7.4 OVERSHADOWING

This section considers the potential overshadowing impacts of the replacement bridge on the public domain areas of Thompson Square, the Hawkesbury River waterway, the northern foreshore and adjoining private properties.

BACKGROUND

The shadow cast by the existing bridge is restricted to the water directly under the bridge and the pedestrian accessible area at the southern abutment due to its relatively low elevation above the river. Early morning and late afternoon shadows extend beyond the footprint of the bridge over the river, although the numerous trees growing along both foreshores and in the adjoining parklands mostly cast their shadows over the river and the bridge.

The replacement bridge would, by contrast, cast a larger and more obvious shadow across the water and the foreshore areas around the abutments due largely to the increased elevation and width of the new structure. The areas affected by overshadowing would include the lower areas of Thompson Square and the adjoining areas along the southern foreshore; areas of the northern foreshore adjacent to the bridge abutment, and the river itself.

The potential overshadowing impacts have been analysed using the accompanying shadow diagrams which were prepared by Urban Circus using a computer model of the study area and the proposed replacement bridge. The two sets of following diagrams depict the shadows cast by the replacement bridge during the winter solstice (21 June) and the summer solstice (21 December) at three times of day; 9am, midday and 3pm.

For the purposes of the analysis the existing vegetation and the proposed replacement tree planting have been excluded from the model. The absence of vegetation portrays a clearer depiction of the extent of overshadowing caused by the replacement bridge. The existing vegetation, when combined with mature replacement tree planting, proposed as a part of the concept for the project, would substantially increase the amount of overshadowing of the river and both foreshores.

Thompson Square and the adjoining foreshore

The potential overshadowing effects of the replacement bridge would commence where the approach road on the alignment of Old Bridge Street becomes elevated on a fill embankment as it approaches the abutment. The lower areas of Thompson Square closer to the river foreshore would be mostly affected by overshadowing in the early morning during winter when the sun's angle is low and in the north eastern sky. Overshadowing would still occur during summer although to a lesser degree due to the morning sun rising in the south east and on a higher trajectory through the sky. Whilst the shadow cast by the replacement bridge would obscure the sun in a section of the lower parkland in the morning, the majority of the parkland would not be overshadowed by the replacement bridge and the approach road embankment and therefore park users would have access to sun in other areas of the parkland.

Trees currently growing in the parkland in Thompson Square and along the foreshore, between The Terrace and the river, create a dappled overshadowing effect in this area, however most of the trees within the project area would be removed during the construction of the replacement bridge and the foreshore retaining wall. Therefore current patterns of overshadowing in this area would change when the bridge was constructed, however replacement plantings of trees proposed in this area would gradually increase the levels of overshadowing throughout the day, as these trees mature.

The section of The Terrace and adjoining foreshore which would be located directly beneath the replacement bridge, immediately adjacent to the abutment, would be in deep shadow for extensive periods of the day during all seasons of the year. Midday sun in summer would result in a deep shadow approximately 15 metres wide, directly under the replacement bridge. However morning sun would see a wider shadow start to the west of the replacement bridge and gradually cross over to the eastern side of the replacement bridge as the sun's trajectory passes across into the western sky and eventually to the horizon. Although existing trees in the area currently cast shadows across these areas of The Terrace and the foreshore, the replacement bridge will cause continual and more solid shadow to occur in this area.

Adjoining private properties

Based on the current design, there is only one private property that could potentially be affected by limited overshadowing from the replacement bridge This property is No. 4 Old Bridge Street, which is closest to the proposed abutment. However, this would only occur very late in the afternoons as the sun is setting. The area of the property most likely to be affected would be the garden area below the house and closest to the river foreshore. Trees growing along the foreshore and in the adjoining car park area, would also cast shadows around this time over the lowest parts of this garden. Overshadowing effects of the replacement bridge on this property would be unlikely to have a deleterious effect on the use of this garden area.

The northern foreshore

The current northern foreshore area, in the vicinity of the proposed roundabout and northern approaches to the replacement bridge, is predominately cleared of trees, except for the area immediately adjacent to the river foreshore. The proposed construction works for the replacement bridge would require the removal of these trees around the abutment and in the adjoining areas where earthworks including foreshore scour protection would be required. The overshadowing caused by these trees would be replaced to some extent by the overshadowing caused by the bridge and adjoining earthworks associated with the abutment, as well as replacement plantings of trees proposed in this area, which would gradually increase the levels of overshadowing throughout the day, as the trees mature.

Although the replacement bridge deck at the northern end is slightly wider than at the southern foreshore, the lower clearance at this northern end of the replacement bridge, combined with the approach road being mostly level with the existing grade, less overshadowing is likely in this area. Overshadowing of the northern foreshore and would be mainly restricted to the undercroft of the bridge and an area either side. The longest shadows would occur in Winter during the early morning when the area to the west of the abutment would be in shadow. These areas are to be used by pedestrians and cyclists moving through the area and the balance of the area for vegetation to create a parkland, as well as foreshore stabilisation and screening of the scour protection works.

The river

The bridge deck would cast a distinct shadow over the river moving from west to east throughout the whole day. The shadow would appear over the water on the western side of the replacement bridge in the morning and whilst being of a substantial width it would be diffuse in appearance. As the sun rose into the sky, the shadow would migrate closer to the replacement bridge in an easterly direction, and increase in intensity until it was aligned directly under the replacement bridge deck. As the sun tracked to the west, the shadow would continue moving to the east and become increasingly diffuse until the sun set.

The public wharf currently provides the only stationary activity over the water in this location and whilst the replacement bridge would be closer to the wharf than the existing bridge, it is not likely to affect the wharf activities due to overshadowing, as this would occur only in the very late afternoon. Boating is unlikely to be affected by the overshadowing of the river by the replacement bridge. The existing bridge is proposed to be demolished and this would lessen the cumulative overshadowing of the river, if it were to be retained.

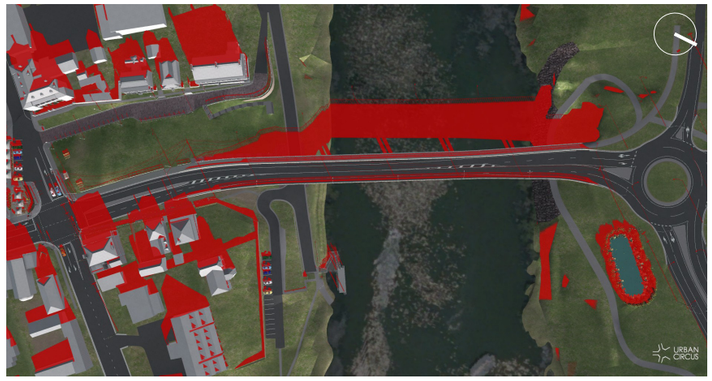
CONCLUSION

The greatest overshadowing impacts would be most likely experienced on the southern foreshore due to the height, width and length of the approach road, abutment and the elevated replacement bridge deck over The Terrace and the foreshore. The overshadowing of these areas is likely to affect users' experience, depending on the time of day and the season. These effects are likely to be relatively temporary as people would be mostly moving through the area. There is potential for these foreshore areas to have increased pedestrian and cycle activity which would be subjected to the increased overshadowing. However as the increased activity is likely to be generated in part, by the improved access created when Bridge Street is removed from Thompson Square, creating direct access to the river foreshore, this overshadowing would be an unavoidable but not significant outcome.

Some overshadowing impacts would occur on the northern foreshore although these would be limited to a relatively confined area along the foreshore and only affect passing pedestrians and cyclists for a relatively short period of time.

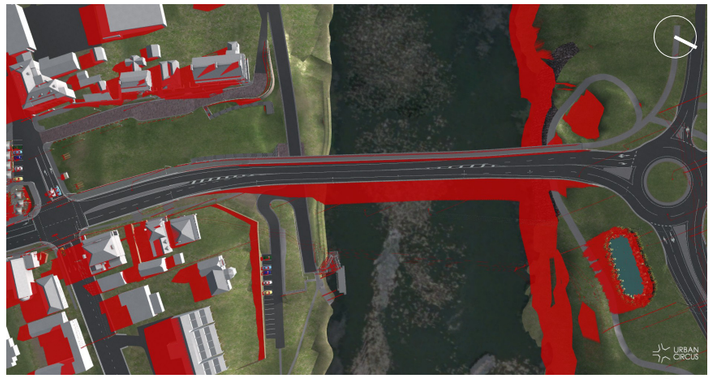
Overshadowing would occur on the river however it would be unlikely to impact any activities occurring on the water.

21st JUNE



9am

12pm



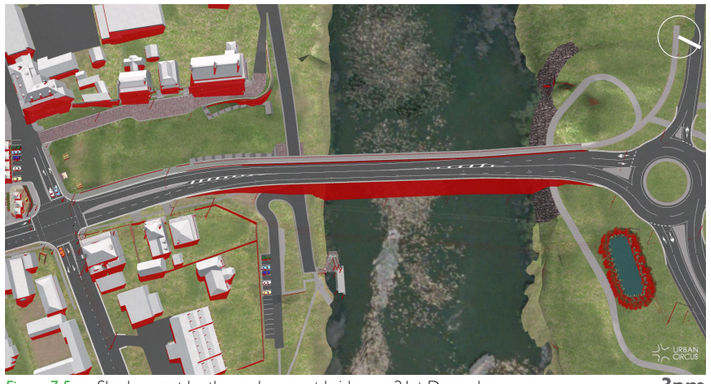
3pm

Figure 7.4: Shadow cast by the replacement bridge on 21st June.

21st DECEMBER

9am

12pm



3pm

Figure 7.5: Shadow cast by the replacement bridge on 21st December.

7.5 MITIGATION STRATEGY

INTRODUCTION

This section describes the mitigation measures that have been undertaken as part of the concept design phase, described in Chapter 6 of this report and a summary of further mitigation measures to be undertaken during the detailed design and construction phases of the project. They have been developed in accordance with the urban design and landscape objectives and principles, outlined in Chapter 5.

MITIGATION INCORPORATED IN THE CONCEPT DESIGN

The integration of the engineering and performance objectives with urban and landscape design objectives for the Windsor bridge replacement project aims to produce a design outcome that has high visual quality. In order to achieve this, a range of mitigation measures have been incorporated into the project as the concept has developed. These measures combine to develop a solution that seeks to protect and enhance the existing visual character of the Windsor township, the Hawkesbury River and floodplain, where possible.

The mitigation measures that have been undertaken during the development of the urban and landscape design concept are summarised in Table 7.2.

Table 7.2: SUMMARY OF MITIGATION MEASURES FOR THE PROJECT.

PROJECT ELEMENT	SUMMARY OF MITIGATION MEASURES INCLUDED IN THE CONCEPT DESIGN PHASE OF THIS PROJECT
The bridge The new bridge would be a prominent feature in the landscape. During the design process, a number of decisions were undertaken to minimise the impact of the new structure.	¬ The selection of a design speed of 50km/h would allow for the bridge level to be kept as low as possible to the existing ground level on the approaches from the north and south. ¬ The selection of an incrementally launched bridge type would minimise the number of piers required, keeping views through and across the bridge as open as possible. ¬ The selected bridge type would allow for structural members to be below the bridge deck level, minimising the bulk and impact of the structure from surrounding elevated areas. ¬ The bridge piers with a curved form would give them a finer appearance. ¬ The placement and design of bridge abutments has been undertaken to improve access along the river foreshore and this would provide better surveillance to deter vandalism and anti social behaviour. ¬ The placement of the vehicle barriers between the travel lanes and the shared path allows for the placement of a pedestrian railing on the outside of the bridge which creates a finer and more transparent edge to the bridge.
Thompson Square Reducing the impact of the project on the existing character of Thompson Square has been a high priority for this project.	¬ Direct access through and around Thompson Square is provided by the infilling of the existing Bridge Street cutting, consolidating the parkland and providing a more direct connection down to the river. ¬ Views across the upper area of Thompson Square have been maximised through the siting of the bridge approach road as close as possible to existing ground levels. ¬ Improved pedestrian access has been achieved with the placement of traffic signals at the Bridge Street and George Street intersection.

PROJECT ELEMENT	SUMMARY OF MITIGATION MEASURES INCLUDED IN THE CONCEPT DESIGN PHASE OF THIS PROJECT
The Terrace and river foreshore Re-connection of The Terrace along the river's edge providing access to the river.	¬ The removal of Bridge Street would allow The Terrace to be reconnected, facilitating pedestrian and cycle movements between the foreshore parklands. ¬ Revegetation of the foreshores would assist in integrating the scour protection works on the foreshores. ¬ The foreshore area would be rehabilitated with suitable riparian vegetation once the scour protection works would be constructed.
The northern foreshore and intersection Integration of the northern intersection works into the existing character and adjoining land uses has been considered as part of this project.	¬ Pedestrian and cyclist access is provided around the intersection and under the abutment. ¬ New tree planting would be undertaken in the area surrounding the roundabout works, reducing the scale of the works over time as the tree planting matures. ¬ The design of the water quality basin would be refined to create a more natural form and its size reduced to the minimum operational size and it would be planted with native riparian species. ¬ Construction of the rock faced scour protection with roughly dimensioned sandstone blocks, loosely coursed, would create a more ordered and more attractive appearance. ¬ The spaces between the scour protection rocks would be planted, wherever possible, with sedges to minimise the hard visual appearance of the works.

MITIGATION TO BE INCORPORATED INTO DETAILED DESIGN

Following the environmental approval process, it is recognised that further work will be required to develop the final urban design and landscape plan for the project.

Whilst development of the concept design has attempted to mitigate the overall impact of the project focussing on the major project components, their design and integration within the Hawkesbury River and Windsor setting, opportunities will arise during detail design to further refine the design of the project to produce more positive urban design outcomes.

Table 7.3 contains a summary of the key mitigation and management strategies that would be undertaken during detail design of the project.

The urban design and bridge design objectives and principles outlined in section 5.2 and 5.3, together with the urban design, landscape and bridge design concept included in chapter 6, would be used to further guide the detailed design of key project elements of the new bridge, approach roads and public domain areas.

A preliminary list of detail items and elements which is included in Appendix D, will be considered as a basis to guide specific aspects of the detailed design process. These items have been identified by the project design team and from comments received through the consultation process to date. It is recognised the list is preliminary only and that many further opportunities would likely arise during the detail design phase and as a result of further consultation and design development by the project team. The detailed design process would be driven by the need to further minimise impacts on views and vistas wherever practicable.

Table 7.3: DETAILED DESIGN MITIGATION STRATEGY.

PROJECT ELEMENT	SUMMARY OF MITIGATION MEASURES TO BE UNDERTAKEN DURING THE DETAILED DESIGN PHASE OF THE PROJECT
The bridge The new bridge would be a prominent feature in the landscape. During the detail design process, further measures would be examined to reduce the impact of the new structure on the area.	¬ Refinement of the bridge, its abutments and constituent parts and details to ensure a high quality outcome in response to its prominence within the Hawkesbury River's landscape setting and the township of Windsor. ¬ Lighting design would be refined to integrate with the design and character of the bridge, approach roads and public domain, with consideration of minimising potential impacts associated with light spill and glare.
Thompson Square Reducing the impact of the project on the existing character of Thompson Square would be considered in greater detail during the detail design phase.	¬ Further consultation would be undertaken with Hawkesbury City Council and other relevant stakeholders to develop an urban design, landscape and open space use plan for Thompson Square and adjacent areas on the southern foreshore. ¬ The concept design of Thompson Square presented in this proposal would form the basis for ongoing consultation. ¬ Retention and protection of as many trees as possible will be undertaken but in particular the most significant existing trees would be incorporated into the design wherever possible. ¬ Review the potential benefits of locating the shared path on the eastern side of the proposed bridge to increase the area of green space in Thompson Square. ¬ New tree planting would be consistent and complement the existing species that are to be retained. Planting locations would facilitate direct views to the river and screen the replacement bridge where possible. ¬ Any new lighting would strike a balance between illumination for safety and the context of the parkland and its adjoining areas.

PROJECT ELEMENT	SUMMARY OF MITIGATION MEASURES TO BE UNDERTAKEN DURING THE DETAILED DESIGN PHASE OF THE PROJECT
The Terrace and river foreshore Further refinement of the re-connection of The Terrace along the river's edge would be considered in the detail design phase.	¬ Further consultation would be undertaken with Hawkesbury City Council to develop an urban design, landscape plan for the southern foreshore and adjacent areas. ¬ Further design refinement of The Terrace and foreshore area to achieve high quality public access and amenity along the river's edge and to the river, including the appropriate provision of lighting where required. ¬ Detailed design of the form, materials and finishes of the foreshore retaining wall would be undertaken to maximise the integration of the wall into the river setting. ¬ Consideration would be given to the design of The Terrace roadway including materials and form and to integrate it into the surrounding parkland. ¬ New tree, shrub and groundcover planting would be incorporated in the foreshore areas to enhance the parkland setting and views to the river.
The northern foreshore and intersection Integration of the northern intersection works into the existing character and adjoining land uses would be considered in greater detail during the detail design phase.	¬ Further consultation would be undertaken with Hawkesbury City Council to develop an urban design, landscape plan for the northern foreshore and adjacent areas. ¬ Further design refinement would be undertaken to improve the integration of the northern intersection responding to its location and role as the northern arrival point to Windsor and Macquarie Park ¬ Safe pedestrian and cycle connections throughout the project and links with existing path network within Macquarie Park would be further examined. ¬ Appropriate provision for lighting would be considered and lighting infrastructure utilised only where required.
Pedestrian and cycle access Further refinement of the pedestrian and cycle access will occur in the detail design phase.	¬ Further consultation would be undertaken with Hawkesbury City Council to develop a pedestrian and cycle access plan for the project and the surrounding area, in order to integrate the pedestrian and cycle connections into the surrounding network.

MITIGATION DURING CONSTRUCTION

The following mitigation measures would be implemented during construction:

- Detail design and documentation drawings would define the extent of all construction activity including temporary works in order to protect the area during construction.
- Construction facilities should be contained within the construction works zone boundary and occupy the minimum area practicable for their intended use.
- Provide suitable barriers to screen views from adjacent areas during construction.
- Once construction is complete, or progressively throughout the works where possible, return these sites to at least their pre-construction state.
- Keep pollution and dust emissions to a minimum and monitor throughout the project construction period.
- Divert or re-route footpaths that would be affected by construction activities.
- Existing trees to be retained within construction facilities areas would be identified, protected and maintained.
- Temporary lighting should be screened or diverted to reduce unnecessary light spill.
- Heritage items should be protected, as identified in the heritage working paper.
- Material used for temporary land reclamation would be removed once the works are complete.