landscape Detailed Design Report IA098200-GUD-RP-185. (SMM, Dated September 2017).</i></p>

CoA No.	Requirement	Design amendments required?	Comment	Reference
			Further information on these elements are contained in the draft UDLP.	
	<i>(d) changes to the detailed design of the SSI to mitigate heritage impacts.</i>	Yes	As above	As above
	<i>The Applicant shall prepare and submit a detailed Interpretation Plan prior to the commencement of pre-construction and construction activities for the Thompson Square Conservation Area including individually listed sites, non-Aboriginal archaeology and Aboriginal archaeology for the approval of the Director-General. The detailed Interpretation Plan must be prepared in consultation with the OEH and include specific media design, content, location and materials, prepared in accordance with the Guidelines of the NSW Heritage Council."</i>	Yes	<ul style="list-style-type: none"> <li>A draft Interpretation Plan (<i>Reference 20</i>) was submitted to DPE on 16 November 2017. This Plan has been developed to incorporate the interpretation elements as detailed in the Thompson Square Interpretation Strategy. Key elements of the design that have changed include: <ul style="list-style-type: none"> <li>Key design amendment 7: Interpretation details on the southern bridge abutment (<i>Reference 21</i>).</li> <li>proposed street lighting sympathetic to the colonial elements of Windsor (use of Bourke Hill luminaires, subject to council approval) (<i>Reference 22</i>).</li> <li>Key design amendment 8: Should Council accept the asset and its maintenance, retention of existing bridge elements for interpretation purposes (<i>Reference 19</i>).</li> </ul> </li> </ul> <p>Further information on these elements are contained in the Interpretation Plan.</p>	<p><i>20. Thompson Square Windsor NSW, Interpretation Plan, Draft (AAJV, Dated November 2017).</i></p> <p><i>21. Detailed design drawings Vol 11.1 Bridge – Drawing No. DS2012/000155 (Sheets 141 and 142 - Issue 2)</i></p> <p><i>22. Webb. Thompson Square street lighting calculation drawings M963A (Pages 3 and 4 Dated 18/10/2017).</i></p> <p><i>19. Windsor Bridge replacement project - Urban Design &amp; Landscape Detailed Design Report IA098200-GUD-RP-185. (SMM, Dated September 2017).</i></p>
B2	<i>Prior to the commencement of pre-construction works on the southern side of the Hawkesbury River, the Applicant shall complete a detailed Archival Recording of all historic heritage sites within the Strategic Conservation Management Plan study area in accordance with the Guidelines issued by the NSW Heritage Council and to the satisfaction of the Director-General and in consultation with the NSW Heritage Council. The recording shall include, but not be limited to:</i>	No	The design was not changed following the completion of detailed Archival Recording ( <i>Reference 23</i> ).	<i>23. Thompson Square and Windsor Bridge, Windsor, Detailed Photographic Archival Recording (AAJV, Dated 12 February 2018)</i>

CoA No.	Requirement	Design amendments required?	Comment	Reference
	<p><i>(a) detailed survey and analysis of Thompson Square Conservation Area, Windsor Bridge and the immediate surrounds using 3D laser scanning; and</i></p> <p><i>(b) photographic and archival recording of all affected heritage sites, as identified in the specialist reports prepared as part of the Environmental Impact Statement for the project. Recording is to be completed. Copies of these recordings should be made available to the Director-General, the NSW Heritage Council, the Local Studies Library and the Local Historical Society in Windsor."</i></p>			
B3:	<p><i>The Applicant shall undertake an Archaeological Investigation Program comprising Aboriginal and non-Aboriginal Heritage in the project area on the southern side of the Hawkesbury River, prior to the commencement of preconstruction and construction activities in the southern area. The program shall be conducted to the satisfaction of the Director-General and in accordance with:</i></p> <p><i>(a) the Heritage Council's Archaeological Assessments Guideline (1996) using a methodology prepared, in consultation with the NSW Heritage Council for non- Aboriginal heritage; and</i></p> <p><i>(b) prepared in consultation with the OEH (Aboriginal heritage) and the Aboriginal stakeholders.</i></p> <p><i>The Archaeological Investigation Program is to be undertaken by an archaeological heritage consultant approved by the Director-General in consultation with the NSW Heritage Council and by the OEH (Aboriginal heritage) and by an Excavation Director who shall demonstrate an ability to comply with the Heritage Council's Criteria for the Assessment of Excavation Directors (July 2011) and in particular must be able to demonstrate compliance with Criterion A.4 that: 'work under any approvals previously granted by the Heritage Council has been completed in accordance with the conditions of that consent and the final report has been submitted to the NSW Heritage Council.</i></p>	Yes	<p>The design was not changed significantly in the most part in the southern side of the Hawkesbury River as a result of the Aboriginal Archaeological Testing Report and the Detailed Salvage Strategy.</p> <p>Some minor design adjustments have been made to the detail design as follows:</p> <p>Archaeology</p> <p>Aboriginal</p> <ul style="list-style-type: none"> <li>• Key design amendment 1: Re-design of the retaining wall at the southern abutment to incorporate a piled footing (Reference 13).</li> </ul> <p>Historical</p> <ul style="list-style-type: none"> <li>• Key design amendment 2: provision of shallow pavement to avoid heritage items in particular the Telford pavement (Reference 14).</li> <li>• Key design amendment 3: pavement details to partially salvage and protect the brick fence footing found in archaeological test pit SA25 (Reference 14).</li> </ul>	<p><i>13. Retaining Wall Arrangement Drawings DS2012/000155 Sheets 102 and 103 – IFT Issue 2, Dated 3/11/2017</i></p> <p><i>14. Detailed design drawings Volume 5 – Pavement and kerbs - Drawings No. NB98005-ECC-DG-0521 and 0543 – IFT rev 2 Dated 3/11/2017.</i></p>

CoA No.	Requirement	Design amendments required?	Comment	Reference
	<p><i>The Archaeological Investigation Program shall include archaeological testing and geophysical investigation, as required for the significance assessment. The results of the Archaeological Investigation Program are to be detailed in a Historic Archaeological Report and a Detailed Salvage Strategy comprising the non-Aboriginal and Aboriginal heritage findings. These are to be prepared in consultation with the OEH (Heritage Branch and Aboriginal heritage) and to the satisfaction of the Director-General, and shall include, but not necessarily be limited to:</i></p> <p><i>(a) detailed recommendations for further archaeological work;</i></p> <p><i>(b) consideration of measures to avoid or minimise disturbance to archaeology sites, where archaeology of historical and Aboriginal heritage archaeological significance are found to be present;</i></p> <p><i>(c) where impacts cannot be avoided by construction of the SSI, recommend actions to salvage and interpret salvaged sites, conduct further research and archival recording of the historic heritage and Aboriginal heritage value of each site, and to enhance and preserve the archaeology of historical non-Aboriginal and Aboriginal heritage significance;</i></p> <p><i>(d) consideration of providing visual evidence of heritage sites within the final landscape design of the SSI to preserve and acknowledge the heritage value of the Thompson Square Conservation Area and the site;</i></p> <p><i>(e) management and mitigation measures to minimise impacts due to preconstruction and construction activities; and</i></p> <p><i>(f) preparation of a Hawkesbury Region Sand Bodies Study to the satisfaction of the Director-General and undertaken by suitably qualified and experienced persons whose appointment has been approved by the Director-General, in the event that any Pleistocene and/or early Holocene is encountered during the works referred to in condition B3. This study is required to be</i></p>		<ul style="list-style-type: none"> <li>• Key design amendment 4: Relocation of the proposed underground utilities (Reference 15).</li> <li>• Key design amendment 5: Reduction in the proposed drainage system along The Terrace (Reference 16).</li> <li>• Key design amendment 9: 1814 Brick Barrel Drain. The Western Wall is being re-designed with a pile footing design to straddle the brick drain (Reference 24 and Reference 25).</li> </ul> <p>Maritime</p> <ul style="list-style-type: none"> <li>• Key design amendment 2: scour protection details to protect maritime heritage items on the southern river bank (Reference 17 and Reference 18).</li> </ul>	<p>15. Utility Co-ordination Drawing DS2012/000289 Drawing No. NB98005-EEC-DG-0422 – IFT Rev 2, Dated 3/11/2017</p> <p>16. Drainage and Water Quality Drawing DS2012/000289 Drawing No. NB98005-EEC-DG-0322 – IFT Rev 2, Dated 3/11/2017</p> <p>24. Brick Barrel Drain Design Drawings Issue 3 – Various Sheet Numbers and Issues, Dated 6/4/2018</p> <p>25 Technical advice regarding brick barrel drain</p> <p>17. Scour Protection Detailed design drawings Volume 9 – Scour protection - Drawings No. NB98005-ECC-DG-0903, 0911 and 0921 – IFT rev 2 Dated 3/11/2017</p> <p>18. Southern River Bank Stability and Scour Protection Detailed Design Report (Jacobs, dated 1 September 2017)</p>

CoA No.	Requirement	Design amendments required?	Comment	Reference
	<p><i>prepared in consultation with the Department, the OEH and Aboriginal stakeholders and is required to:</i></p> <ul style="list-style-type: none"> <li><i>(i) be undertaken in accordance with a research design and action plan approved by the Director-General prior to the study commencing;</i></li> <li><i>(ii) be directed towards locating and evaluating sand bodies likely to contain evidence of early Aboriginal habitation in the Hawkesbury River area, in the project location in areas disturbed by construction of the project, including the existing Windsor Bridge and new bridge locations;</i></li> <li><i>(iii) findings are to be made publicly available; and</i></li> <li><i>(iv) make recommendations concerning the preservation and future management of any finds.</i></li> </ul> <p><i>In the event that any Pleistocene and/or early Holocene is encountered, the recommendations of the Hawkesbury Region Sand Bodies Study are to be fully complied with.</i></p>			
B4	<p><i>The Applicant shall undertake an Archaeological Investigation Program comprising Aboriginal Heritage in the northern side of the Hawkesbury River project area, prior to the commencement of pre-construction and construction activities in the northern area. The program shall be conducted to the satisfaction of the Director-General and prepared in consultation with the OEH (Aboriginal heritage) and the Aboriginal stakeholders.</i></p> <p><i>The results of the Archaeological Investigation Program conducted in the project area on the northern side of the Hawkesbury River are to be detailed in a Historic Archaeological Report and a Detailed Salvage Strategy comprising the Aboriginal heritage findings in northern side of the Hawkesbury River. These are to be prepared in consultation with the OEH (Aboriginal heritage) and to</i></p>	No	The design was not changed in the Northern side of the Hawkesbury River as a result of the Historic and Aboriginal Archaeological Reports and the Detailed Salvage Strategy.	N/A



CoA No.	Requirement	Design amendments required?	Comment	Reference
	<p><i>the satisfaction of the Director-General, and shall include but not necessarily be limited to:</i></p> <p><i>(a) detailed recommendations for further Aboriginal archaeological work;</i></p> <p><i>(b) consideration of measures to avoid or minimise disturbance to Aboriginal sites, where archaeology of Aboriginal heritage archaeological significance are found to be present;</i></p> <p><i>(c) where impacts cannot be avoided by construction of the SSI, recommend actions to salvage and interpret salvaged sites, conduct further research and archival recording of the Aboriginal heritage value of each site, and to enhance and preserve the Aboriginal heritage significance;</i></p> <p><i>(d) consideration of providing visual evidence of heritage sites within the final landscape design of the SSI to preserve and acknowledge the Aboriginal heritage value of the northern project area;</i></p> <p><i>(e) management and mitigation measures to minimise impacts due to preconstruction and construction activities; and</i></p> <p><i>(f) preparation of a Hawkesbury Region Sand Bodies Study as detailed in Condition B3(f)</i></p>			
B5	<p><i>The Applicant shall not commence construction of the project on or within those areas likely to alter flood conditions until such time as works identified in the Hydrological Mitigation Report, required under condition C27, have been completed, unless otherwise agreed by the Director-General.</i></p>	No	<p>The design has not changed following completion of the Hydrological Mitigation Report.</p> <p>The Hydrological Mitigation Report (Reference 26) has been finalised and accepted by DP&amp;E and addressed condition C27. The report found that:</p> <ul style="list-style-type: none"> <li>the implementation of any mitigation measures or works is not required during operational phase as flooding has</li> </ul>	<p><i>26 Windsor Bridge Replacement Hydrological Mitigation Report Document No. IA098200-NHY-RP-259 (Revision F) Dated 15 November 2017.</i></p> <p>Refer to Section 3.1.1 and 3.1.2 in Reference 26.</p>

CoA No.	Requirement	Design amendments required?	Comment	Reference
			<p>negligible and minor impacts to access and property.</p> <ul style="list-style-type: none"> <li>the project will provide scour protection works to mitigate any potential scour impacts to infrastructure during the construction and operational phases.</li> <li>during the construction phase the project would be programmed to minimise the period when both the existing bridge and replacement bridge are in place at the same time.</li> </ul>	<p>Refer to Section 3.1.3 and 3.2.6 in <i>Reference 26</i>.</p> <p>Refer to Section 3.2.2 and 3.2.3 in <i>Reference 26</i>.</p>
B6	<i>Terracing is not approved as part of landscaping for the SSI.</i>	Yes	<p>The current detailed design (<i>Reference 27 and 28</i>) has removed any terracing proposed at Thompson Square during the concept design and EIS. The assessment undertaken that lead to adoption of the preferred surface grading of Thompson Square has been address in detail in a report (<i>Reference 4</i>). In summary, in this report, six options have been considered for the Thompson Square urban design and landscaping. Option 4A was considered the preferred option as it meets the requirement to maintain access to the existing wharf (by lowering The Terrace by about 0.7m), provides a safe slope (4H:1V) for mowing and maintenance and involves a seamless flow to the Terrace, thereby improving public amenity.</p>	<p><i>27. Detailed design drawings Volume 2 – Roadworks - Drawings No. NB98005-ECC-DG-0252 and 0236 – IFT rev 2 Dated 3/11/2017.</i></p> <p><i>28. Detailed design drawings Volume 12 – Landscape design - Drawings No. NB98005-ESD-DG-0109 and 0303 – IFT rev 2 Dated 3/11/2017</i></p> <p><i>4. Windsor Bridge Replacement Project Options Assessment for Access to Windsor Wharf and Urban and Landscape Design of Thompson Square. 6 June 2016.</i></p>
B7	<i>The Applicant shall prepare an Urban Design and Landscape Plan prior to the commencement of pre-construction and construction activities in the southern side of the Hawkesbury River to guide the landscaping for the project. The Plan shall be prepared in consultation with the OEH, and Hawkesbury Council and shall present an integrated urban design for the project that is sympathetic to the heritage values and significance of the Thompson Square Conservation Area and shall be prepared in accordance with the requirements of condition C47</i>	Yes	<p>A draft Urban Design and Landscape Plan (UDLP) was available for community comment from 13 March to 7 April 2017. RMS has responded to comments received from the community in a Submissions Report (<i>Reference 29</i>) and the Urban Design and Landscape Plan has been finalised (<i>Reference 19</i>).</p> <p>Landscape</p>	<p><i>29. Windsor Bridge Replacement Urban Design and Landscape Plan Submissions report (Roads and Maritime, Dated September 2017)</i></p> <p><i>19. Windsor Bridge replacement project - Urban Design &amp; Landscape Detailed Design Report IA098200-GUD-RP-185. (SMM, Dated September 2017).</i></p>

CoA No.	Requirement	Design amendments required?	Comment	Reference
			<p>The draft Urban Design and Landscape Plan has been developed to be sympathetic to the exiting heritage values of Thompson Square including:</p> <ul style="list-style-type: none"> <li>• maintaining historical views</li> <li>• unification of Thompson Square</li> <li>• selected removal of ornamental trees</li> <li>• use of similar trees species that existed prior</li> <li>• simplistic material selection in urban design elements</li> <li>• informal structuring of Thompson Square</li> <li>• framing vistas within the square</li> </ul> <p>Further information on these elements are contained in the draft UDLP. This will also be subject to further consultation in conjunction with the SCMP.</p>	

### 3 Preservation of the Brick barrel drain

Discovery of the historic brick barrel drain during recent archaeological salvage works in Thompson Square required changes to the detailed design as the location of the barrel drain would interfere with the footing configuration of the southern bridge abutment and associated western retaining wall. The options considered that would preserve the brick barrel drain included the relocation of the retaining wall, which would have required further encroachment into the open space of Thompson Square; a Reinforced Soil Wall which was deemed undesirable due to possible flood damage; and redesign of the retaining wall footing. The later was deemed most advantageous.

The main objective of the design changes was to alter the footing system of these structural elements to retain the brick barrel drain in its original location while preserving and protecting its integrity during the construction and operation phases of the proposed works.

The first step of the re-design was to develop options for an alternative structural footing system that would be sufficiently clear from the barrel drain, withstand the intended design loads and eliminate the need to amend above-surface elements previously designed. The preferred concept design of the revised footing system was then distributed for discussions with the project team, archaeologists, a material conservator (ICS) and a vibration specialist.

Based on the feedback and advice received from these specialists a strategy to preserve and protect the brick barrel drain was developed. The development of this strategy considered the key elements outlined in Table 3-1.

**Table 3-1 Summary of technical advice**

Issue	Advice (refer Reference 25)	Key elements	Where addressed in design
Proposed Loads	Memorandum titled ' <i>Loads imposed on brick barrel drain</i> ' dated 23 March 2018, prepared by Jacobs.	regarding the proposed loads on the brick barrel drain during construction and operation	Detailed design (Reference 24)
Potential vibration and piling impacts	Memorandum titled ' <i>Barrel Drain – Potential Piling Vibration Impacts</i> ' dated 9 March 2018, prepared by Jacobs.	concerns regarding risks of vibration-related damage to the brick barrel drain during piling and drilling activities	The recommendations in this memorandum (including the piling trial) have been incorporated into the design drawings (Reference 24) and the project specifications for the construction contractor (namely G1 Job Specific Specification and G36 Environmental Protection Specifications).
Material Conservation	Letter titled ' <i>Windsor Bridge- Conservation of Archaeological Remains – Revised Advice</i> ' dated 24 April 2018, prepared by International Conservation Services.	concerns associated with the long term in-situ preservation of the brick barrel drain due to: <ul style="list-style-type: none"> <li>• Water movement (ground water movement, potential flooding)</li> <li>• Crystallisation of salts (carried by the water) and subsequent physical damage</li> <li>• Erosion and physical damage of exposed remains as a result</li> <li>• Possible plant, algae and moss growth on any exposed remains or disturbance of buried remains</li> </ul>	The recommendations in this memorandum (including the piling trial) have been incorporated into the design drawings (Reference 24) and the project specifications for the construction contractor (namely G1 Job Specific Specification and G36 Environmental Protection Specifications).

As outlined in the overarching advice provided by Jacobs on 24 April 2018 (refer Reference 25), they are satisfied that:

- the re-design of the structural footing system and methodology to be adopted for the protection and preservation of the brick barrel drain has been adequately assessed and documented; and

- when the contractor undertakes the works in accordance with the defined methodology, the barrel drain would be adequately protected and preserved to its original condition during the construction and operation phase of the proposed works.

## 4 Consultation

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The key consultation activities undertaken with Office of Environment and Heritage (OEH) and Hawkesbury City Council (Council) are outlined in the sections below.

### 4.1 OEH

The following consultation activities have been undertaken with Council in regards to the proposed Interpretation design elements and the brick barrel drain:

- OEH were provided a copy of the draft Interpretation Strategy and comments were received by Roads and Maritime in October 2016.
- A presentation on the Interpretation Plan was delivered to OEH on 7 July 2017 to present details of the plan and explain how OEH's comments were addressed in the updated design. OEH were supportive of the general approach for the bridge abutment cladding and interpretative signage.
- A meeting with OEH was held on 20 December 2017 to advise and discuss the uncovering of the brick barrel drain in Area 1. Roads and Maritime received a positive response from OEH about the intention to leave the brick barrel drain in-situ.
- Letter sent to OEH on 19 February 2018 providing design details on the brick barrel drain outlining the proposed mitigation measures for preserving the drain in situ.
- Following submission of specific technical details in relation to the preservation of the brick barrel drain in-situ, a meeting between OEH, DPE and Roads and Maritime was held to discuss the revised design. Issues discussed included the redesign of the bridge approach and technical advice from a material conservator, a vibration specialist and structural engineer (refer Section 3 for further information). The concerns raised by DPE and OEH have been addressed in the report and the *Heritage Mitigation and Options Review Report*.

### 4.2 Hawkesbury City Council

The following consultation activities have been undertaken with Council in regards to the proposed Interpretation design elements and the brick barrel drain:

- Regular project update meetings held with Roads and Maritime and Council staff during 2016 and 2017, which included discussions on the urban design and landscape plan (UDLP), the viewing platform and the lighting design.
- The Interpretation Strategy was provided to Council for comment, it was advised on 17 October 2016 that Council had no comments on the strategy.
- A presentation was provided to Council in December 2017 which outlined the proposed urban design and proposed Interpretation Plan for the project including the proposed viewing platform.
- The proposal to retain the first span of the bridge and convert it to a viewing platform is an option that has been offered to Council. At this point in time Council has not committed to accepting the responsibility of this asset. Further discussion and resolution on the viewing platform will be held with Council prior to the finalisation of the Interpretation Plan required under condition B1.
- Hawkesbury City Council's Councillors and member of the Council's Heritage Advisory Committee attended the archaeological site at Area 1 on 21 February 2018. Discussions on site related to the brick barrel drain and the sand body and included presentation from the archaeologists.
- Council's Manager of Waste Services has inspected the site to understand the potential impacts that Council's requirements to protect its sewer might impact on the brick barrel drain.

- Roads and Maritime are in the process of obtaining an 'Asset Maintenance Agreement' with Council to maintain the design features and interpretation signs in the completed project area.

## 5 References

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1. *Detailed Design Information Drawings Archaeological Salvage & Heritage Management. Drawings No. NB98005-EEN-DG-0101 to 0321 – FIO rev 4 Dated 13/3/2018.*
2. *100% Concept design drawing No. DS2012/000289 – Sheet 121 - Issue B.*
3. *Detailed design drawing No. NB98005-ECC-DG-0241 – IFT rev 2 Dated 3/11/2017*
4. *Windsor Bridge Replacement Project Options Assessment for Access to Windsor Wharf and Urban and Landscape Design of Thompson Square. 6 June 2016.*
5. *Detailed design drawings Volume 2 - Roadworks - Drawing No. NB98005-ECC-DG-0212 – IFT rev 2 Dated 3/11/2017*
6. *Detailed design (Construction Staging) drawings No. NB98005-ECS-DG-0320, 0222 and 0322, – FIO rev 2 Dated 3/11/2017*
7. *RMS QA Specification G10 – Traffic Management (Version for Windsor Bridge Replacement - Oct 2017)*
8. *Detailed design drawings Volume 6 – Pavement marking, signs, barriers and street furniture - Drawing No. NB98005-ECC-DG-0614 – IFT rev 2 Dated 3/11/2017*
9. *Detailed Design Report – Roadworks (Jacobs, dated 8 December 2017)*
10. *Thompson Square Windsor NSW Strategic Conservation Management Plan Volume 1: Site Identification, Historical Background and Heritage Status (AAJV, Dated January 2018)*
11. *Thompson Square Windsor NSW Strategic Conservation Management Plan Volume 2: Physical Analysis, Assessment of Significance, Constraints and Opportunities, Policies and Implementation (AAJV Dated January 2018).*
12. *Thompson Square Windsor NSW Strategic Conservation Management Plan Volume 3: Windsor Bridge Replacement Project specific information (AAJV, Dated January 2018).*
13. *Retaining Wall Arrangement Drawings DS2012/000155 Sheets 102 and 103 – IFT Issue 2, Dated 3/11/2017*
14. *Detailed design drawings Volume 5 – Pavement and kerbs - Drawings No. NB98005-ECC-DG-0521 and 0543 – IFT rev 2 Dated 3/11/2017.*
15. *Utility Co-ordination Drawing DS2012/000289 Drawing No. NB98005-EEC-DG-0422 – IFT Rev 2, Dated 3/11/2017*
16. *Drainage and Water Quality Drawing DS2012/000289 Drawing No. NB98005-EEC-DG-0322 – IFT Rev 2, Dated 3/11/2017*
17. *Scour Protection Detailed design drawings Volume 9 – Scour protection - Drawings No. NB98005-ECC-DG-0903, 0911 and 0921 – IFT rev 2 Dated 3/11/2017*
18. *Southern River Bank Stability and Scour Protection Detailed Design Report (Jacobs, dated 1 September 2017)*
19. *Windsor Bridge replacement project - Urban Design & Landscape Detailed Design Report IA098200-GUD-RP-185. (SMM, Dated September 2017).*
20. *Thompson Square Windsor NSW, Interpretation Plan, Draft (AAJV, Dated November 2017).*
21. *Detailed design drawings Vol 11.1 Bridge – Drawing No. DS2012/000155 (Sheets 141 and 142 - Issue 2)*
22. *Webb. Thompson Square street lighting calculation drawings M963A (Pages 3 and 4 Dated 18/10/2017).*
23. *Thompson Square and Windsor Bridge, Windsor, Detailed Photographic Archival Recording (AAJV, Dated 12 February 2018)*
24. *Brick Barrel Drain Design Drawings Issue 3 – Various Sheet Numbers and Issues, Dated 6/4/2018*
25. *Technical advice regarding brick barrel drain*
  - *Windsor Bridge Replacement Project – Preservation of Brick Barrel Drain (overarching advice provided by Jacobs, dated 24 April 2018)*
  - *Windsor Bridge Project – Conservation of Archaeological Remains (International Conservation Services, dated 24 April 2018)*
  - *Windsor Bridge Replacement Project – Barrel Drain – Potential Piling Vibration Impacts (Jacobs, dated 9 March 2018)*
  - *Windsor Bridge Replacement Project – Loads imposed on brick barrel drain (Jacobs, dated 23 March 2018).*



26. *Windsor Bridge Replacement Hydrological Mitigation Report Document No. IA098200-NHY-RP-259 (Revision F) Dated 15 November 2017.*
27. *Detailed design drawings Volume 2 – Roadworks - Drawings No. NB98005-ECC-DG-0252 and 0236 – IFT rev 2 Dated 3/11/2017.*
28. *Detailed design drawings Volume 12 – Landscape design - Drawings No. NB98005-ESD-DG-0109 and 0303 – IFT rev 2 Dated 3/11/2017*
29. *Windsor Bridge Replacement Urban Design and Landscape Plan Submissions report (Roads and Maritime, Dated September 2017)*