2 Design objectives and criteria

2.1 Design objectives

The primary objective of the study is to alleviate traffic congestion along the corridor between Richmond and North Richmond. The secondary objective of the study is to provide an improved level of flood immunity for the corridor. To support these key objectives, the following additional objectives also need to be satisfied by the study:

- Ensure the operations of Richmond Bridge and its approaches can be maintained during construction.
- Maintain/Improve the accessibility of Richmond Bridge.
- Minimise the impacts on the built and natural environment along the route.
- Improve safety for pedestrians, cyclist and motorists.
- Minimise the project whole of life cost.

2.2 Design criteria

2.2.1 Engineering standards

The following Engineering Standards have been used in the development of the strategic concept options:

- AUSTROADS (previously NAASRA) Guidelines and publications.
- RMS Supplements and Technical Directions.
- Australian Standards

2.2.2 Road design criteria

The following road design criteria have been adopted in the development of the options:

- The provision of the necessary number of travel lanes along the corridor and with suitable intersection treatments to provide an acceptable Level of Service to manage traffic congestion in 2036.
- The mainline carriageway horizontal alignment is to be designed for a design speed of 70km/h in the town centres and 90km/h outside the town centres.
- The mainline carriageway vertical alignment is to be designed for a design speed of 70km/h in the town centres and 90km/h outside the town centres.

The road design criteria are summarised in Table 1 below.

Table 1 - Road Design Criteria

Road design element	*Description*
Design speed – urban section	70km/h
Design speed – rural section	90km/h
Sign posted speed limit – urban and rural sections	10km/h less than the design speed
Stopping Sight Distance (SSD) – rural section	120 metres with a reaction time of 1.5 seconds
Stopping Sight Distance (SSD) – urban section	80 metres with a reaction time of 1.5 seconds

2.2.3 Typical cross section and clearances

Typical cross section and clearance dimensions are summarised in Table 2 below.

Table 2 - Typical cross section and clearances design criteria

Cross section element	*Minimum values (and range)*
Lane width	Existing carriageway: 2.9 - 3.2 metres New carriageway: 3.0 - 3.5 metres
Typical median width	Minimum width = 4.2 metres (where applicable)
Typical verge width	2.0 metres or retaining existing width
Shoulder width	Existing carriageway - 0.5 metres New carriageway: 1.5 - 2.0 metres (where applicable)
Shared use path width	3 metres
Footpath width (existing)	1.2 metres
Vertical clearance	5.3 metres

2.2.4 Bridge design criteria

The following bridge design criteria has been adopted in the development of the options:

- Australian Standard 5100 (Bridge Design Code).
- RMS Supplements and Technical Directions.
- 100 year design life.

Bridge design criteria are summarised in Table 3 below.

Table 3 - Bridge design criteria

Bridge design element	*Description*
Lane width	3.25 metres for Option A 3.5 metres for Options B, C, D
Shoulder width	2.0 metres for Option A 1.5 – 2.0 metres for Options B,C and D
Footpath width	Existing width of footpath (2.1 metres) for Option A 3 metre wide shared use path for Options B, C, D
Contra flow barrier width	0.6 metres (Option A only)
Longitudinal grade	To match the road alignment
Crossfall	3 percent to match the road alignment
Superstructure	Classified as partially submerged as closed cell structures are considered unsuitable
Design loads	Theoretical design loads to model traffic loadings (SM1600 and HLP400).

2.3 Road design constraints

The road design constraints along the corridor include the following:

- The existing Richmond Bridge.
- Existing property boundaries.
- The existing alignment through a built up urban area with mixed land uses in Richmond from East Market Street to Chapel Street (along March Street and Kurrajong Road) and in North Richmond, Bells Line of Road from the Hannapak industrial complex to Grose Vale Road/Terrace Road.
- Sensitive heritage (Aboriginal and non-Aboriginal) elements.
- Flora and fauna habitats and species.
- Conflict with utility services.

2.4 Urban design assessment parameters

The urban design vision parameters for this project were to develop and present an integrated engineering and urban design outcome that:

- Fits sensitively into the built, natural and community environments through which the bridge, its approaches and associated traffic upgrades pass.
- Is well designed and contributes to the character and function of the area.
- Contributes to the overall quality of the public domain for the community and all road users.

In addition to the urban design vision parameters, a number of principles were agreed in order to inform the development of the various Stage 2 proposals. These included:

- Principle 1 - Contributes to urban structure and revitalisation.
- Principle 2 - Fits into the built fabric.
- Principle 3 - Connects modes and communities.
- Principle 4 - Fits the landform.
- Principle 5 - Responds to the natural pattern.
- Principle 6 - Incorporates heritage and cultural contexts.
- Principle 7 - Designs (provide) an experience in movement.
- Principle 8 - Creates self-explaining road environments.
- Principle 9 - Achieves an integrated and minimal maintenance design.

2.4.1 Characteristics of the local area

The corridor currently provides a single lane in both directions on a relatively straight alignment. It travels through several types of landscape, varying from commercial and light industrial through to residential to rural.

From Richmond the alignment rolls down the river terrace at the western end of town to the rural floodplain and Hawkesbury River before bending in a west-north-west direction to cross the river via Richmond Bridge. At this point the alignment curves down to meet the bridge on either side before heading straight again through North Richmond.

The study area can be separated into four distinct landscape zones. These are defined as:

Zone 1 – Richmond

This zone is characterised by the urban development of the suburb of Richmond, set on the flood terrace above the river and floodplain. Its character is defined by a streetscape of small deciduous trees and a mix of modern and historic single and double storey properties. The carriageway consists of parking lanes and traffic lanes providing a total width of four lanes. Several intersections reflect the grid layout of Richmond. Two of these intersections are traffic signal controlled.

Zone 2 – Hawkesbury Nepean floodplain

This zone is characterised by a wide flat floodplain of essentially pasture grasses reflecting the agricultural usage of the area. Stands of trees screen or interrupt views with forestry plantation and boundary/fence line plantings along the corridor.

Zone 3 – Hawkesbury River and Richmond Bridge

This zone is defined by the river banks and associated riparian vegetation. It forms a well-defined and contained unit. The bridge is a heritage structure of distinctive form and engineering significance. It provides an attractive asset crossing the river with the arched form of its superstructure a defining element.

Zone 4 – North Richmond

This zone is located on the western bank of the river on the adjoining flood terrace. It is characterised by the development of North Richmond which is relatively recent compared to Richmond, with big box Industrial and commercial development dominating the streetscape.

2.5 Study area investigations

A number of investigations have been undertaken in order to inform and refine the options identified in this report. These investigations include:

- A review of Stage 1 proposals which has been used to inform and identify short term congestion mitigation measures.
- Completion of a Traffic and Transport Assessment based on the traffic modelling information undertaken for the Stage 1 investigations and RMS strategic modelling for the corridor. As part of Stage 2 preliminary modelling of the intersections along the March Street, Kurrajong Road, Bells Line of Road corridors has also been carried out.
- A built and natural landscape character and visual assessment of the corridor.
- A search of electronic ecological databases of areas within 10 kilometres of the study areas and a field survey.
- A search of the NSW Government Department of Primary Industries (DPI) Fishing and Aquaculture records for listed aquatic and marine taxa to identify the listed species that may be present in the study area.
- Recordings taken to identify potential bat habitat under the existing bridge structure.
- Reviews of the State Heritage Inventory (SHR) and Draft Hawkesbury Local Environmental Plan (HLEP) 2011 to identify any non-Aboriginal heritage items.
- A search of the Aboriginal Heritage Information Management System (AHIMS) database.
- National Native Title Tribunal applications database searches.
- Flood modelling.
- Dial Before You Dig (DBYD) utility service investigations and communication with utility service providers with services in the study area.
- Atlas of NSW Wildlife for threatened flora records (for locations within 10 kilometres of the study area)
- Australian Heritage Database.
- DPI Noxious Weeds list for the Hawkesbury LGA
- EPBC Protected Matters Search database.
- Former Department of Infrastructure, Planning and Natural Resources (DIPNR) Potential Acid Sulphate Soils (ASS) Database.
- National Pollutant Inventory website.
- NSW Directory of Important Wetlands for wetlands within the Hawkesbury LGA,
- NSW Office of Environment and Heritage, Cumberland Plain Endangered Ecological Community Mapping
- OEH Contaminated Lands Records for the Hawkesbury LGA.