PRELIMINARY ROUTE OPTIONS REPORT

Part 2

6 Preliminary route options

This chapter describes the five corridors and the 25 preliminary route options within these corridors for assessment and short-listing purposes.

The 25 preliminary route options are presented in Figure 52. These options were initially identified in the *Feasibility Assessment Report* (RTA, June 2011) and include options that were suggested by the community during community consultation following the release of the February 2010 and December 2010 community updates.

Since the release of the June 2011 *Feasibility Assessment Report*, the project team has undertaken engineering refinements to the 25 preliminary route options. The refined preliminary route options incorporating engineering refinements are shown in Appendix 4.

As shown in Figure 52 and Table 15, the preliminary route options are grouped into five corridors which represent the strategic desire lines across the Clarence River.

Table 15: Preliminary route options within the five corridors.

Corridor	**Corridor description**	**Preliminary route options** (from upstream to downstream)
Corridor 1	Corridor 1 comprises the preliminary route options upstream of the existing bridge, connecting the Gwydir Highway at South Grafton from Abbott Street and Cowan Street to the Grafton central business district at Villiers Street.	Option F Option E
Corridor 2	Corridor 2 comprises preliminary route options in the vicinity of the existing bridge, connecting from the Pacific and Gwydir highways between Wharf Street and Alipou Creek in South Grafton to the Grafton central business district between Fitzroy Street and Bacon Street.	Option 5 Option A Option B Option 6 Option C Option D Option I Option 8 Option 9 Option 10
Corridor 3	Corridor 3 is located downstream of the existing bridge and upstream of North Street, connecting the Pacific Highway east of South Grafton to the area north of the Grafton central business district (south of North Street). It includes preliminary route options between McClaers Lane and Eggins Lane / Meona Lane in South Grafton, and between Fry Street and Crown Street in Grafton.	Option 11 Option J Option K Option 12 Option L
Corridor 4	Corridor 4 contains preliminary route options downstream of the existing bridge, connecting the Pacific Highway east of South Grafton to North Street in Grafton.	Option 14 Option 20 Option 21 Option M
Corridor 5	Corridor 5 contains preliminary route options connecting the Pacific Highway east of South Grafton and the Summerland Way, north of North Street in Grafton. It is the corridor furthest downstream from the existing bridge.	Option 15 Option 23 Option 25 Option 26

Basic engineering plans and longitudinal section drawings of the 25 preliminary route options are presented in Appendix 4 while a summary description of the options is presented below. Table 15 above and the summary description are ordered from Corridor 1 to Corridor 5, and from upstream

to downstream within each corridor. Hence, the numbering and lettering of some of the options are not in ascending or alphabetical order.

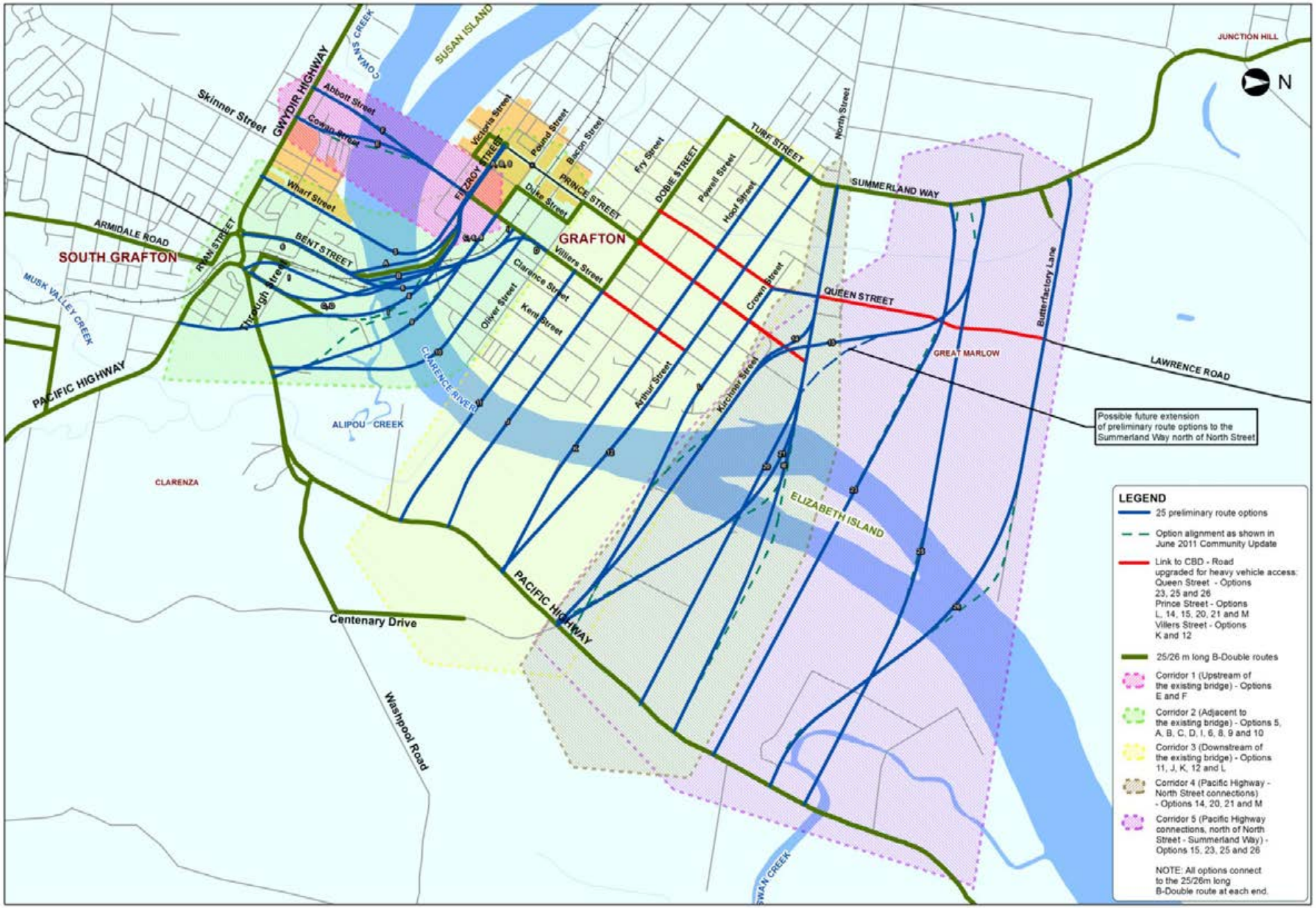

Figure 52: Preliminary route options and corridors.

6.1 Corridor 1

Corridor 1 comprises the preliminary route options upstream of the existing bridge, connecting the Gwydir Highway at South Grafton from Abbot Street and Cowan Street to the Grafton central business district at Villiers Street. Table 16 describes the preliminary route options identified within Corridor 1 as shown in Figure 53.

Table 16: Preliminary route options in Corridor 1.

Preliminary route options	Description
Option F	This option consists of a new bridge west (upstream) of the existing bridge and immediately south-east (downstream) of Susan Island. It would connect to the Gwydir Highway at Abbott Street in South Grafton and to Villiers Street in Grafton. Subsequent to the June 2011 Community Update, the alignment for this option has been refined by moving it slightly downstream to straighten the bridge alignment. This allows for an incrementally launched bridge to be constructed. The option would extend along Villiers Street beneath the existing railway viaduct (between Pound and Bacon Streets) where the vertical clearance would be increased to 5.3 m. Option F would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 1.
Option E	This option consists of a new bridge west (upstream) of the existing bridge and south-east (downstream) of Susan Island, slightly downstream from Option F. It would connect to the Gwydir Highway at Cowan Street in South Grafton and to Villiers Street in Grafton. Subsequent to the June 2011 Community Update, the alignment for this option has been refined slightly so that the horizontal curve extends for the full length of the bridge. This allows for an incrementally launched bridge to be constructed. The option would extend along Villiers Street beneath the existing railway viaduct (between Pound and Bacon Streets) where the vertical clearance would be increased to 5.3 m. Option E would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 2.

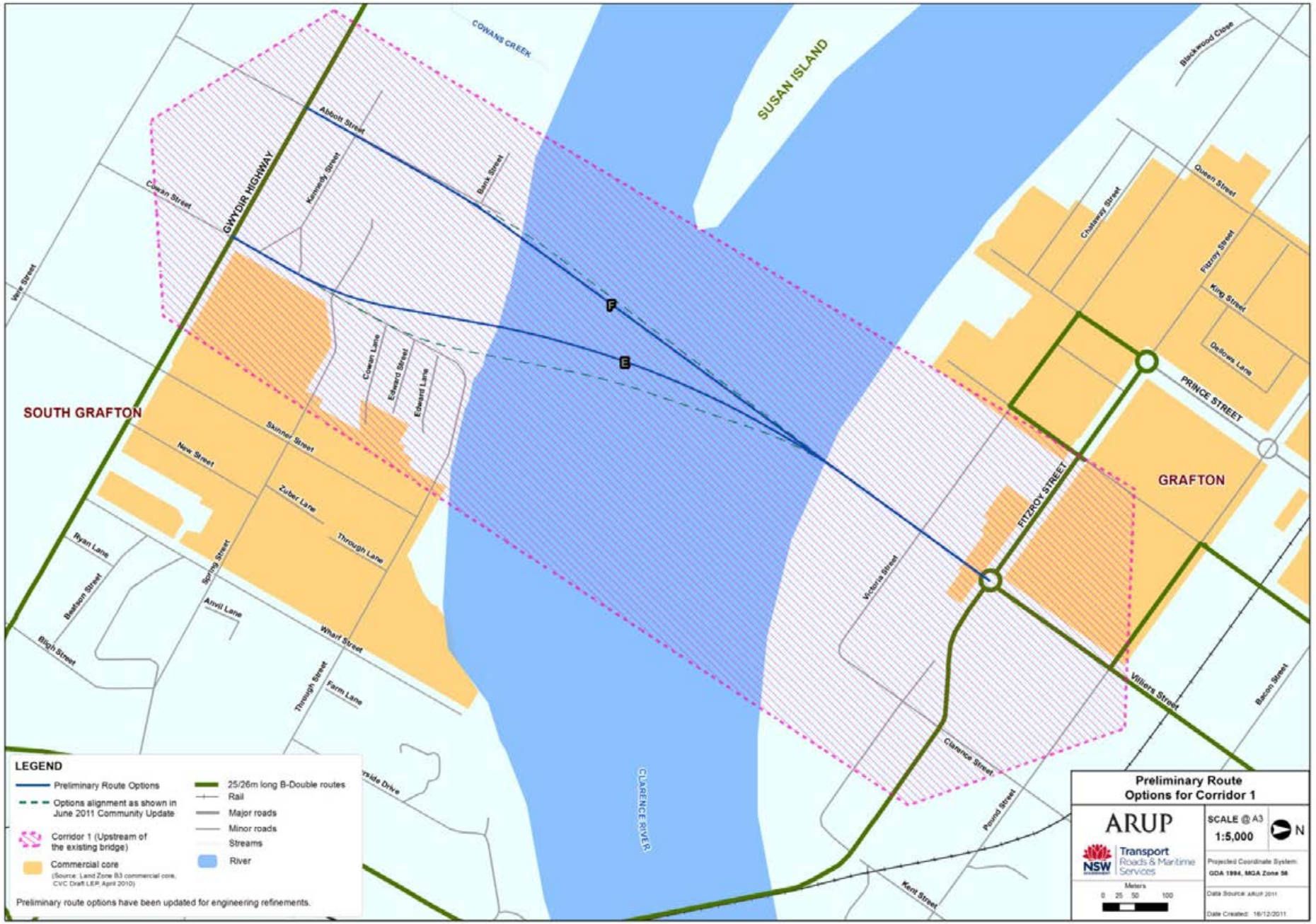

Figure 53: Preliminary route options in Corridor 1.

6.2 Corridor 2

Corridor 2 comprises preliminary route options in the vicinity of the existing bridge, connecting from the Pacific and Gwydir Highways between Wharf Street and Alipou Creek in South Grafton to the Grafton central business district between Fitzroy Street and Bacon Street. Table 17 describes the preliminary route options identified within Corridor 2 as shown in Figure 54.

Table 17: Preliminary route options in Corridor 2.

Preliminary route options	Description
Option 5	This option consists of a new bridge west (upstream) of the existing bridge. It would connect to the Gwydir Highway at Wharf Street in South Grafton and to Fitzroy Street in Grafton. This option would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). The existing bridge would remain as one northbound lane and one southbound lane. However, the approach roads to the existing bridge in Grafton would be diverted to connect to Pound Street. A plan and longitudinal section for this option are presented in Appendix 4, sheet 3.
Option A	This option is the same as 'Option 2A' that was considered in the corridor evaluation workshop held in April 2004 (Refer to Figure 63). It consists of a new bridge parallel and immediately west (upstream) of the existing bridge and connects to the existing road network at Bent Street in South Grafton and to Fitzroy Street in Grafton. This option would have two northbound lanes and one southbound lane for vehicles and a cycle/pedestrian lane. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). The existing bridge would become a one-lane southbound bridge. A plan and longitudinal section for this option are presented in Appendix 4, sheet 4.
Option B	This option is the same as 'Option 2B' that was considered in the corridor evaluation workshop held in April 2004 (Refer to Figure 63). Option B consists of a new bridge parallel and immediately east (downstream) of the existing bridge. It connects to the existing road network at Bent Street in South Grafton and to Fitzroy Street in Grafton. This option crosses over the rail line twice, once on the south side of the river and once on the north side. Each of these crossings would provide a vertical clearance of 5.2m above the rail line. Option B would have one northbound lane and two southbound lanes for vehicles and a cycle/pedestrian lane. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). The existing bridge would become a one-lane northbound bridge. A plan and longitudinal section for this option are presented in Appendix 4, sheet 5.
Option 6	This option consists of a new bridge immediately east (downstream) of the existing bridge. It connects to the existing road network at Bent Street in South Grafton and Pound Street in Grafton. Subsequent to the June 2011 Community Update, the alignment of this option has been refined so that the horizontal curve extends for the full length of the bridge. This allows for an incrementally launched bridge to be constructed. The southern approach would pass above the rail line with a vertical clearance of 5.2 m. The northern approach section between Kent Street and Clarence Street would pass beneath the existing railway viaduct to achieve a vertical clearance of 5.3 m and would connect to the existing road network in Grafton at Pound Street. Option 6 would have one northbound lane and two southbound lanes for vehicles and a cycle/pedestrian lane. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). The existing bridge would become one northbound lane only. A plan and longitudinal section for this option are presented in Appendix 4, sheet 6.

Preliminary route options	Description
Option C	This option consists of a new bridge parallel and immediately east (downstream) of the existing bridge. It would connect to the Pacific Highway at Iolanthe Street in South Grafton and to Pound Street in Grafton. This option would include a new intersection with the Pacific Highway south-west of Bunnings Warehouse. The new northern approach would be lowered beneath the existing railway viaduct (between Kent Street and Clarence Street) to achieve a vertical clearance of 5.3m and would connect to the existing road network in Grafton at Pound Street. Option C would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 7.
Option D	This option consists of a new bridge parallel and immediately east (downstream) of the existing bridge. It would connect to the Pacific Highway at Iolanthe Street in South Grafton and to Villiers Street in Grafton. This option would include a new intersection with the Pacific Highway south-west of Bunnings Warehouse. Option D would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 8.
Option I	This option consists of a new bridge immediately east (downstream) of the existing bridge. The southern approach would start with a new intersection at the junction of the Gwydir Highway and Pacific Highway in South Grafton. A new road would run alongside the eastern edge of the existing railway line in South Grafton. On the Grafton side of the river, the new road would follow the existing railway line to connect into Villiers Street. Option I would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 9.
Option 8	This option consists of a new bridge east (downstream) of the existing bridge. It would connect to the Pacific Highway at Heber Street, cross the Pacific Highway near Bunnings Warehouse, and then connect to Fitzroy Street in Grafton. Subsequent to the June 2011 Community Update, the alignment of this option has been refined at the southern end so that it follows Heber Street rather than Federation Street, reducing the impact on residential properties. The alignment for this option has also been moved slightly upstream so that the horizontal curve extends for the full length of the bridge. This allows for an incrementally launched bridge to be constructed. On the Grafton side of the river it crosses above the railway line in the vicinity of Kent Street. This crossing would provide a vertical clearance of 5.2 m above the railway line and would connect to the existing road network at Fitzroy Street. In Grafton, northbound traffic would overpass the approach to the existing bridge and merge back in with the existing northbound traffic along Fitzroy Street prior to Villiers Street. Southbound traffic would split prior to the northbound overpass near Clarence Street to use either the new or existing bridge (See Appendix 4, sheet 10). Option 8 would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 10.

Preliminary route options	Description
Option 9	This option consists of a new bridge east (downstream) of the existing bridge. It would create a new intersection with the Pacific Highway in the proximity of Alipou Street in South Grafton and would connect to Pound Street in Grafton. Subsequent to the June 2011 Community Update, the alignment for this option has been refined to follow a single horizontal curve across the river. This allows for an incrementally launched bridge to be constructed. A section of the Pacific Highway would require upgrading to provide 1 in 20 year flood immunity. The northern approach between Kent Street and Clarence Street would be lowered beneath the existing railway viaduct to achieve a vertical clearance of 5.3 m and would connect to the existing road network at Pound Street. This option would include a short viaduct structure across the floodplain south of the Clarence River. Option 9 would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 11.
Option 10	This option consists of a new bridge east (downstream) of the existing bridge and would create a new intersection with the Pacific Highway in the proximity of Alipou Street in South Grafton and would connect to Bacon Street in Grafton. A section of the Pacific Highway would require upgrading to provide 1 in 20 year flood immunity. This option would include a short viaduct structure across the floodplain south of the Clarence River. It would also include an upgrade of Bacon Street to enable it to meet future traffic volumes. Option 10 would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). The existing bridge would remain as one northbound lane and one southbound lane. Option 10 would provide a 15 m vertical clearance above Clarence River, in accordance with NSW Maritime (now part of RMS) requirements. All other options provide a minimum of 9.1 m clearance. A plan and longitudinal section for this option are presented in Appendix 4, sheet 12.

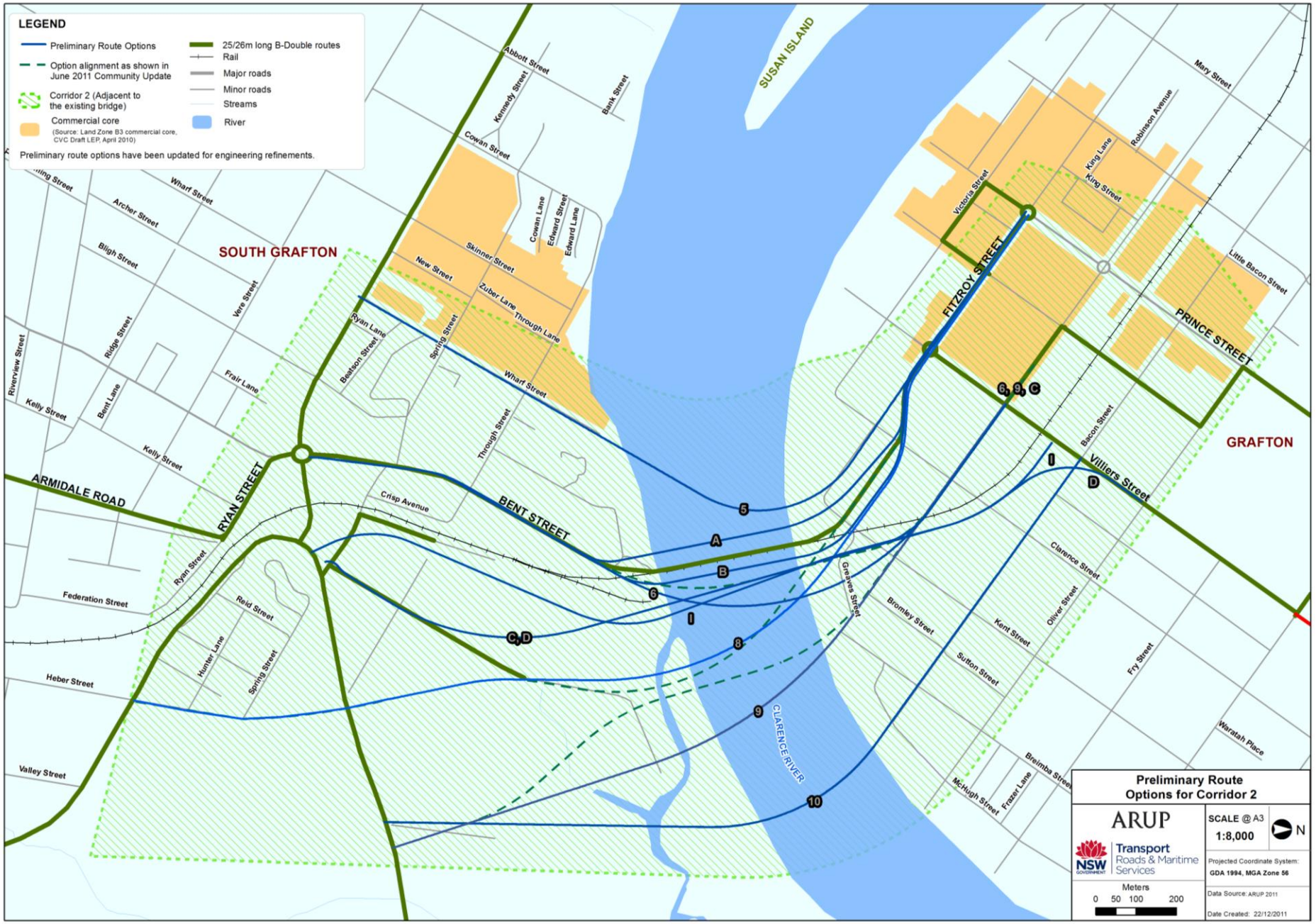

Figure 54: Preliminary route options in Corridor 2.

6.3 Corridor 3

Corridor 3 is located downstream of the existing bridge and upstream of North Street, connecting the Pacific Highway northeast of South Grafton to the area north of the Grafton central business district (south of North Street). It includes preliminary route options between McClaers Lane and Eggins Lane in South Grafton, and between Fry Street and Crown Street in Grafton. Table 18 describes the preliminary route options identified within Corridor 3 as shown in Figure 55.

Table 18: Preliminary route options in Corridor 3.

Preliminary route options	Description
Option 11	This option consists of a new bridge northeast (downstream) of the existing bridge and would provide a connection between the Pacific Highway, northeast of McClaers Lane, and Fry Street in Grafton. This option would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Option 11 would include two viaduct structures across the floodplain between the Pacific Highway and the Clarence River. One viaduct structure crosses a small creek located in proximity to the Pacific Highway and a second and longer viaduct structure is required on the approach to the main river bridge. It would include an upgrade of Fry Street to enable it to meet future traffic volumes. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 13.
Option J	This option consists of a new bridge northeast (downstream) of the existing bridge and would provide a connection between the Pacific Highway in South Grafton and Dobie Street in Grafton. This option would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Option J would include two viaduct structures across the floodplain between the Pacific Highway and the Clarence River. One viaduct structure crosses a small creek located in proximity to the Pacific Highway and a second and longer viaduct structure is required on the approach to the main river bridge. It would include an upgrade of Dobie Street through to Villiers Street to enable it to meet future traffic volumes. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 14.
Option K	This option consists of a new bridge northeast (downstream) of the existing bridge. It would provide connection between the Pacific Highway in South Grafton and Hoof Street in Grafton. This option would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Option K would include a long viaduct structure from the Pacific Highway across the floodplain to the Clarence River. Hoof Street would require an upgrade through to Turf Street to enable it to meet future traffic volumes and would also require upgrading to provide 1 in 20 year flood immunity. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). Villiers Street would also need to be upgraded from Hoof Street to Dobie Street for heavy vehicle access into central Grafton. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 15.

Preliminary route options	Description
Option 12	This option consists of a new bridge northeast (downstream) of the existing bridge. It would provide a connection between the Pacific Highway, about 400 m southwest of Centenary Drive, and Arthur Street in Grafton. Subsequent to the June 2011 Community Update, the alignment for this option has been refined slightly so that the horizontal curve extends for the full length of the bridge. This allows for an incrementally launched bridge. Option 12 would include a long viaduct structure from the Pacific Highway across the floodplain to the Clarence River. Arthur Street would require an upgrade through to Turf Street to enable it to meet future traffic volumes and would also require regrading to improve flood immunity. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). Villiers Street would also need to be upgraded from Arthur Street to Dobie Street for heavy vehicle access into central Grafton. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 16.
Option L	This option consists of a new bridge northeast (downstream) of the existing bridge. It would create a new intersection with Centenary Drive and the Pacific Highway in South Grafton and connect to Crown Street in Grafton. Subsequent to the June 2011 Community Update, the alignment for this option has been refined slightly by relocating the connection to the Pacific Highway opposite Centenary Drive. The option has also been extended to connect through to the Summerland Way, following Queen Street to North Street and then North Street through to the Summerland Way. Option L would include a long viaduct structure from the Pacific Highway across the floodplain to the Clarence River. Crown Street would require an upgrade through to Queen Street to enable it to meet future traffic volumes and would also require upgrading to provide 1 in 20 year flood immunity. The section of Queen Street to North Street and North Street through to the Summerland Way would be similarly upgraded. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). Prince Street would also need to be upgraded from Crown Street to Dobie Street for heavy vehicle access into central Grafton. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 17 and 18.

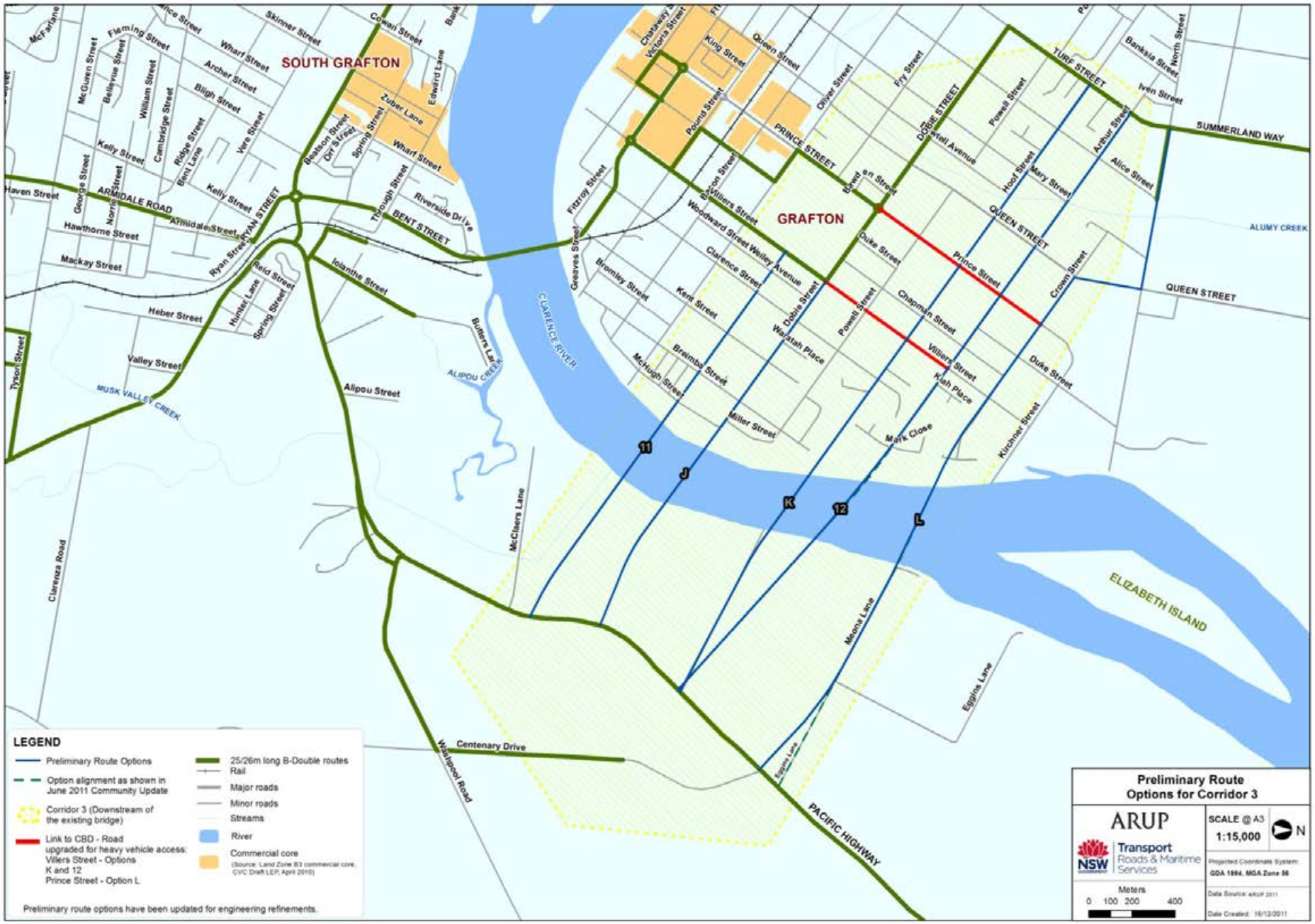

Figure 55: Preliminary route options in Corridor 3.

6.4 Corridor 4

Corridor 4 contains preliminary route options downstream of the existing bridge, connecting the Pacific Highway northeast of South Grafton to North Street in Grafton. Table 19 describes the preliminary route options identified within Corridor 4 as shown in Figure 56.

Table 19: Preliminary route options in Corridor 4.

Preliminary route options	Description
Option 14	This option consists of a new bridge northeast (downstream) of the existing bridge. It would create a new intersection with Centenary Drive and the Pacific Highway in South Grafton and connects to Kirchner Street and North Street in Grafton. Subsequent to the June 2011 Community Update, the alignment for this option has been refined by relocating the connection to the Pacific Highway opposite Centenary Drive and by straightening the alignment across the river. This allows for an incrementally launched bridge to be constructed. This option would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Kirchner Street and North Street would require an upgrade through to Turf Street to accommodate future traffic volumes and would also require upgrading to provide 1 in 20 year flood immunity. Option 14 would include a viaduct structure from the Pacific Highway across the floodplain to the Clarence River. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). Prince Street would also need to be upgraded from Kirchener Street to Dobie Street for heavy vehicle access into central Grafton. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 19.
Option 20	This option consists of a new bridge northeast (downstream) of the existing bridge. It would connect to the Pacific Highway northeast of Eggins Lane in South Grafton and to North Street in Grafton. It would cross over the upstream end of Elizabeth Island. This option would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. North Street would require an upgrade to accommodate future traffic volumes and would also require upgrading to provide 1 in 20 year flood immunity. Option 20 would include a long viaduct structure from the Pacific Highway across the floodplain to the Clarence River. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). Prince Street would also need to be upgraded from North Street to Dobie Street for heavy vehicle access into central Grafton. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheets 20 and 21.
Option 21	This option consists of a new bridge northeast (downstream) of the existing bridge. It would create a new intersection with Centenary Drive and the Pacific Highway in South Grafton and North Street in Grafton. It would cross over the upstream end of Elizabeth Island. This option would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. North Street would require an upgrade to accommodate future traffic volumes and would also require upgrading to provide 1 in 20 year flood immunity. Option 21 would include a long viaduct structure from the Pacific Highway across the floodplain to the Clarence River. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). Prince Street would also need to be upgraded from North Street to Dobie Street for heavy vehicle access into central Grafton. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheets 22 and 23.

Preliminary route options	Description
Option M	This option consists of a new bridge northeast (downstream) of the existing bridge and would cross over the southern end of Elizabeth Island. It would provide connection between the Pacific Highway, approximately 700 m north of Centenary Drive, and North Street in Grafton. Subsequent to the June 2011 Community Update, the alignment for this option has been refined to provide a single horizontal curve and avoid the drainage channel on the floodplain. This option would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Option M would include a long viaduct structure from the Pacific Highway across the floodplain to the Clarence River. North Street would require an upgrade to accommodate future traffic volumes and would also require upgrading to provide 1 in 20 year flood immunity. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). Prince Street would also need to be extended and upgraded from North Street to Dobie Street for heavy vehicle access into central Grafton. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheet 24 and 25.

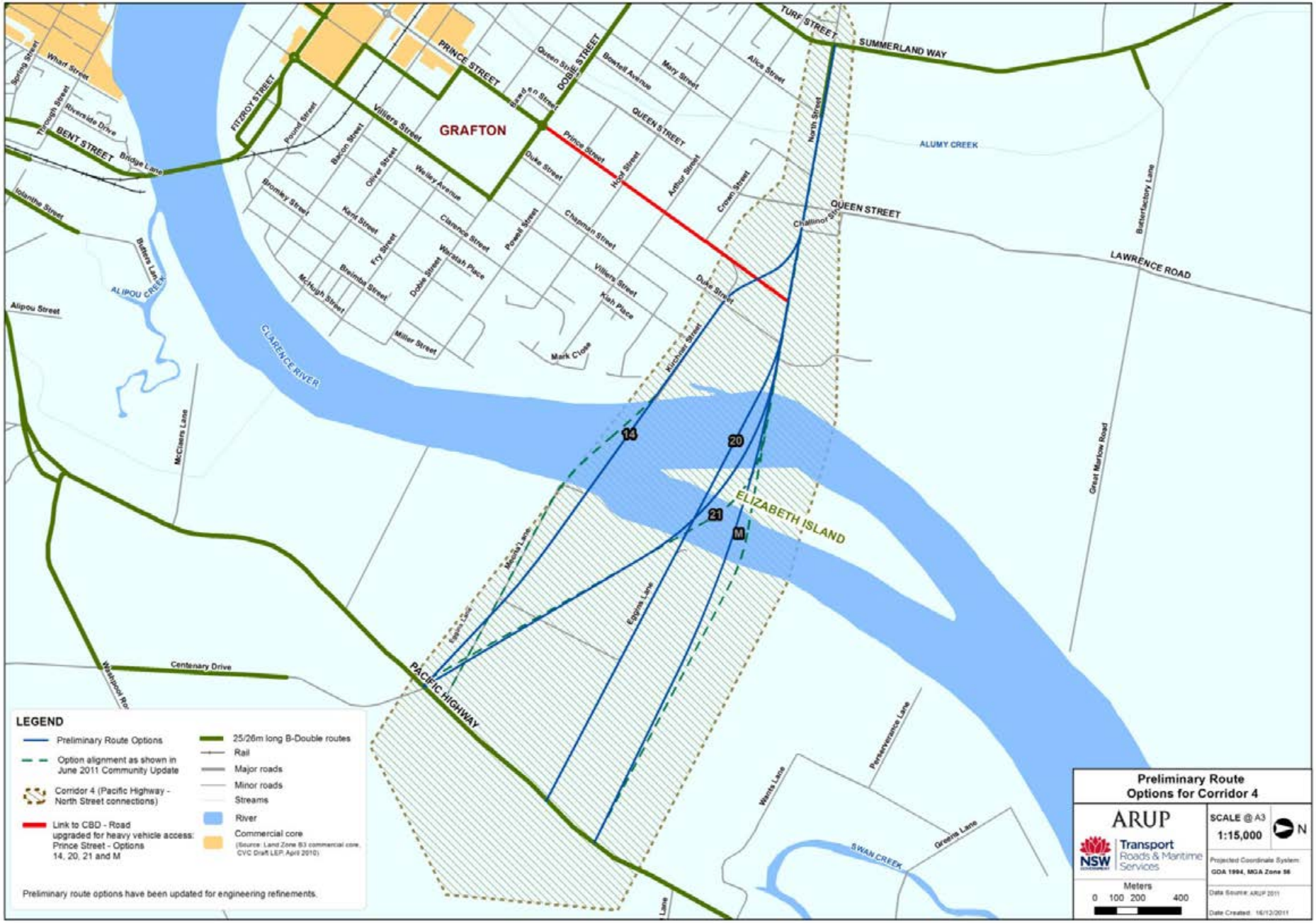

Figure 56: Preliminary route options in Corridor 4.

6.5 Corridor 5

Corridor 5 contains preliminary route options connecting the Pacific Highway northeast of South Grafton and the Summerland Way, north of North Street in Grafton. It is the corridor furthest downstream from the existing bridge. Table 20 describes the preliminary route options identified within Corridor 5 as shown in Figure 57.

Table 20: Preliminary route options in Corridor 5.

Preliminary route options	Description
Option 15	This option consists of a new bridge northeast (downstream) of the existing bridge. It would create a new intersection with Centenary Drive and the Pacific Highway in South Grafton and connects to Kirchner Street, and then to the Summerland Way approximately 400 m south of Butterfactory Lane in Grafton. This option would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Option 15 would include a long viaduct structure from the Pacific Highway across the floodplain to the Clarence River. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). Prince Street would also need to be upgraded from Kirchner Street to Dobie Street for heavy vehicle access into central Grafton. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheets 26 and 27.
Option 23	This option consists of a new bridge northeast (downstream) of the existing bridge and would cross over the middle portion of Elizabeth Island. It would provide a new connection between the Pacific Highway, approximately 450 m southwest of Wants Lane, and the Summerland Way, just north of the Gateway Village Holiday Park in Grafton. This option would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Option 23 would include a long viaduct structure from the Pacific Highway across the floodplain to the Clarence River. It would also include a short viaduct structure on the Grafton side of the river. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). Queen Street would also need to be upgraded to Dobie Street for heavy vehicle access into central Grafton. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheets 28 and 29.
Option 25	This option consists of a new bridge northeast (downstream) of the existing bridge. It would connect the Pacific Highway at Perseverance Lane in South Grafton and the Summerland Way, just north of the Gateway Village Holiday Park in Grafton. It would cross over the downstream end of Elizabeth Island. This option would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Option 25 would include a long viaduct structure from the Pacific Highway across the floodplain to the Clarence River. It would also include a short viaduct structure on the Grafton side of the river. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). Queen Street would also need to be upgraded to Dobie Street for heavy vehicle access into central Grafton. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheets 30 and 31.

Preliminary route options	Description
Option 26	This option consists of a new bridge northeast (downstream) of the existing bridge. It would create a new connection between the Pacific Highway at Wants Lane in South Grafton and Great Marlow Road through to the Summerland Way in Grafton. Subsequent to the June 2011 Community Update, the alignment for this option has been refined to provide a single horizontal curve over the Clarence River to allow for an incrementally launched bridge to be constructed. This option would have one northbound lane and one southbound lane for vehicles and a cycle/pedestrian lane. Option 26 would include a long viaduct structure from the Pacific Highway across the floodplain to the Clarence River. It would also include a short viaduct structure on the Grafton side of the river. Villiers Street would need to be upgraded to provide 5.3m vertical clearance for heavy vehicles beneath the railway viaduct (between Pound and Bacon Streets). Queen Street would also need to be upgraded from Great Marlow Road to Dobie Street for heavy vehicle access into central Grafton. The existing bridge would remain as one northbound lane and one southbound lane. A plan and longitudinal section for this option are presented in Appendix 4, sheets 32 and 33.

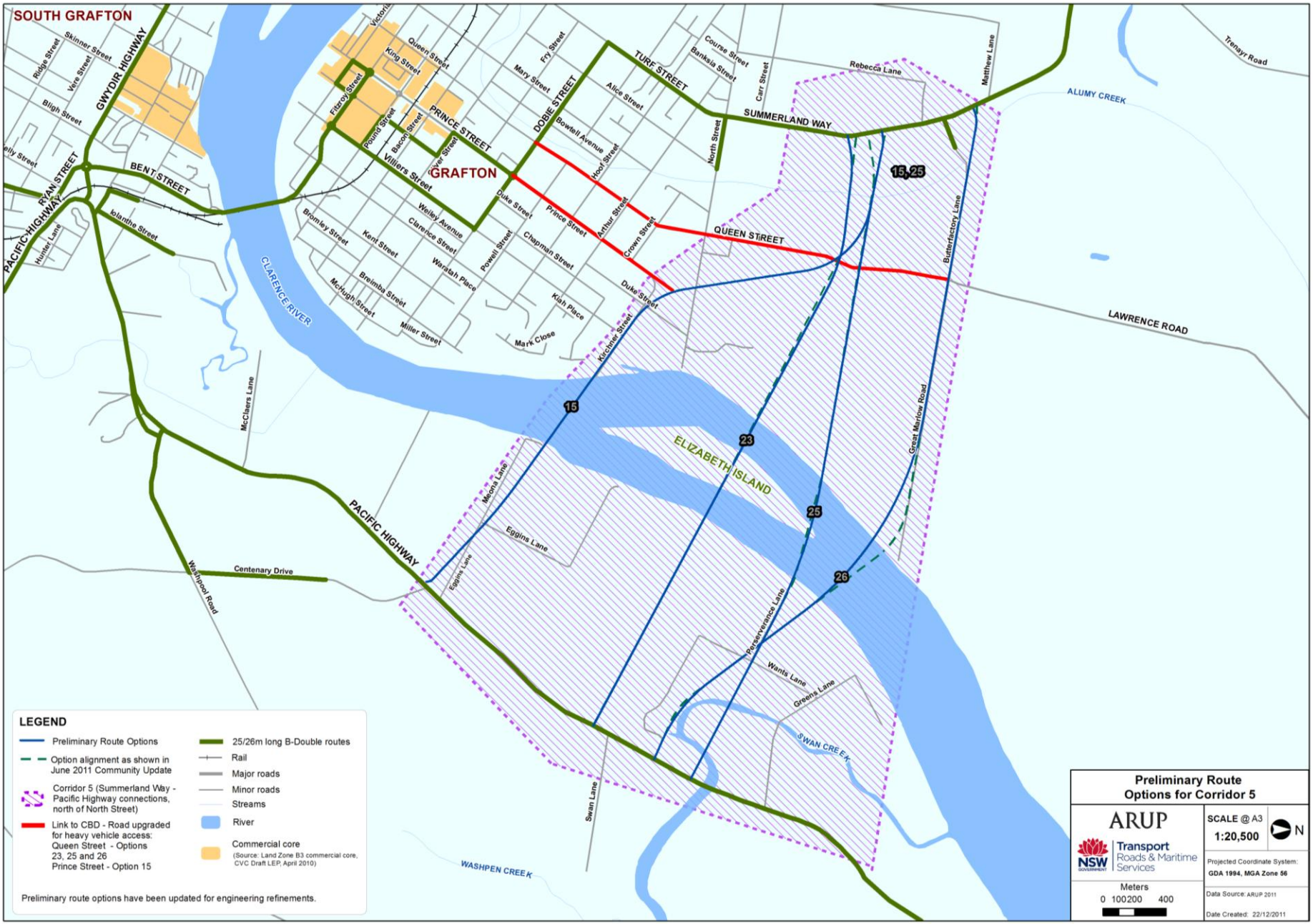

Figure 57: Preliminary route options in Corridor 5.

7 Assessment of preliminary route options

This chapter of the report describes the methodology and indicators used for the assessment of the preliminary route options described in Chapter 6 and presents the findings of the assessment.

The assessment presented in this chapter will be part of the input into the short-listing process. For details on the short-listing process, please refer to Chapter 9.1.

The overall aim of the assessment of the 25 preliminary route options is to facilitate the short-listing process to identify the best route option(s) within each of the corridors.

7.1 Assessment methodology

An overview of the methodology to assess the preliminary route options is presented in the following figure.

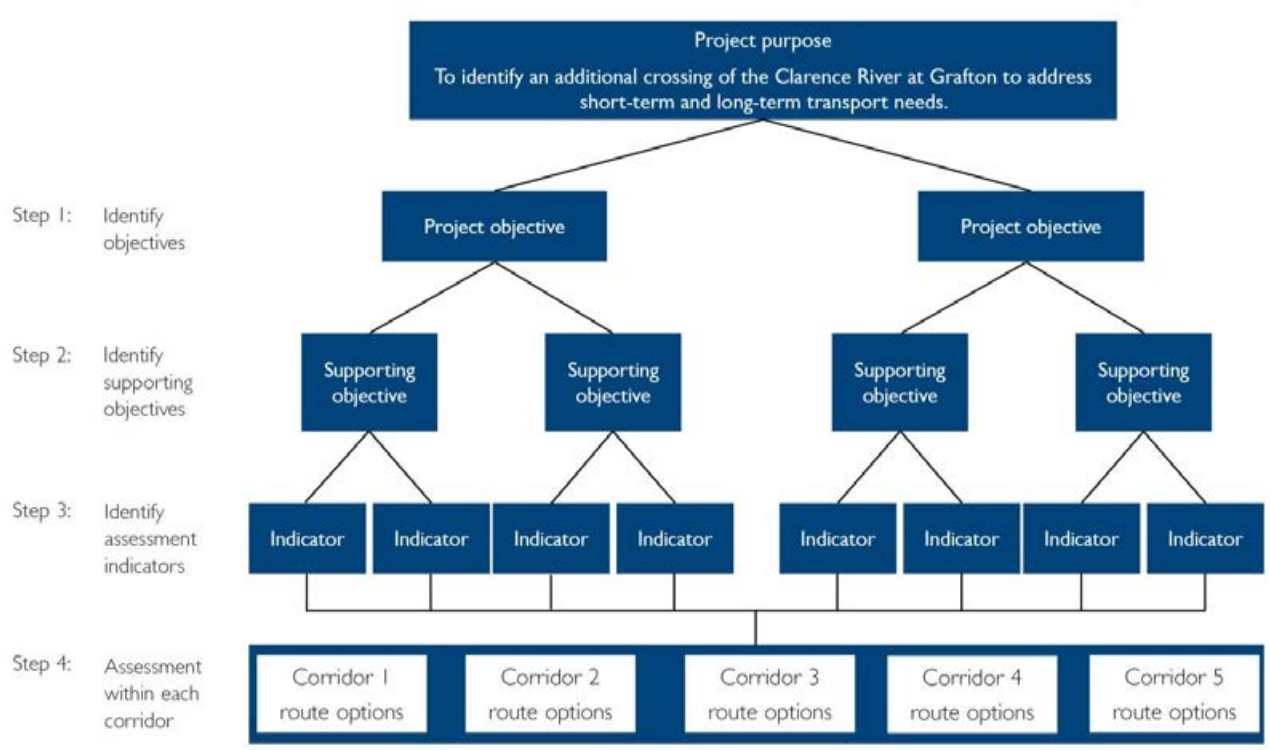

Figure 58: Preliminary route options assessment methodology.

The steps followed for the assessment of the 25 preliminary route options are described in the following chapters and summarised as follows:

- Step 1: Identify project objectives to be used in the assessment.
- Step 2: Identify project supporting objectives to be used in the assessment.
- Step 3: Identify indicators to be used in the assessment.
- Step 4: Assess preliminary route options within each corridor.

7.1.1 Step 1: Identify project objectives to be used in the assessment

The assessment of the preliminary route options was based on the following project objectives:

- Enhance road safety for all road users over the length of the project.
- Improve traffic efficiency between and within Grafton and South Grafton.
- Support regional and local economic development.
- Provide value for money.
- Minimise impact on the environment.

The project objective “Involve all stakeholders and consider their interests” relates to the consultation and communication processes that are being undertaken throughout the project. As this objective does not provide indicators for the assessment of each of the route options, it is not one of the objectives included in this assessment.

Community feedback received on the *Preliminary Route Options Report - Part 1* was received in August 2011 and is summarised in Appendix 3. Community feedback received on the *Preliminary Route Options Report - Parts 1 and 2* was received in October/November 2011 and is summarised in Appendix 7. Where relevant, the report has been amended to address community feedback received.

This community comment, the assessment in this report and the outcomes of a community and stakeholder evaluation workshop will all be inputs into the selection of the short-listed route option(s) within each corridor to be taken forward for further investigation.

7.1.2 Step 2: Identify supporting objectives relevant to the assessment

As shown in Chapter 2.3 of this report, each project objective has beneath it a set of supporting objectives. The supporting objectives provide measureable indicators that reflect and belong to the relevant project objective.

Some of these supporting objectives are considered relevant to this stage of the process, while others either do not provide differentiation between options in the same corridor, or are more relevant for the next stage of the overall process. The supporting objectives identified for the assessment of the 25 preliminary options are listed in Table 21.

Table 21: Supporting objectives used in the assessment of the preliminary route options.

Objective	Supporting objective
Enhance road safety for all road users over the length of the project	- Reduce the potential for road crashes and injuries on the bridge and approaches including any intersections and connecting roads.
Improve traffic efficiency between and within Grafton and South Grafton	- Provide efficient access for a second crossing of the Clarence River and for the State road network. - Provide a traffic management network which reduces delays between Grafton and South Grafton in peak periods to an acceptable level of service for 30 years after opening.
Support regional and local economic development	- Provide transport solutions that complement existing and future land uses and support development opportunities. - Provide for commercial transport including B-Doubles where required. - Provide flood immunity for the bridge for a 1 in 100-year flood event, and for the approach roads for a 1 in 20-year flood event, where economically justified.
Provide value for money	- Achieve a justifiable benefit / cost ratio at an affordable cost.

Objective	Supporting objective
Minimise impact on the environment	- Minimise the impact on the social environment, including property impacts. - Minimise the impact on residential amenity, including noise, vibration, air quality etc. - Minimise the impact on heritage (Aboriginal and non-Aboriginal). - Minimise impact on the natural environment. - Provide a project that fits sensitively into the built, natural and community context. - Minimise flooding impact caused by the project.

The supporting objectives shown below in Table 22 were not used in the assessment of the 25 preliminary route options for the reasons set out in the table.

Table 22: Supporting objectives excluded from the assessment of the preliminary route options.

Objective	Supporting objective	Reason for not being used in this assessment
Enhance road safety for all road users over the length of the project	Provide safe facilities for pedestrians and cyclists	All preliminary route options would provide safe pedestrian and cyclist facilities. Therefore this supporting objective does not provide any differentiation between options.
Improve traffic efficiency between and within Grafton and South Grafton	Provide adequate vertical clearance for heavy vehicles	All preliminary route options would provide adequate vertical clearance for heavy vehicles. Therefore this supporting objective does not provide any differentiation between options.
	Consider demand management strategies to minimise delays to local and through traffic	This is part of an overall strategy for improving the road network and is likely to be required in any case.
Support regional and local economic development	Provide improved opportunities for economic and tourist development for Grafton	It is not considered that this would differentiate between options located in the same corridor but it would be used at a later stage to assess the short-list of route options.
	Provide navigational clearance from the additional crossing for river users	All preliminary route options would provide the designated navigational clearance as identified by NSW Maritime (now part of RMS) in Chapter 4.9. Therefore this supporting objective does not provide any differentiation between options.
Provide value for money	Develop a strategy to integrate future upgrades into the project.	All preliminary route options would include a strategy to integrate future upgrades into the project.

Where appropriate, the above supporting objectives which have not been included in this assessment may be used at a later stage for the assessment of the short-list of route options.

7.1.3 Step 3: Identify assessment indicators

Key indicators for each supporting objective were developed by the project team in consultation with specialist sub-consultants to measure the impact or effectiveness of each option in achieving the supporting objectives, and hence the project objectives.

The indicators were developed to be as simple, meaningful and manageable as possible and to support the overall intent of this assessment (ie facilitate the short-listing process to identify the best route option(s) within each of the corridors). The adopted indicators for the assessment of the preliminary route options are presented below and have been grouped into the five project objectives from Chapter 7.1.1.

Objective: Enhance road safety for all road users over the length of the project

Supporting objective: Reduce the potential for road crashes and injuries on the bridge and approaches including any intersections and connecting roads.

<table>
<tr><th>Indicator</th><th>Description</th></tr>
<tr><td>Road geometry:
- number of instances where desirable design requirements (horizontal, vertical curves, grades) are not achieved</td><td>Road geometry is used as an indicator to provide a measure of the likely relative safety of the options within a corridor.
While all options meet minimum design requirements, there are constraints that would limit the extent to which some options meet current desirable RMS road geometry design requirements which could potentially result in a higher crash rate if the option is constructed. The three road geometry elements that have been selected as indicators representing relative road safety are:
(i) Tight horizontal curves.
(ii) Sharp crest curves which reduce sight distance.
(iii) Steep grades.
For each of these three geometry elements, desirable requirements were broadly based on RMS current design standards. These requirements are set out below. The number of locations where road geometry elements do not meet the desirable geometric requirements set out in the table were measured for each option.

<table>
<tr><th>Description of option location</th><th>Min Radius</th><th>Min crest K Value</th><th>Max Grade</th></tr>
<tr><td colspan="4">On bridge and approach roads for options within urban areas: Posted Speed Limit 60 km/h. Applies for options in Corridors 1, 2, 3 and 4</td></tr>
<tr><td>Desirable geometric design criteria</td><td>150 m</td><td>28</td><td>4.5 %</td></tr>
<tr><td colspan="4">On bridge and approach roads for options outside urban areas: Posted Speed Limit 80 km/h. Applies for Options in Corridor 5</td></tr>
<tr><td>Desirable geometric design criteria</td><td>340 m</td><td>44</td><td>3.5 %</td></tr>
</table>
</td></tr>
<tr><td>Number of intersections across the network where traffic volumes on approaches exceed threshold values in 2019:
- Number of intersections that would carry very high volumes
- Number of intersections that would carry moderately high volumes</td><td>The indicator identifies those intersections across the whole network where the estimated number of vehicles approaching the intersection is relatively high in 2019 and would require intersection improvements to provide the required capacity at a reasonable level of service.
The number of vehicles approaching each intersection is estimated by the strategic traffic model prepared specifically for the assessment of the 25 preliminary route options. Refer to Chapter 7.1.3.1 for more details.
For the purposes of this assessment, ‘very high volumes’ are volumes greater than 4,000 vehicles entering a given intersection (summing all approaching traffic) during the AM peak period (between 7 am and 9 am) in 2019, while ‘moderately high volumes’ are volumes between 3,000 and 4,000 vehicles entering a given intersection during the AM peak period.
Intersections where traffic volumes on approaches exceed these threshold values are likely to require upgrading. These upgrades have been allowed for in the strategic costs.</td></tr>
</table>

Objective: Improve traffic efficiency between and within Grafton and South Grafton

Supporting objective: Provide efficient access for a second crossing of the Clarence River and for the State road network.

Indicator	Description
Estimated vehicle hours travelled (VHT): - across whole network at assumed bridge opening in 2019 - across whole network 20 years after opening in 2039	VHT is a measure of the estimated total number of hours spent travelling by all vehicles within Grafton and South Grafton on an average AM peak period in the future year quoted. It includes all classes of light, medium and heavy vehicles but excludes cyclists. VHT is estimated by the strategic traffic model. Refer to Chapter 7.1.3.1 for more details. Mathematically, VHT is a function of the number of trips per AM peak period, the average length of trips and the average speed of the trip. The number of trips per AM peak period is constant for all options in a given year. The average distance per trip and the average speed will vary from option to option and are derived from the strategic traffic model. Options with a lower VHT indicate less time spent travelling on average and a more efficient road network. Benefits of a lower VHT include less congestion and commuting time, and improved accessibility to work and services.

Supporting objective: Provide a traffic management network which reduces delays between Grafton and South Grafton in peak periods to an acceptable level of service for 30 years after opening.

Indicator	Description
Estimated average travel time in minutes between Grafton and South Grafton in 2049	This measures the estimated average travel time between Grafton and South Grafton (based on travel times between representative points of the intersection of Bent Street and Gywdir Highway, South Grafton, and the intersection of Prince Street and Pound Street (clock tower), Grafton during the AM peak period) in the year 2049. As this is a measure of the reduction in delays the travel times used have been taken for vehicles using the existing bridge. The higher the travel time, the greater the congestion experienced. This indicator is estimated by the strategic traffic model. Refer to Chapter 7.1.3.1 for more details.

Objective: Support regional and local economic development

Supporting objective: Provide transport solutions that complement existing and future land uses and support development opportunities.

Indicator	Description
Vehicle hours travelled (VHT) for heavy vehicles across the whole network in 2049	This measures the estimated total number of hours travelled on an average AM peak period by heavy vehicles (eg buses, semi-trailers, B-doubles) travelling within Grafton and South Grafton in the year 2049. It includes heavy vehicles making 'through' trips as well as heavy vehicles with an origin or destination in Grafton or South Grafton. The method of measurement of VHT is as described for the previous VHT indicator but only includes heavy vehicles. Refer to Chapter 7.1.3.1 for more details. Options with a lower VHT indicate less time spent travelling on average and a more efficient road network for heavy vehicles. Benefits of a lower VHT would be expected to include lower transport costs and improved accessibility for deliveries.

Supporting objective: Provide for commercial transport including B-Doubles where required.

Indicator	Description
Estimated average travel time in minutes between the Pacific Highway and the Summerland Way in 2049	This indicator, for all vehicles, is based on travel times across the new bridge during the AM peak period (between 7 am and 9 am) between two representative points. It is measured between the intersection of the Pacific Highway and Centenary Drive south in South Grafton, and the intersection of Summerland Way and Butterfactory Lane in Grafton. This indicator is being used to assess B-double transport. Therefore, as it is assumed that heavy vehicles will be banned from the existing bridge, the travel time has been taken for vehicles using the new bridge. The higher the travel time, the greater the congestion experienced. The travel times are estimated by the strategic traffic model. Refer to Chapter 7.1.3.1 for more details.

Supporting objective: Provide flood immunity for the bridge for a 1 in 100-year flood event, and for the approach roads for a 1 in 20-year flood event, where economically justified.

Indicator	Description
Does option provide approach road flood immunity (1 in 20 year flood) under upgraded levee scenario? (yes/no)	All preliminary route options would have flood immunity for the bridge for a 1 in 100-year flood event. This indicator examines whether the approach roads of the options would be flooded in a 1 in 20-year flood event.

Notes:

- A description of the existing flooding conditions in the Grafton area, including mapping of areas affected by the 1 in 20-year flood event is presented in Chapter 5.8.
- Details of the flooding assessment methodology for the preliminary route options are presented in Chapter 7.1.3.1. The assessment of the likely flooding impacts resulting from the route options is based on information provided by BMT WBM consultants. The lower Clarence River flood model, developed as part of the *Lower Clarence River Flood Study Review* (WBM, 2004), has been used for this assessment.

Objective: Provide value for money

Supporting objective: Achieve a justifiable benefit / cost ratio at an affordable cost.

Indicator	Description
Benefit-cost ratio over 30 years from 2019 based on strategic cost estimates	Road user benefit-cost ratio (BCR) is used in cost-benefit analysis to summarise the overall value for money of a project. The ratio is obtained by dividing the anticipated benefits of the option by its anticipated costs over the assumed life of the project (30 years in this case). All future costs and benefits are discounted to current day values for the BCR calculations. The analysis only considers road user and road maintenance costs and benefits. The greater the ratio, the better the option from an economic value for money perspective. A BCR that is greater than 1.0 suggests that the road user benefits exceed the costs and that in economic terms the project could be justified.

Indicator	Description
Strategic cost estimate	Strategic high-level cost estimates have been prepared to allow a comparison of likely relative costs of options within a given corridor. While actual costs may vary from these strategic estimates due to a range of factors including the outcomes of further investigations, changes to the extent (or scope) of the project, design refinements and timing of construction, it is unlikely that the relative costs of options within a corridor would change significantly. Costs are given in 2011 dollars and include an allowance for concept development, detailed design and documentation, property acquisition, utility adjustment, infrastructure construction and handover costs. A contingency allowance was added to each cost item for each option in accordance with normal RMS procedures. Major potential future upgrades to the Summerland Way or Pacific Highway have not been allowed for at this stage.

Objective: Minimise impact on the environment

Supporting objective: Minimise the impact on the social environment, including property impacts.

Indicator	Description
Number of community facilities potentially directly affected.	Indicates the degree of impact on community facilities including: schools (including pre-schools and adult education facilities), churches, aged care facilities, parks and recreational uses of the river (such as the rowing course, sailing club activities and river festival spectator areas). For the purposes of this assessment, a community facility is regarded as potentially directly affected if an option is likely to require full or partial land acquisition of the facility or would otherwise cross within its boundary (in the case of river based activities). Commercial properties are excluded except for Grafton CBD (including Shopping World), South Grafton CBD and Bi-Lo shopping complex located between Bligh Street and Bent Street in South Grafton. The greater the number, the greater the potential impact.
Number of other properties potentially directly affected.	Indicates the number of other properties likely to be directly affected. For the purposes of this assessment, a property is regarded as potentially directly affected if an option may require full or partial land acquisition of the property. This count includes developed and undeveloped properties, residential, rural, commercial and industrial zoned properties and crown land but excludes community facilities which are considered in the community facilities indicator above. It also excludes road reservations. The greater the number, the greater the potential impact.

Notes:

- A description of the existing social and economic conditions and social and economic constraints in the Grafton area, including mapping of community and recreation infrastructure and potential social and economic constraints is presented in Chapter 5.3.
- The assessment of the potential impacts of the preliminary route options on the social environment is based on information provided by BBC Consulting Planners and the social and economic constraints identified in Chapter 5.3.
- Other social indicators associated with vulnerable sections of the community, the potential loss of affordable housing, the viability of the South Grafton commercial precinct, the effect on river users (recreation, cultural and tourism) and community views on these community and recreation facilities and social issues will be considered for the assessment of the short-list of route options.
- Community facilities are as shown in Figure 25.
- Property impacts are based on limited design information and are primarily for comparison between options within corridors. While the absolute numbers might change, the relativity between the options should be retained and this indicator therefore provides a suitable measure of social impact.

Supporting objective: Minimise the impact on residential amenity, including noise, vibration, air quality etc.

Indicator	Description
Number of potential noise sensitive receivers fronting roads with a doubling (or more) of traffic at 10 years after opening (2029).	Potential noise sensitive receivers include schools, hospitals, places of worship (eg churches), open spaces (when occupied, for example, a park), childcare facilities, aged care facilities and residential dwellings (for example, a residence located in an industrial area). Traffic doubling is equivalent to an increase in noise of approximately 3dBA. This is the change in noise level considered noticeable to the human ear. Traffic doubling has been estimated from the strategic traffic model. The greater the number, the greater the negative impact of increasing noise to community and residential potential noise receivers.
Number of potential noise sensitive receivers fronting roads with a halving (or more than halving) of traffic at 10 years after opening (2029).	Potential noise sensitive receivers include schools, hospitals, places of worship (eg churches), open spaces (when occupied, for example, a park), childcare facilities, aged care facilities and residential dwellings (for example, a residence located in an industrial area). Traffic halving is equivalent to a decrease in noise of approximately 3dBA. This is the change in noise level considered noticeable to the human ear. Traffic halving has been estimated from the strategic traffic model. The greater the number, the greater the positive impact of reducing noise to community and residential potential noise receivers.

Notes:

- A description of the existing noise environment in the Grafton area, including mapping of non-residential noise sensitive receivers is presented in Chapter 5.6.
- Noise modelling for each of the 25 preliminary route options has not been undertaken at this stage. The number of potential sensitive receivers adjacent to each route is considered to be a simple, meaningful and manageable indicator and a good proxy of the likely noise impacts caused by each preliminary option.
- Background noise measurements will be available for the short-listing process. These background measurements will be used to model each of the short-listed options to determine the likely noise impacts on sensitive receivers. This will be reported in the *Route Options Development Report*.
- Sections of the Grafton area road network where traffic would double/halve at 10 years after opening were identified for each option using the strategic traffic model. Refer to Chapter 7.1.3.1 for more details.
- The non-residential noise sensitive receivers as shown in Figure 37 have been used to assess community facilities affected by doubling and halving of traffic volumes.

Supporting objective: Minimise the impact on heritage (Aboriginal).

Indicator	Description
Is option likely to directly affect a culturally significant Aboriginal site (yes/no)	These sites relate to Aboriginal cultural sites such as ceremonial or dreaming sites. Refer to Chapter 5.4 for more details.
Length through high archaeological potential area (m)	Measures the length of each option that crosses through areas associated with major creek lines, raised flat landforms such as ridges and hills, or where there has been minimal disturbance to the specific area. In these areas it is considered that there is high Aboriginal archaeological potential. Artefacts that remain within these areas are likely to be high in density and large in size. For the purposes of this assessment, the length has been measured along the centreline of the new road corridor and all associated road upgrades. The greater the length, the greater the potential impact.

Notes:

- A description of the known Aboriginal archaeological and cultural heritage in the Grafton area, including mapping of known Aboriginal cultural values and areas of Aboriginal archaeological potential is presented in Chapter 5.4.
- The assessment of the potential impacts of the preliminary route options on Aboriginal heritage is based on information provided by Biosis Research and the constraints identified in Chapter 5.4.
- The identification of culturally significant sites and areas of high archaeological potential were limited by the amount of data available. The boundaries defined for areas of archaeological potential are broadly based on the desktop analysis, the findings of previous archaeological work, landform modelling, previous land use disturbances and the findings of the reconnaissance field surveys. These areas are not absolute and will be refined following further consultation with the local Aboriginal community and detailed archaeological field survey and additional archaeological work, such as test excavations, on the short-list of options.

Supporting objective: Minimise the impact on heritage (non-Aboriginal).

Indicator	Description
Number of heritage items likely to be affected by the option - State significance	Measures the number of items likely to be affected by the options that are listed in the State Heritage Register (Refer to Chapter 5.5 and *Volume 2 -Technical Paper: Non-Aboriginal Heritage* for a description of these items). For the purposes of this assessment, a State heritage item is considered as 'likely to be affected' if it is within a new road corridor (generally 40 m wide) or is immediately adjacent to an existing road which would need to be upgraded for the option to function adequately in the longer term. The greater the number, the greater the potential impact.
Number of heritage items likely to be directly affected by the option - local significance	Measures the number of items likely to be directly affected by the options that are listed in the *Grafton Local Environmental Plan 1988* (Refer to Chapter 5.5 and *Volume 2 -Technical Paper: Non-Aboriginal Heritage* for a description of these items). For the purposes of this assessment, an item of local significance is counted as 'likely to be directly affected' if it is within a new road corridor (generally 40 m wide). The greater the number, the greater the potential impact.
Length through conservation area	Measures the length of each option through the urban conservation area as defined in the *Grafton Local Environmental Plan 1988* (Refer to Chapter 5.5, Figure 33 and *Volume 2 - Technical Paper: Non-Aboriginal Heritage* for a description of this area) affected by the options. For the purposes of this assessment, the length has been measured along the centreline of the new road corridor and all associated road upgrades. The greater the length, the greater the potential impact.

Notes:

- A description of the non-Aboriginal heritage in the Grafton area, including mapping of heritage items listed in the State Heritage Register and the *Grafton Local Environmental Plan 1988* (which defines the urban conservation area) is presented in Chapter 5.5.
- The assessment of the potential impacts of the preliminary route options on non-Aboriginal heritage is based on information provided by Biosis Research and the information presented in Chapter 5.5.
- The number of heritage items on the gazetted *Grafton Local Environmental Plan 1988* increased dramatically as of June 10, 2011 with the gazettal of additional items proposed for listing. The transition from "proposed" to "gazetted" heritage items was captured in Clarence Valley Council's GIS data, which may not be entirely proofed. As a result, counts of the heritage items that are affected by each preliminary route option may not be exact but are considered to be adequate for the purposes of this assessment.

- Unconfirmed and/or unknown non-Aboriginal archaeological sites are also acknowledged as one of the constraints for the additional crossing and will be considered at a later stage during the assessment of the short-list of route options.

Supporting objective: Minimise impact on the natural environment.

Indicator	Description
Length through potential endangered ecological communities (EECs) (metres)	Measures the length of each option through ecological communities considered endangered by the *NSW Threatened Species Conservation Act 1995*. Endangered ecological communities include sub tropical coastal floodplain (riparian forest and remnant eucalyptus), lowland rainforest on floodplains and freshwater wetlands on coastal floodplains (reedlands). It is an indicator of the impact on the natural environment. For the purposes of this assessment, the length has been measured along the centreline of the new road corridor and all associated road upgrades. The greater the length, the greater the potential impact.
Length through other native vegetation (metres)	Measures the length of each option through native vegetation. It also includes planting containing both native and exotic vegetation. For the purposes of this assessment, the length has been measured along the centreline of the new road corridor and all associated road upgrades. The greater the length, the greater the potential impact.

Notes:

- A description of the existing terrestrial and aquatic ecological conditions and constraints in the Grafton area, including mapping of potential endangered ecological communities (EECs) and other native vegetation is presented in Chapter 5.7.
- The assessment of the potential impacts of the preliminary route options on the natural environment has been conducted by Arup based on information provided by Biosis Research and the constraints identified in Chapter 5.7.
- The calculation of length of endangered ecological communities to be impacted by each option is for preliminary comparison only and based on the desktop assessment and limited fieldwork undertaken to date.

Supporting objective: Provide a project that fits sensitively into the built, natural and community context.

Indicator	Description
Height of new crossing compared to existing bridge (metres)	Indicates the potential impact on the visual integrity of the existing bridge. A new bridge that is higher than the existing bridge may have an adverse impact on the visual integrity of the existing bridge, especially if the new bridge is in close proximity to the existing bridge. This criterion is relevant only where the proposed new bridge is viewed in relation to the existing bridge; as such, it applies only to the options in Corridor 2. Levels on existing bridge are: road deck level: 18.7 m Australian Height Datum. Railway deck level: 10.4 m Australian Height Datum. Heights of the new bridge deck level are measured relative to the height of the existing road deck level. In the other corridors, the minimum bridge height is governed by NSW Maritime (now part of RMS) Waterway clearance requirement. All options within a corridor (except Corridor 2) will have the same minimum clearance.

Indicator	Description
Length of new bridge and viaduct (metres)	Indicates the degree of change to the existing character of the Clarence River and the degree of change to the urban and landscape character of the local area. The length of new bridge is an indicator of the degree of change to the character of the river, with a longer bridge potentially creating a greater visual change to the river setting. The length of viaduct and smaller bridges (road elevated on structure over land or creeks) is also an indicator of the degree of potential change to the urban and landscape character of the local area, especially in those areas where there are currently no viaduct or bridge structures.
Length of new or upgraded approach roads (at grade or on embankment) (metres)	Indicates the degree of potential change to the existing urban and landscape character of the local area. The new or upgraded approach roads could have a larger scale and be at a higher level to achieve the required flood immunity, which could change the existing character of the areas in which the approach roads are to be located. The longer the approach road, the greater the potential impact.
Geometry of the new route aligns with existing street or landscape patterns (Yes/No)	Indicates the degree of change to the integrity of the existing urban fabric and also the degree of potential change to the existing urban and landscape character of the local area. Where route options align with these existing patterns, the integrity of the existing urban fabric and the existing landscape and urban character can be better preserved. Where route options do not align with these existing patterns, new geometries are introduced that would change the existing character of the local area and may degrade the integrity of the existing urban grid. Furthermore, the property fragmentation that would occur as a result of route options cutting across land parcels could also affect the existing character of the local area.

Notes:

- A description of the landscape and urban character of the Grafton area is presented in Chapter 5.1.
- The assessment of the potential impacts of the preliminary route options on the built, natural and community context has been conducted by Spackman Mossop Michaels consultants.

Supporting objective: Minimise flooding impact caused by the project.

Indicator	Description
Length of bridge across river (metres)	Measures the length of the new bridge across the river. It is an indicator of the potential flooding impact that might be caused by the new structure. The longer the bridge and the greater the skew, the greater the potential impact.
Length of viaduct across floodplain and minor creek crossings (m)	This is the total length of viaduct required within the floodplain on both sides of the river to allow the passage of flood waters with a minimum effect on flood levels. It is an indicator of the potential flooding impact that might be caused by the new structure. The longer the bridge and the greater the skew, the greater the potential impact.

Notes:

- A description of the existing flooding conditions in the Grafton area, including mapping of the areas affected by the flood event that commences overtopping of the levee walls, (ie the 1 in 20-year flood event) is presented in Chapter 5.8.
- Details of the flooding assessment methodology for the preliminary route options are presented in Chapter 7.1.3.1. The assessment of the likely flooding impacts resulting from the route options has been conducted by BMT WBM consultants. The lower Clarence River flood model, developed as part of the *Lower Clarence River Flood Study Review* (WBM, 2004), has been used for this assessment.

7.1.3.1 Additional traffic and flooding investigations

Additional traffic and flooding investigations were undertaken for the assessment of the preliminary route options. The traffic assessment required refinement of the existing strategic traffic model for the Grafton area while the flooding assessment involved the use of the existing lower Clarence River flood model developed as part of the *Lower Clarence River Flood Study Review* (WBM, 2004).

A description of the methodology for the traffic and flooding assessment of the preliminary route options is presented below.

Traffic assessment

The strategic traffic model (a computer model used to analyse the overall road network performance) of Grafton and its surrounds was extended to include the area occupied by the 25 preliminary route options. The strategic traffic model was refined to enable better prediction of traffic volumes likely to use each of the 25 preliminary route options and approach roads. The refinement included the use of additional traffic count data undertaken in June 2011 and updated population forecasts developed by Clarence Valley Council and the Department of Planning and Infrastructure (Chapter 4.5).

Specifically, the traffic model was used to assess the preliminary route options against the following indicators which are identified above in Chapter 7.1.2:

- Estimated AM peak vehicle hours travelled across whole network at assumed bridge opening in 2019.
- Estimated AM peak vehicle hours travelled across whole network 20 years after opening in 2039.
- Estimated average travel time in minutes between Grafton and South Grafton in 2049.
- AM peak vehicle hours travelled for heavy vehicles (semis and B-doubles) across the whole network in 2049.
- Estimated average travel time in minutes between the Pacific Highway to the south and the Summerland Way to the north in the AM peak in 2049.
- Roads with doubling of traffic at 10 years after opening (2029) (as an indication of the relative number of noise sensitive receivers that could potentially be adversely affected by each option).
- Roads with a halving of traffic at 10 years after opening (2029) (as an indication of the relative number of noise sensitive receivers that could potentially be beneficially affected by each option).

The refined strategic traffic model was prepared specifically for the assessment of the 25 preliminary route options. Details of the strategic traffic model are included in *Volume 2 – Technical Paper: Strategic Traffic Assessment.* Traffic information used for the assessment was obtained from the following sources:

Table 23: Traffic data sources for strategic model.

Source	Type of data	Date
Surveys undertaken by AusTraffic on behalf of GTA Consultants as part of the South Grafton Paramics model.	Turning Movement Data and Origin Destination Data	2007

Source	Type of data	Date
Traffic Volume data supplied by Clarence Valley Council (numerous sites).	Two-way daily traffic volume counts at numerous sites across the study area. Data also includes limited average speed data.	2006-2009
Surveys undertaken by AusTraffic on behalf of GTA Consultants as part of the Additional Crossing of the Clarence River, Grafton – Heavy Vehicle Study, Report (February 2011).	Origin and Destination Surveys for one week.	2010
Surveys undertaken by TTM Group on behalf of GTA Consultants as part of the Additional Crossing of the Clarence River, Grafton – Heavy Vehicle Study, Report (February 2011).	Automatic tube count data at numerous sites across the study area for two weeks.	2010
Surveys undertaken by AusTraffic on behalf of GTA Consultants for this assessment in June and July2011.	Automatic tube count data at numerous sites across the study area for a duration of two weeks.	2011

The model used the historical traffic growth presented in Table 2 and Table 3 and the growth forecast presented in Chapter 4.5 to estimate future year traffic demands. Strategic traffic models were prepared for 2011 (representing existing conditions) and future years 2019, 2029, 2039 and 2049 to represent future conditions.

The strategic model covers the Grafton, South Grafton, Junction Hill, Clarenza and Waterview areas of Grafton. The road network in the model reflects actual road characteristics (speed and capacity), road alignment and orientation. Road network features such as existing speed limits, link capacities and turn bans were confirmed through on-site observations along with general network operating conditions in terms of travel times and vehicle delays.

The model was calibrated and validated to provide confidence that the model had a good match between modelled and observed data.

Assessment assumptions and limitations

A number of key assumptions were used in undertaking the strategic traffic assessment, in particular those for the future year model. A summary of the key assumptions used to determine the future year growth are as follows:

- The proposed inland freight terminal located on the NSW and Queensland borders has been discussed at high levels of government and is currently in planning infancy. The proposed inland terminal has several connections to the Pacific Highway north of Grafton but the assumed future year growth in Grafton does not include any specific allowance for a change in heavy vehicle growth rates due to additional long distance heavy vehicle freight movements travelling to / from the terminal, in particular those travelling through Grafton and South Grafton. The traffic assessment for the short-listed options will include a sensitivity assessment of a change in long distance heavy vehicle freight movements travelling through Grafton and South Grafton due to the proposed development.
- A future industrial estate and freight hub has been planned for the nearby Casino township (located approximately 100 km north of Grafton). The assumed heavy vehicle growth rates on the Summerland Way do not allow for significant growth in Casino and as such the development described has not been accounted for in determining the forecast traffic. The traffic assessment for the short-listed options will include a sensitivity analysis of a change in long distance heavy vehicle freight movements travelling through Grafton and South Grafton due to the proposed development.
- All future year modelling has assumed that the Pacific Highway Bypass of Grafton would be operational by 2019.

- For the purposes of the modelling it has been assumed that the new bridge will be open in 2019.
- The Australian Bureau of Statistics suggests that the persons per household within Grafton and South Grafton are not increasing significantly due to the ageing population.
- Forecast traffic growth considers growth in Clarenza and Junction Hill and other minor infill areas. Population figures from Clarence Valley Council and the Department of Planning and Infrastructure (refer to Chapter 4.5) were used for the traffic modelling.
- The population in Grafton is forecast to grow at 1.7 per cent per annum between 2011 and 2019. Assuming the current trip making patterns in Grafton are similar in the future, this population growth would result in significant peak cross river travel. A review of the existing bridge traffic count data suggests the northbound direction is currently at or above capacity between 7.45 am and 9.15 am. A comparison of the available capacity of the existing bridge during the peak and the potential growth in traffic revealed the existing bridge would not be able to accommodate the additional demand. It is anticipated that development and trip making behaviour will adjust to the limited peak period capacity on the existing bridge until the new bridge is built. For the purposes of the traffic modelling, growth has been limited to the available capacity, which results in growth of cross river traffic being consistent with the long term Grafton Bridge growth rate. After 2019, the assumed opening year for the new bridge, the additional capacity will enable stronger growth in cross river travel. The modelling assumes that the growth from 2019 to 2029 will be higher than the long term average for Grafton Bridge. The average growth in cross river travel beyond 2029 will be in line with the forecast growth in population.
- At 2049 it is forecast that traffic flows on the Pacific Highway will exceed the estimated capacity. In order to understand the effectiveness of the downstream options, excluding the Pacific Highway congestion effects, widening of the highway was assumed between South Grafton and the intersection of the Pacific Highway and the new bridge link.

Once a short-list of route options has been identified, microsimulation modelling will be used to assess the operation of the network for the short-listed options. The microsimulation model is a more detailed investigation and will assess the performance of the network at a vehicle by vehicle level to determine the infrastructure requirements for each of the short-listed options.

Flooding assessment of the preliminary route options

The flooding assessment aims to facilitate the short-listing of route options within the five corridors through consideration of flood risk and associated impacts. The assessment does not involve modelling of individual options. Rather, it uses the lower Clarence River flood model developed as part of the *Lower Clarence River Flood Study Review* (WBM, 2004) to provide an indicative assessment of the waterway area and embankment heights for each option. Following short-listing of options, flood modelling will be undertaken to more accurately quantify potential impacts.

The flood levels within the urban areas of Grafton and South Grafton are sensitive to changes in flood level within the main river channel of the Clarence River. For the purpose of option short-listing, an assessment of the options has been carried out based on qualitative flooding advice using existing catchment flood behaviour. Specifically, the following design inputs have been identified for all route options:

- The approximate length and sizes of waterway openings necessary to limit impacts to acceptable levels during flood events.
- The height of waterway structures to maintain acceptable freeboard during a 1 in 100 year flood event.

- The heights of embankments required to achieve the desired flood immunity of the bridge approaches during a 1 in 100 year flood event.
- The heights of main roads accessing the bridge approaches, required to achieve the desired flood immunity during a 1 in 20 year flood event.

Indicative waterway crossing widths and embankment/structure heights have been defined for each option based on the existing flood behaviour within the catchment. The definition of these elements provides an important input into the costing of each option, and hence represents a significant indicator for comparing route options.

The assessment focused on quantifying the existing catchment peak flow rates along the alignment of the proposed route options. This was taken from the 1 in 100 year flood event, as defined in the lower Clarence River flood model (WBM, 2004).

To undertake this assessment, each proposed route option was divided into hydraulic common segments (ie Clarence River, Grafton floodplain and South Grafton floodplain). The peak 1 in 100 year flood event flow rates were defined for each of the hydraulic common segments. These peak flow rates were then used to calculate expected indicative culvert/bridge/viaduct waterway areas by assuming an appropriate structure velocity. Based upon the current 1 in 100 year flood event behaviour, a design velocity of 0.5 m/s was adopted for floodplain areas whilst a value of 1.0 m/s was used for the Alumy Creek drainage channel. This methodology allows for an indicative assessment of the options by calculating approximate waterway areas and embankment heights.

Assessment assumptions and limitations

The lower Clarence River flood model, developed as part of the *Lower Clarence River Flood Study Review* (WBM, 2004), has been used for this assessment. Calculation of waterway and embankment details has been completed based on the existing flood behaviour within the catchment. These calculations have been determined based on an assumed design velocity and existing catchment peak 1 in 100 year flood event defined using the lower Clarence River flood model (WBM, 2004).

The existing topography has been simulated and the existing flows are used as a guide to determine the required indicative waterway structure areas.

The proposed route options are not simulated in the existing flood model as road embankments or waterway structures (eg bridges, viaducts and culverts). Following short-listing of route options, flooding modelling will be undertaken. This more detailed flood assessment will involve the simulation of the proposed option as a road embankment with appropriate waterway structures.

7.1.4 Step 4: Assessment of preliminary route options within corridors

Preliminary route options were assessed using the indicators described above. The assessment was carried out on a corridor-by-corridor basis to facilitate the short-listing process that will identify the best route option(s) within each corridor. The assessment findings are presented in Chapters 7.2 to 7.6.

Constraint mapping for each of the corridors is presented in Appendix 5. These constraint maps were developed from the information and constraints identified in Chapter 5.

7.2 Assessment results for options in Corridor 1

The following table presents the assessment results of the preliminary route options within Corridor 1. The assessment results are ordered per project objective, and from upstream to downstream. Hence, the options are not presented in alphabetical or numerical order.

Table 24: Assessment results for preliminary route options in Corridor 1.

Indicator			Preliminary route options	
			Option F	Option E
Enhance road safety for all road users over the length of the project				
Road geometry	Instances not meeting desirable design requirements	Horizontal Radius (No.)	0	0
		Crest curve (No.)	1	0
		Vertical Grade (No.)	0	0
Number of intersections where traffic volumes exceed 2019 threshold values	Very high volumes (No.)		0	1
	Moderately high volumes (No.)		3	4
Improve traffic efficiency between and within Grafton and South Grafton				
Estimated vehicle hours travelled (VHT) across whole network	At assumed bridge opening in 2019 (hours)		1996	1977
	20 years after opening in 2039 (hours)		3177	3168
Estimated average travel time between Grafton and South Grafton using the existing bridge	30 years after opening in 2049 (minutes)		5	5
Support regional and local economic development				
Vehicle hours travelled (VHT) for heavy vehicles across the modelled network in 2049 (hours)			60	59
Estimated average travel time between the Pacific Highway to the south and the Summerland Way to the north in 2049 (minutes)			16	16
Does the option provide approach road flood immunity (1-in-20 year flood) under upgraded levee scenario? (Yes/No)			Yes	Yes
Provide value for money				
Benefit-Cost Ratio (BCR) based on strategic cost estimate			2.3	2.5
Strategic cost estimate (2011 $M)			$170	$163
Minimise the impact on the social environment, including property impacts				
Number of community facilities potentially affected (No.)			5	5
Number of properties (excluding community facilities) potentially affected (No.)			15	8
Minimise the impact on residential amenity, including noise, vibration, air quality etc				
Number of potential sensitive receivers adjacent to route with doubling of traffic at 10 years after opening (2029)	Community facilities (No.)		1	2
	Residences (No.)		7	32
Number of potential sensitive receivers adjacent to route with halving of traffic at 10 years after opening (2029)	Community facilities (No.)		7	12
	Residences (No.)		86	104
Minimise the impact on heritage (Aboriginal)				
Is option likely to directly affect a culturally significant Aboriginal site (Yes/No)			No	No
Length through high archaeological potential area (m)			350	350
Minimise the impact on heritage (non-Aboriginal)				
Number of heritage items (State significance) likely to be affected (No.)			0	0
Number of heritage items (local significance) likely to be directly affected (No.)			6	6
Length through urban conservation area (m)			2140	2110

Indicator		Preliminary route options	
		Option F	Option E
Minimise impact on the natural environment			
Length through potential EEC (m)		10	10
Length through other native vegetation (m)		240	430
Provide a project that fits sensitively into the built, natural and community context			
Length of new bridge and viaduct (m)		730	690
Length of new or upgraded approach road (at-grade or on embankment) (m)		1008	1065
Geometry of the new route aligns with existing street or landscape patterns (Yes/No)		Yes	No
Minimise flooding impact caused by the project			
Length of bridge across river (m)		730	690
Length of viaduct across floodplain and minor creek crossings (m)	Grafton	0	0
	South Grafton	0	0

Key findings

Enhance road safety for all road users over the length of the project

- Both options perform in a similar manner. This is due to their close proximity and their common connection to Villiers Street.
- There is no significant difference in terms of safety. The single sharp crest curve at the south end of Option F would be relatively easy to eliminate and is not a significant differentiator.
- Option F is the best performing options against this indicator. Compared to Option E it has fewer intersections above the high volume and moderate to high volume thresholds. Option F has no intersections above the high volume threshold whereas Option E has one (Gwydir Highway / Skinner Street). The reason is that Option E attracts a greater proportion of traffic to the new bridge than Option F and results in more intersections in South Grafton exceeding the threshold values.

Improve traffic efficiency between and within Grafton and South Grafton

- In 2019 total network vehicle hours travelled for Option E is forecast to be marginally lower than Option F. The difference is a result of less traffic incurring delay on the existing bridge. At 2039 the forecast total travel time for Option E remains marginally lower than for Option F. Growth in total vehicle hours travelled between 2019 and 2039 under Option F is marginally lower than for Option E.
- Both options perform similarly when estimating average trip time between South Grafton and Grafton using the existing bridge. Both Option E and Option F will reduce the travel time to approximately five minutes in 2049.

Support regional and local economic development

- Options E and F have similar heavy vehicle hours travelled in 2049. This is reflected in the estimated trip time between the Pacific Highway and Summerland Way of approximately 16 minutes for both options.
- The approach roads for both options provide flood immunity for a 1 in 20-year flood event as they are located within the Grafton and South Grafton urban levees.

Provide value for money

- Option E would cost slightly less than Option F, mainly because the length of the bridge over the river is slightly shorter.

- Option E also has marginally higher travel time savings which, when combined with the lower cost, result in a slighter higher BCR.

Minimise the impact on the social environment, including property impacts

- Options F and E both impact five community facilities. These include the an exclusive use area on Clarence River for wakeboard competitions, St Mary's Primary School (closed), McAuley Catholic College and St Patrick's Catholic Church and McKittrick Park.
- Option F significantly impacts more properties (excluding community facilities) than Option E.
- For both options, potential impact on properties (excluding community facilities) would occur within only one neighbourhood, located in South Grafton. However, this neighbourhood contains some of Grafton City's more affordable housing stock of which there is an identified shortage.

Minimise the impact on residential amenity, including noise, vibration, air quality etc

- Option E affects more than four times the number of potential residential sensitive receivers adjacent to roads where traffic doubles 10 years after opening than Option F. Option E also potentially affects one more community facility than Option F. The affected properties are at the southern end of Villiers Street in Grafton and the feeder and approach roads to the new bridge in South Grafton.
- More community and residential potential noise sensitive receivers would benefit from a halving of traffic volumes at 10 years after opening for Option E compared to Option F. Option E attracts more traffic to the new bridge and is therefore more effective in attracting traffic away from the existing bridge. The affected properties are along feeder and approach roads to the existing bridge in both Grafton and South Grafton.

Minimise the impact on heritage (Aboriginal)

- No known culturally significant Aboriginal sites would be impacted by the two options.
- The options would have the same impact on high archaeological potential areas.

Minimise the impact on heritage (non-Aboriginal)

- No items of State significance are likely to be affected by Options E or F.
- Options E and F both would have the same level of impact on items of local significance and similar impacts on the Grafton and South Grafton urban conservation areas.

Minimise impact on the natural environment

- Options E and F would cross a small area of endangered ecological community containing freshwater wetlands on coastal floodplains (Reedlands).
- Both options would also cross areas containing other native vegetation including planted figs, with Option E affecting a greater length of native vegetation.

Provide a project that fits sensitively into the built, natural and community context

- Option E requires a shorter length of new bridge and viaduct compared to Option F. However, Option F has a shorter length of new or upgraded approach road to the bridge.
- In Corridor 1, the Grafton and South Grafton historical urban grid are clearly evident. Option E would be consistent with existing grid patterns on the Grafton side of the river. However, it is not consistent with the existing street pattern on the South Grafton side of the river, with substantial segmentation across parcels of land. Option F is consistent with existing grid patterns on both sides of the river.

Minimise flooding impact caused by the project

- Due to the similarities in alignment and location, the flood mitigation measures required for Options E and F are largely comparable.
- Options E and F would not require viaduct structures.

7.3 Assessment results for options in Corridor 2

The following chapters present the assessment results of the preliminary route options within Corridor 2. The assessment results are ordered per project objective, and from upstream to downstream. Hence, the numbering and lettering of the options are not in ascending or alphabetical order.

Table 25: Assessment results for preliminary route options in Corridor 2.

Indicator			Preliminary route options									
			Option 5	Option A	Option B	Option 6	Option C	Option D	Option I	Option 8	Option 9	Option 10
Enhance road safety for all road users over the length of the project												
Road geometry	Instances not meeting desirable design requirements	Horizontal Radius (No.)	0	3	1	0	0	0	0	1	0	0
		Crest curve (No.)	2	3	3	3	3	2	1	1	0	0
		Vertical Grade (No.)	1	2	1	1	1	1	1	1	0	1
Number of intersections where traffic volumes exceed 2019 threshold values	Very high volumes (No.)		2	2	3	1	1	0	0	1	0	0
	Moderately high volumes (No.)		3	3	2	4	3	2	4	2	4	4
Improve traffic efficiency between and within Grafton and South Grafton												
Estimated vehicle hours travelled (VHT) across whole network	At assumed bridge opening in 2019 (hours)		1968	1953	1958	1954	1986	1982	1987	1992	2036	2051
	20 years after opening in 2039 (hours)		3173	3135	3210	3142	3192	3173	3180	3193	3274	3302
Estimated average travel time between Grafton and South Grafton using the existing bridge	30 years after opening in 2049 (minutes)		5	4	5	4	6	6	6	6	6	7
Support regional and local economic development												
Vehicle hours travelled (VHT) for heavy vehicles across the modelled network in 2049 (hours)			60	57	57	58	59	58	59	59	61	61
Estimated average travel time between the Pacific Highway to the south and the Summerland Way to the north in 2049 (minutes)			16	13	16	15	14	13	14	15	16	15
Does the option provide approach road flood immunity (1-in-20 year flood) under upgraded levee scenario? (Yes/No)			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Provide value for money												
Benefit-Cost Ratio (BCR) based on strategic cost estimate			1.6	2.1	1.8	1.9	2.2	1.8	1.9	1.8	1.8	1.6
Strategic cost estimate (2011 $M)			$261	$192	$214	$217	$177	$220	$207	$216	$209	$229

Indicator		Preliminary route options									
		Option 5	Option A	Option B	Option 6	Option C	Option D	Option I	Option 8	Option 9	Option 10
Minimise the impact on the social environment, including property impacts											
Number of community facilities potentially affected (No.)		7	7	3	3	2	3	3	1	2	0
Number of properties (excluding community facilities) potentially affected (No.)		36	27	26	34	30	54	48	36	31	23
Minimise the impact on residential amenity, including noise, vibration, air quality etc											
Number of potential sensitive receivers adjacent to route with doubling of traffic at 10 years after opening (2029)	Community facilities (No.)	1	2	0	0	2	6	2	2	0	1
	Residences (No.)	37	7	0	40	3	14	20	11	152	232
Number of potential sensitive receivers adjacent to route with halving of traffic at 10 years after opening (2029)	Community facilities (No.)	10	4	4	7	11	11	11	8	1	5
	Residences (No.)	56	36	15	46	79	80	72	72	27	14
Minimise the impact on heritage (Aboriginal)											
Is option likely to directly affect a culturally significant Aboriginal site (Yes/No)		No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Length through high archaeological potential area (m)		10	80	100	10	10	10	10	210	410	490
Minimise the impact on heritage (non-Aboriginal)											
Number of heritage items (State significance) likely to be affected (No.)		0	3	3	2	0	0	1	0	0	0
Number of heritage items (local significance) likely to be directly affected (No.)		22	16	11	14	12	20	19	10	9	7
Length through urban conservation area (m)		3100	3210	3260	2490	1410	1110	920	1070	1590	1390
Minimise impact on the natural environment											
Length through potential EEC (m)		10	40	30	20	30	30	20	100	160	210
Length through other native vegetation (m)		670	360	400	300	420	340	390	280	260	110
Provide a project that fits sensitively into the built, natural and community context											
Height of new crossing compared to existing bridge (m)		-6.4	-6.7	+1.0	+2.3	-6.0	-6.0	-6.6	+2.4	-4.6	+0.5
Length of new bridge and viaduct (m)		760	600	780	765	640	785	775	945	645	780
Length of new or upgraded approach road (at-grade or on embankment) (m)		1691	1900	1814	1870	1871	1834	1677	2306	3116	3056

Indicator		Preliminary route options									
		Option 5	Option A	Option B	Option 6	Option C	Option D	Option I	Option 8	Option 9	Option 10
Geometry of the new route aligns with existing street or landscape patterns (Yes/No)		Yes	No	Yes	No	No	No	No	No	No	No
Minimise flooding impact caused by the project											
Length of bridge across river (m)		610	465	535	545	435	435	420	530	565	700
Length of viaduct across floodplain and minor creek crossings (m)	Grafton	150	135	245	220	205	350	355	415	0	0
	South Grafton	0	0	0	0	0	0	0	0	80	80

Key findings

Enhance road safety for all road users over the length of the project

- Options 9 and 10, the options furthest downstream from the existing bridge in Corridor 2, have the fewest geometric constraints and the best geometry.
- Options A and B, the options closest to the existing bridge, are the most constrained in terms of geometry which may result in higher accident rates.
- Options B and 8 are higher than the other bridges in order to pass above the existing railway line on the Grafton side of the river and both require long, relatively steep grades on the northern side.
- Option 6, C and 9 would require lowering of Pound Street where it passes under the railway, and lateral clearance to the existing railway viaduct piers may be a safety issue.
- Options D, I, 8, 9 and 10 are the best performing options against this indicator. They have the fewest intersections above the high volume and moderate to high volume thresholds. These options perform better as traffic is not concentrated at key points in the network but is distributed more evenly across the road network.
- Option B is the worst performing option against this indicator. It has three intersections above the high volume threshold (Gwydir Highway / Bent Street, Bent Street / Through Street, Pound Street / Villiers Street and Pound Street / Clarence Street) and two intersections above the moderate to high volume threshold. Options 5, A and 6 similarly have a relatively high number of intersections with volumes above the thresholds. With these options, all traffic is concentrated to key points in Grafton and South Grafton rather than being dispersed.

Improve traffic efficiency between and within Grafton and South Grafton

- In 2019 Option A, B and 6 are estimated to have the lowest total vehicle hours travelled in this corridor. These options are the closest to the existing bridge and the conversion of the existing bridge to one lane only improves the efficiency and capacity of the network.
- In 2039 Option A and 6 are estimated to have the lowest total vehicle hours travelled in this corridor.
- In 2019 and 2039 Options 9 and 10 are estimated to have the highest estimate of total hours travelled.
- Option A and 6 perform the best at reducing average trip time between South Grafton and Grafton via the existing bridge, at approximately four minutes. Estimated trip time under Option 10 is the highest at seven minutes. This reflects the inability of Option 10 to attract more traffic away from the existing bridge when compared with the other options in this corridor.

Support regional and local economic development

- All options have a similar total number of heavy vehicle hours travelled in 2049.
- Option A and D perform best at reducing the travel time between the Pacific Highway and Summerland Way. The estimated trip time is 13 minutes. A number of options have the highest trip time of 16 minutes for a trip from the Pacific Highway to Summerland Way; Options 5, B and 9.
- All options provide flood immunity for approach roads in a 1 in 20 year flood. For Options 9 and 10, an upgrade of the Pacific Highway, raising the road level above 7.8 m Australian Height Datum, connecting these to South Grafton would be required. This is because these options do not have approach roads within the Grafton and South Grafton urban levees. The upgrade has been allowed for in the cost estimates for these options.

Provide value for money

- Option C has the lowest estimated cost, mainly because the combined length of the bridge and viaduct structures is lower than most of the other options.
- Option 5 has the highest estimated cost because the bridge geometry would not allow the adoption of the incrementally launched form of construction.
- As well as having the lowest cost, Option C has the highest BCR.
- Options 5 and 10 have the lowest BCR. These are both relatively high cost options.

Minimise the impact on the social environment, including property impacts

- All options would require the acquisition of properties.
- Options 5 and A would impact the highest number of community facilities. Option 5 impacts the Sailing Club, North Coast Institute of TAFE, South Grafton District Ex-Servicemen's Club, South Grafton Bowling Sports and Recreation Club, Grafton GP Super Clinic and Salty Seller Reserve. Option A impacts the Sailing Club, North Coast Institute of TAFE, Silver Jubilee Park, Derek Palmer Place, Earle Page Park, Induna Reserve and Salty Seller Reserve.
- Option10 is not expected to directly affect any community facilities.
- Option B impacts North Coast Institute of TAFE, Silver Jubilee Park and Derek Palmer Place.
- Option 6 impacts Gummyaney Aboriginal Pre-School, Silver Jubilee Park and Derek Palmer Place.
- Options C, D and I impact the Tourist Information Centre and Pacific Highway public open space, with Options D and I also impacting Gummyaney Aboriginal Pre-School. Impacts on the tourist information centre could have a major impact on tourism in the town. A similar facility would require development to mitigate its loss.
- Option 8 impacts North Coast Institute of TAFE.
- Option 9 impacts boat mooring and Girl Guide Park including Pound Street jetty.
- Options D and I would impact the highest number of properties (excluding community facilities).
- Options A, B and 10 would impact the least number of properties (excluding community facilities).

Minimise the impact on residential amenity, including noise, vibration, air quality etc

- Option D has the highest number of potential community sensitive receivers affected by traffic doubling at 10 years after opening. Most of these affected facilities are on the immediate feeder and approach roads to the new bridge in Grafton.
- Options B, 6 and 9 have no potential community sensitive receivers affected by traffic doubling at 10 years after opening.
- Options 9 and 10 have the highest number of potential residential sensitive receivers affected by traffic doubling at 10 years after opening. These options increase the traffic on the feeder and approach roads to the new bridge in Grafton.
- Options A, B and C have the least number of potential residential sensitive receivers affected by traffic doubling at 10 years after opening.
- Options 5, C, D and I have the highest number of potential community sensitive receivers affected by traffic halving at 10 years after opening. These options reduce the traffic on the feeder and approach roads to the existing bridge in Grafton and South Grafton.

- Options A, B, 9 and 10 have the least number of potential community sensitive receivers affected by traffic halving at 10 years after opening.
- Options C, D, I and 8 have the highest number of potential residential sensitive receivers affected by traffic halving at 10 years after opening. These options reduce the traffic on the feeder and approach roads to the existing bridge in Grafton and South Grafton.
- Options B and 10 have the least number of potential residential sensitive receivers affected by traffic halving at 10 years after opening.

Minimise the impact on heritage (Aboriginal)

- Known cultural values would be impacted by Options B, 6, C, D, I, 8, 9 and 10. The area identified around Alipou Creek as being the Golden Eel site would be impacted by these options.
- All options encroach in areas of Aboriginal archaeological potential, Options A, B, 8, 9 and 10 cross significant sections of these areas.
- AHIMS Site # 12-6-0086 would be impacted by Options 9 and 10.

Minimise the impact on heritage (non-Aboriginal)

- Options A and B may affect three heritage items of State significance. Two items are immediately adjacent to these options: Cathedral Church of Christ the King including hall and cottages (SHR No. 01654), and Grafton City Railway Station Group (SHR No. 01154). The third item which may be affected is the Grafton Rail and Road Bridge over Clarence River (SHR No. 01036).
- Option 6 may affect two heritage items of State significance. One item is immediately adjacent to this option: Grafton City Railway Station Group (SHR No. 01154). The second item which may be affected is the Grafton Rail and Road Bridge over Clarence River (SHR No. 01036).
- Option I may affect one heritage item of State significance. This item is immediately adjacent to this option: Grafton City Railway Station Group (SHR No. 01154).
- All options in Corridor 2 are likely to directly affect various heritage items of local significance. Options 5, D and I would have the largest number of items of local significance likely to be affected. Options 5, A and B have the longest lengths through the Grafton urban conservation area.

Minimise impact on the natural environment

- All of the preliminary route options within Corridor 2 would cross areas containing endangered ecological communities. Options 8, 9 and 10 would have the longest sections crossing such areas.
- Options C, D, 6, 8, 9 and 10 cross endangered ecological communities containing sub-tropical coastal floodplain forest (riparian forest and/or remnant eucalyptus). All options except Option 10 cross endangered ecological communities containing freshwater wetlands on coastal floodplain.
- All of the preliminary route options within Corridor 2 would cross areas containing native vegetation. Option 5 would have the longest section crossing such vegetation.

Provide a project that fits sensitively into the built, natural and community context

- Options B, 6, 8 and 10 would be higher than the existing bridge. As such, they would adversely affect the visual integrity of the existing bridge. The adverse effect of options B and 6 would be greater as they are located immediately adjacent to the existing bridge.

- Bridge options 5, A, C, D, I and 9 would be lower than the existing bridge overall, although the deck level of each would sit higher than the existing railway (lower) deck level on the existing bridge. In each of these options, the lower level on the proposed bridge would allow the existing bridge to take visual precedence.
- Option 8 would require the longest length for the new bridge and viaduct while Option A would have the shortest length.
- In Corridor 2, the historical urban grid is clearly evident at South Grafton town centre, west of Bent Street, and is less evident in the existing industrial area east of Bent Street. The historical urban grid is clearly evident in Grafton. With the exception of Options 5 and B, options within this corridor are not consistent with Grafton and South Grafton grid patterns.

Minimise flooding impact caused by the project

- The length of the bridge structure across the Clarence River varies between 420 m (Options I) and 700 m (Option 10).
- Within Grafton, following overtopping of the levee upstream of the existing Grafton bridge, a significant flow path develops, flowing north through the existing Grafton Bridge and railway line viaducts. Embankments constructed within this existing flow path have the potential to result in significant localised flood impacts. Due to this, Options 5, A, B, 6, C, D, I, and 8 all include viaducts where their alignments traverse the flow path. Located further to the north, outside this major flow path, Options 9 and 10 do not require viaducts within Grafton.
- Within South Grafton, the high ground associated with the approach to the existing Grafton Bridge dominates the flood behaviour and associated flood mitigation requirements. Options within Corridor 2 with approaches either upstream or aligned with the high ground do not require viaducts. Options 9 and 10 do not have approaches aligned with the above mentioned high ground, instead crossing the Alipou Creek floodplain before connecting with the Pacific Highway. Within this portion of the catchment, following overtopping of the Alipou Creek rural levees, low velocity backwater inundation of the Alipou Creek floodplain occurs. Design of an embankment across the Alipou Creek floodplain along Options 9 and 10 may result in significant regional flood impacts. To mitigate these flood impacts, Options 9 and 10 include allowances for viaducts within their respective designs within the Alipou Creek floodplain.

7.4 Assessment results for options in Corridor 3

The following table presents the assessment results of the preliminary route options within Corridor 3. The assessment results are ordered per project objective, and from upstream to downstream. Hence, the numbering and lettering of the options are not in ascending or alphabetical order.

Table 26: Assessment results for preliminary route options in Corridor 3.

Indicator			Preliminary route options				
			Option 11	Option J	Option K	Option 12	Option L
Enhance road safety for all road users over the length of the project							
Road geometry	Instances not meeting desirable design requirements	Horizontal Radius (No.)	0	0	0	0	0
		Crest curve (No.)	0	0	0	0	0
		Vertical Grade (No.)	1	0	0	0	0
Number of intersections where traffic volumes exceed 2019 threshold values	Very high volumes (No.)		2	2	2	2	2
	Moderately high volumes (No.)		2	2	2	2	2
Improve traffic efficiency between and within Grafton and South Grafton							
Estimated vehicle hours travelled (VHT) across whole network	At assumed bridge opening in 2019 (hours)		2137	2165	2195	2204	2278
	20 years after opening in 2039 (hours)		3474	3553	3616	3643	3706
Estimated average travel time between Grafton and South Grafton using the existing bridge	30 years after opening in 2049 (minutes)		11	14	14	14	17
Support regional and local economic development							
Vehicle hours travelled (VHT) for heavy vehicles across the modelled network in 2049 (hours)			67	67	69	70	69
Estimated average travel time between the Pacific Highway to the south and the Summerland Way to the north in 2049 (minutes)			17	17	15	15	16
Does the option provide approach road flood immunity (1-in-20 year flood) under upgraded levee scenario? (Yes/No)			Yes	Yes	Yes	Yes	Yes
Provide value for money							
Benefit-Cost Ratio (BCR) based on strategic cost estimate			1.6	1.5	1.0	1.0	0.8
Strategic cost estimate (2011 $M)			$205	$212	$280	$292	$335
Minimise the impact on the social environment, including property impacts							
Number of community facilities potentially affected (No.)			1	1	2	4	0
Number of properties (excluding community facilities) potentially affected (No.)			18	18	23	29	41

Indicator		Preliminary route options				
		Option 11	Option J	Option K	Option 12	Option L
Minimise the impact on residential amenity, including noise, vibration, air quality etc						
Number of potential sensitive receivers adjacent to route with doubling of traffic at 10 years after opening (2029)	Community facilities (No.)	0	1	3	1	1
	Residences (No.)	149	233	80	65	61
Number of potential sensitive receivers adjacent to route with halving of traffic at 10 years after opening (2029)	Community facilities (No.)	6	5	6	6	6
	Residences (No.)	92	66	44	58	59
Minimise the impact on heritage (Aboriginal)						
Is option likely to directly affect a culturally significant Aboriginal site (Yes/No)		No	No	No	No	No
Length through high archaeological potential area (m)		0	240	30	30	0
Minimise the impact on heritage (non-Aboriginal)						
Number of heritage items (State significance) likely to be affected (No.)		0	0	1	1	0
Number of heritage items (local significance) likely to be directly affected (No.)		4	2	3	2	2
Length through urban conservation area (m)		920	730	1260	1200	490
Minimise impact on the natural environment						
Length through potential EEC (m)		60	30	30	60	0
Length through other native vegetation (m)		210	410	170	140	540
Provide a project that fits sensitively into the built, natural and community context						
Length of new bridge and viaduct (m)		870	960	1290	1390	1640
Length of new or upgraded approach road (at-grade or on embankment) (m)		2455	2229	4050	4186	4857
Geometry of the new route aligns with existing street or landscape patterns (Yes/No)		Yes	Yes	Yes	No	Yes
Minimise flooding impact caused by the project						
Length of bridge across river (m)		420	450	545	515	560
Length of viaduct across floodplain and minor creek crossings (m)	Grafton	0	120	80	80	80
	South Grafton	450	390	665	795	1000

Key findings

Enhance road safety for all road users over the length of the project

- All options within this corridor have good geometry. The grade on the Grafton side is slightly steeper for Option 11 but it extends for less than 100 m and is not a significant differentiator.
- For this corridor all the options perform in a similar manner. All options have two intersections with flows greater than the high volume threshold. The two intersections are Gwydir Highway / Bent Street and Fitzroy Street / Clarence Street.

Improve traffic efficiency between and within Grafton and South Grafton

- Option 11 has the lowest estimated total hours travelled in 2019 and 2039.
- Option L has the highest estimated total hours travelled for 2019 and 2039. Total network travel time increases as the new bridge alignment moves further downstream.
- The estimated trip time between South Grafton and Grafton is best for Option 11 at approximately 11 minutes. This is six minutes better than Option L which has an estimated trip time of 17 minutes in 2049.

Support regional and local economic development

- Option 11 and Option J perform marginally better in catering for heavy vehicle travel with the lowest total network hours which is despite a slightly longer trip time for travel between the Pacific Highway and Summerland Way. The downstream options enable trucks to avoid travel through the built up areas when travelling to the Summerland Way and are therefore slightly faster.

Provide value for money

- Estimated costs increase as the options move downstream as the lengths of the bridge and viaducts generally increase.
- Option 11 has the lowest estimated cost, mainly because the length of the bridge and viaduct for the option is shorter in length than the others.
- Option L has the highest estimated cost because of longer bridge and viaduct lengths.
- BCR values decrease as the options move downstream, with Option 11 having the highest BCR and Option L having the lowest BCR.

Minimise the impact on the social environment, including property impacts

- Option 12 would have the greatest impact on community facilities. Community facilities potentially impacted by this option include the Grafton Gaol, Grafton Base Hospital, Clarence Village Hostel and Gordon Wingfield Park.
- Option 11 would impact river user access at the end of Fry Street, Option J would impact Jaycee Park and Option K would impact the Grafton Gaol and Aruma Community Health. All options would have an impact on properties (excluding community facilities) in Grafton. The impact in South Grafton would be negligible as the area covered by this corridor is predominantly rural.
- Option L would not impact community facilities but is likely to affect the greatest number of properties (excluding community facilities).
- All options would provide the opportunity for increased access to the proposed future residential growth area at Clarenza via the northern neighbourhoods of Grafton. All options would also provide more direct access to three major schools at Clarenza (St Andrews School, Clarence Valley Anglican School (Senior School) and McAuley Catholic College).

Minimise the impact on residential amenity, including noise, vibration, air quality etc

- Option K has the highest number of potential community sensitive receivers affected by traffic doubling at 10 years after opening. These affected facilities are on the approach roads to the new bridge in Grafton.
- Option 11 has the least, with no potential community sensitive receivers affected by traffic doubling at 10 years after opening.

- Options 11 and J have the highest number of potential residential sensitive receivers affected by traffic doubling at 10 years after opening. The increase in traffic is on the feeder and approach roads to the new bridge in Grafton and the Pacific Highway in South Grafton. These options attract more traffic compared to other options in this corridor.
- Options K, 12 and L have the least number of potential residential sensitive receivers affected by traffic doubling at 10 years after opening.
- All options have a similar number of potential community sensitive receivers affected by traffic halving at 10 years after opening. These options reduce the traffic on the feeder and approach roads to the existing bridge in Grafton and South Grafton.
- Option 11 has the highest number of potential residential sensitive receivers affected by traffic halving at 10 years after opening. The decrease in traffic is on the feeder and approach roads to the existing bridge in Grafton. This option attracts more traffic away from the existing bridge compared to other options in this corridor.
- Option K has the least number of potential residential sensitive receivers affected by traffic halving at 10 years after opening.

Minimise the impact on heritage (Aboriginal)

- No culturally significant Aboriginal sites would be impacted by the preliminary route options within Corridor 3.
- Option J has the greatest length through areas of potential Aboriginal archaeological sensitivity, with Options 11 and L not affecting any areas.

Minimise the impact on heritage (non-Aboriginal)

- One heritage item of State significance is like to affect Options K and 12 as it is located within the road corridor: Grafton Correctional Centre (SHR No. 00809).
- All options are likely to directly affect heritage items of local significance. In particular, Options 11 and K would have the largest number of items likely to be directly affected.
- Option K and 12 would have the greatest impact in the Grafton urban conservation area.

Minimise impact on the natural environment

- Options J, K and 12 would cross areas of endangered ecological community containing sub-tropical coastal floodplain forest (riparian forest). Option 11 would cross areas of endangered ecological community containing sub-tropical coastal floodplain forest (remnant eucalypts).
- Option J and L would have the longest sections crossing through other native vegetation.

Provide a project that fits sensitively into the built, natural and community context

- Options K, 12 and L would have the longest length of new bridge and viaduct while Options 11 and J would have the shortest.
- In Corridor 3, the historical urban grid in South Grafton has fairly regular parcel grid pattern geometry, consistent with larger scale agricultural type uses. The historical urban grid in Grafton is evident in the regular parcel grid pattern geometry, consistent with suburban development. With exception of Option 12, all options would be generally consistent with existing grid patterns and would result in minimal segmentation across parcels.

Minimise flooding impact caused by the project

- The length of the bridge structure across the Clarence River varies between 420 m (Option 11) and 560 m (Option L), generally increasing as the options move downstream.

- Within Grafton, all options would require comparable design features. For the options crossing Alumy Creek and the minor drainage line, between Villiers Street and Prince Street, minor waterway crossings would be required. No viaduct structures would be required for the approach roads on the Grafton side of the river for any of the options.
- Within South Grafton, all options traverse a significant length of floodplain. Flood flows within this section of floodplain are significant. Embankments constructed within this floodplain would have the potential to result in extensive major flood impacts. Due to this, viaduct structures are assumed for all options in Corridor 3. The required length of viaduct generally increases for the options further downstream.

7.5 Assessment results for options in Corridor 4

The following table presents the assessment results of the preliminary route options within Corridor 4. The assessment results are ordered per project objective, and from upstream to downstream. Hence, the numbering and lettering of the options are not in ascending or alphabetical order.

Table 27: Assessment results for preliminary route options in Corridor 4.

Indicator			Preliminary route options			
			Option 14	Option 20	Option 21	Option M
Enhance road safety for all road users over the length of the project						
Road geometry	Instances not meeting desirable design requirements	Horizontal Radius (No.)	0	0	0	0
		Crest curve (No.)	0	0	0	0
		Vertical Grade (No.)	0	0	0	0
Number of intersections where traffic volumes exceed 2019 threshold values	Very high volumes (No.)		2	2	2	2
	Moderately high volumes (No.)		2	2	2	2
Improve traffic efficiency between and within Grafton and South Grafton						
Estimated vehicle hours travelled (VHT) across whole network	At assumed bridge opening in 2019 (hours)		2414	2497	2437	2510
	20 years after opening in 2039 (hours)		3851	3922	3923	3976
Estimated average travel time between Grafton and South Grafton using the existing bridge	30 years after opening in 2049 (minutes)		16	19	16	18
Support regional and local economic development						
Vehicle hours travelled (VHT) for heavy vehicles across the modelled network in 2049 (hours)			67	69	68	70
Estimated average travel time between the Pacific Highway to the south and the Summerland Way to the north in 2049 (minutes)			14	15	14	15
Does the option provide approach road flood immunity (1-in-20 year flood) under upgraded levee scenario? (Yes/No)			Yes	Yes	Yes	Yes
Provide value for money						
Benefit-Cost Ratio (BCR) based on strategic cost estimate			0.7	0.5	0.6	0.5
Strategic cost estimate (2011 $M)			$357	$408	$416	$416
Minimise the impact on the social environment, including property impacts						
Number of community facilities potentially affected (No.)			1	3	3	3
Number of properties (excluding community facilities) potentially affected (No.)			18	17	18	18
Minimise the impact on residential amenity, including noise, vibration, air quality etc						
Number of potential sensitive receivers adjacent to route with doubling of traffic at 10 years after opening (2029)	Community facilities (No.)		4	5	5	3
	Residences (No.)		63	65	69	67
Number of potential sensitive receivers adjacent to route with halving of traffic at 10 years after opening (2029)	Community facilities (No.)		6	6	4	4
	Residences (No.)		43	43	30	29

Indicator		Preliminary route options			
		Option 14	Option 20	Option 21	Option M
Minimise the impact on heritage (Aboriginal)					
Is option likely to directly affect a culturally significant Aboriginal site (Yes/No)		No	Yes	Yes	Yes
Length through high archaeological potential area (m)		0	140	150	210
Minimise the impact on heritage (non-Aboriginal)					
Number of heritage items (State significance) likely to be affected (No.)		0	0	0	0
Number of heritage items (local significance) likely to be directly affected (No.)		2	2	3	3
Length through urban conservation area (m)		390	390	390	390
Minimise impact on the natural environment					
Length through potential EEC (m)		0	50	40	60
Length through other native vegetation (m)		510	430	530	400
Provide a project that fits sensitively into the built, natural and community context					
Length of new bridge and viaduct (m)		1870	2185	2180	2210
Length of new or upgraded approach road (at-grade or on embankment) (m)		4759	4480	4791	4564
Geometry of the new route aligns with existing street or landscape patterns (Yes/No)		No	Yes	No	Yes
Minimise flooding impact caused by the project					
Length of bridge across river (m)		740	965	990	965
Length of viaduct across floodplain (m)	Grafton	80	60	60	60
	South Grafton	1050	1160	1130	1185

Key findings

Enhance road safety for all road users over the length of the project

- All options within this corridor have good geometry. Compared to the other options within this corridor, Option 14 has poorer horizontal geometry because of the two 280 m radius curves on the Grafton side but this radius is above the desirable minimum value and is not a major differentiator.
- For this corridor all the options perform in a similar manner. All options have two intersections with flows greater than the high volume threshold. The two intersections are Gwydir Highway / Bent Street and Fitzroy Street / Clarence Street.

Improve traffic efficiency between and within Grafton and South Grafton

- In 2019 Option 14 is estimated to have the lowest total hours travelled for the options in this corridor. Option 21 has the second lowest overall network hours travelled as traffic uses Centenary Drive as a preferred route compared to the Pacific Highway; thereby avoiding delay on the Pacific Highway and as a result lower total hours travelled.
- In 2039 Option 14 is estimated to have the lowest total hours travelled for the options in this corridor.
- The option with the highest overall network hours travelled is Option M for both 2019 and 2039.
- Both Option 14 and Option 21 reduce the traffic flows on the existing bridge to a greater extent than Option 20 and Option M. As a result the trip time between South Grafton and Grafton is reduced. Options 14 and 21 generally perform better due to more traffic being attracted to these options because of the advantages offered by Centenary Drive as an alternative to the Pacific Highway.

Support regional and local economic development

- Option 14 performs best with the lowest network vehicle hours travelled for heavy vehicles.
- Options 14 and 21 have the shortest average travel time between the Pacific Highway and Summerland Way using the existing bridge.
- All main approach roads for options within this corridor would have flood immunities greater than the 1 in 20-year flood event.

Provide value for money

- Estimated costs increase as the options move downstream, with the upstream Option 14 considerably cheaper than the other options within this corridor due to the shorter bridge and viaducts.
- Travel time savings for Option 14 are highest and, when combined with the lowest cost, the BCR for Option 14 is better than for the other options in this corridor.

Minimise the impact on the social environment, including property impacts

- Option 20, 21 and M would impact the greatest number of community facilities including the sewage treatment works and waste transfer station, Scout Hall and Volkers Park.
- Option 14 would impact on Corcoran Park.
- The options cannot be clearly differentiated in terms of their impact on properties (excluding community facilities).

Minimise the impact on residential amenity, including noise, vibration, air quality etc

- All options affect a similar number of potential community sensitive receivers where traffic doubles 10 years after opening. These affected facilities are mainly on North Street in Grafton, the approach road for the new bridge.
- All options affect a similar number of potential residential sensitive receivers where traffic doubles 10 years after opening. These affected properties are on the approach road for the new bridge and the feeder roads back into central Grafton.
- All options have a similar number of potential community sensitive receivers affected by traffic halving at 10 years after opening. These options reduce the traffic on the feeder and approach roads on the existing bridge in Grafton.
- Options 14 and 20 have the highest number of potential residential sensitive receivers affected by traffic halving at 10 years after opening. The decrease in traffic is on the feeder and approach roads to the existing bridge in Grafton.
- Option 21 and M have the least number of potential residential sensitive receivers affected by traffic halving at 10 years after opening.

Minimise the impact on heritage (Aboriginal)

- Culturally significant Aboriginal sites (Elizabeth Island and Great Marlow) would be impacted by Options 20, 21 and M.
- Options 20, 21 and M would also result in significant lengths through Aboriginal archaeological potentially sensitive areas.

Minimise the impact on heritage (non-Aboriginal)

- Options within this corridor would not impact listed items of State significance.
- Options within this corridor would impact similar numbers of local significance listed items.

- Options within this corridor would have the same level of impact on the Grafton urban conservation area.

Minimise impact on the natural environment

- Options 20, 21 and M would cross areas of endangered ecological communities containing sub-tropical coastal floodplain forest (riparian forest).
- All options would cross areas with other native vegetation. From these, Options 14 and 21 would have the longest section crossing such vegetation.

Provide a project that fits sensitively into the built, natural and community context

- Option 14 would require the shortest length of new bridge and viaduct whilst Option M, 20 and 21 would require the longest.
- Option 20 would require the shortest length of new or upgraded approach road whilst Options 14 and 21 require the longest.
- In Corridor 4, the South Grafton side of the river is characterised by fairly regular parcel grid pattern geometry, consistent with larger-scale agricultural type uses while the Grafton side of the river is characterised by irregular parcel grid pattern geometry divided by North Street. The geometry of Options 20 and M are generally consistent with the existing grid patterns on both sides of the river. However, Options 14 and 21 are not consistent with existing grid patterns, with some segmentation occurring across parcels of land.

Minimise flooding impact caused by the project

- The length of bridge structure across the Clarence River varies between 740 m (Option 14) and 990 m (Option 21).
- Within Grafton, minor waterway crossings would be required for the route options crossing the Alumy Creek and the minor drainage line between Villiers Street and Prince Street. No viaducts are required to connect the Grafton approach roads to the proposed route option bridges.
- Within South Grafton, all options would connect to the Pacific Highway and traverse a significant length of floodplain. Flood flows within this floodplain are significant, flowing north from Alipou Creek towards Swan Creek. Embankments constructed within this floodplain would have the potential to result in extensive major flood impacts. Due to this, all route options within Corridor 4 have been assumed to have a viaduct traversing this floodplain.

7.6 Assessment results for options in Corridor 5

The following table presents the assessment results of the preliminary route options within Corridor 5. The assessment results are ordered per project objective, and from upstream to downstream.

Table 28: Assessment results for preliminary route options in Corridor 5.

Indicator			Preliminary route options			
			Option 15	Option 23	Option 25	Option 26
Enhance road safety for all road users over the length of the project						
Road geometry	Instances not meeting desirable design requirements	Horizontal Radius (No.)	0	0	0	0
		Crest curve (No.)	0	0	0	0
		Vertical Grade (No.)	0	0	0	0
Number of intersections where traffic volumes exceed 2019 threshold values	Very high volumes (No.)		2	2	2	2
	Moderately high volumes (No.)		2	2	2	2
Improve traffic efficiency between and within Grafton and South Grafton						
Estimated vehicle hours travelled (VHT) across whole network	At assumed bridge opening in 2019 (hours)		2418	2583	2683	2714
	20 years after opening in 2039 (hours)		3855	4205	4342	4373
Estimated average travel time between Grafton and South Grafton using the existing bridge	30 years after opening in 2049 (minutes)		15	23	27	25
Support regional and local economic development						
Vehicle hours travelled (VHT) for heavy vehicles across the modelled network in 2049 (hours)			68	71	73	75
Estimated average travel time between the Pacific Highway to the south and the Summerland Way to the north in 2049 (minutes)			14	14	15	14
Does the option provide approach road flood immunity (1-in-20 year flood) under upgraded levee scenario? (Yes/No)			Yes	Yes	Yes	Yes
Provide value for money						
Benefit-Cost Ratio (BCR) based on strategic cost estimate			0.6	0.4	0.3	0.3
Strategic cost estimate (2011 $M)			$389	$434	$458	$463
Minimise the impact on the social environment, including property impacts						
Number of community facilities potentially affected (No.)			3	0	0	0
Number of properties (excluding community facilities) potentially affected (No.)			19	15	24	31
Minimise the impact on residential amenity, including noise, vibration, air quality etc						
Number of potential sensitive receivers adjacent to route with doubling of traffic at 10 years after opening (2029)	Community facilities (No.)		3	2	1	1
	Residences (No.)		32	84	20	95
Number of potential sensitive receivers adjacent to route with halving of traffic at 10 years after opening (2029)	Community facilities (No.)		6	4	4	4
	Residences (No.)		43	30	30	30

Indicator		Preliminary route options			
		Option 15	Option 23	Option 25	Option 26
Minimise the impact on heritage (Aboriginal)					
Is option likely to directly affect a culturally significant Aboriginal site (Yes/No)		Yes	Yes	Yes	Yes
Length through high archaeological potential area (m)		130	1290	890	1050
Minimise the impact on heritage (non-Aboriginal)					
Number of heritage items (State significance) likely to be affected (No.)		0	1	1	1
Number of heritage items (local significance) likely to be directly affected (No.)		2	2	2	1
Length through urban conservation area (m)		390	840	840	840
Minimise impact on the natural environment					
Length through potential EEC (m)		0	130	130	50
Length through other native vegetation (m)		1110	610	800	860
Provide a project that fits sensitively into the built, natural and community context					
Length of new bridge and viaduct (m)		1915	2395	2480	2420
Length of new or upgraded approach road (at-grade or on embankment) (m)		6175	5994	6237	7634
Geometry of the new route aligns with existing street or landscape patterns (Yes/No)		No	No	Yes	No
Minimise flooding impact caused by the project					
Length of bridge across river (m)		720	755	775	585
Length of viaduct across floodplain and minor creek crossings (m)	Grafton	145	370	420	530
	South Grafton	1050	1270	1285	1305

Key findings

Enhance road safety for all road users over the length of the project

- All options within this corridor have good geometry.
- For this corridor all the options perform in a similar manner. All options have two intersections with flows greater than the high volume threshold. The two intersections are Gwydir Highway / Bent Street and Fitzroy Street / Clarence Street.

Improve traffic efficiency between and within Grafton and South Grafton

- In 2019 and 2039 Option 15 has the lowest estimate of total network vehicle hours travelled.
- Option 26 has the highest estimate of total network vehicle hours travelled in 2019 and 2039.
- Option 15 is able to attract a higher number of trips off the existing bridge than the other options which results is trip time between South Grafton and Grafton of 15 minutes which is between eight to 12 minutes quicker than the other options in the corridor.

Support regional and local economic development

- Option 15 has the lowest number of heavy vehicle hours travelled, which is primarily a result of a shorter trips distance between the Pacific Highway and Summerland Way and better road network connectivity back toward Grafton than the other options in this corridor.
- All options could provide 1 in 20 year flood immunity for approach roads. On the southern side of the river this is only via Centenary Drive instead of Pacific Highway.

Provide value for money

- Estimated costs generally increase as the options move downstream, with the upstream Option 15 considerably cheaper than the other options within this corridor due to the shorter bridge and viaducts.
- Travel time savings for Option 15 are highest and, when combined with the lowest cost, the BCR for Option 15 is appreciably better than for the other options in this corridor.
- All BCRs are very low for this corridor.

Minimise the impact on the social environment, including property impacts

- Option 23, 25 and 26 would not directly affect any community facilities. Option 15 affects three community facilities including the sewage treatment plant, Volkers Park and Corcoran Park including a boat ramp and wharf.
- Option 26 affects the greatest number of properties (excluding community facilities). All options have the potential to impact the small rural village of Great Marlow (for example, property impacts, change in character and social cohesiveness).

Minimise the impact on residential amenity, including noise, vibration, air quality etc

- Option 15 has the highest number of potential community sensitive receivers affected by traffic doubling at 10 years after opening. These affected facilities are on the feeder and approach roads to the new bridge in Grafton which are closer to the urban area.
- Options 25 and 26 have the least potential community sensitive receivers affected by traffic doubling at 10 years after opening.
- Options 23 and 26 have the highest number of potential residential sensitive receivers affected by traffic doubling at 10 years after opening. These properties are mainly on Queen Street and North Street which are feeding traffic into Grafton.
- Options 15 and 25 have the least number of potential residential sensitive receivers affected by traffic doubling at 10 years after opening.
- Option 15 has the greatest number of potential community sensitive receivers affected by traffic halving at 10 years after opening. This option reduces the traffic on the feeder and approach roads to the existing bridge in Grafton.
- Option 15 has the highest number of potential residential sensitive receivers affected by traffic halving at 10 years after opening. This option reduces the traffic on the feeder and approach roads to the existing bridge in Grafton.
- The other options (23, 25 and 26) have the least number of potential community and residential sensitive receivers affected by traffic halving at 10 years after opening.

Minimise the impact on heritage (Aboriginal)

- All options would impact culturally significant Aboriginal sites. Elizabeth Island would be impacted by Options 23 and 25 while the Great Marlow would be impacted by all options.
- Options 23, 25 and 26 transverse significant sections of areas of archaeological potential.

Minimise the impact on heritage (non-Aboriginal)

- Options 23, 25 and 26 may affect one heritage item of State significance. This item is immediately adjacent to this option: Grafton Correctional Centre (SHR No. 00809).
- All options would directly affect heritage items of local significance, however, Option 26 has the least impact.

- All options would affect the Grafton urban conservation area, however, Option 15 has the least impact.

Minimise impact on the natural environment

- Options 23 and 25 would cross areas of endangered ecological communities containing sub-tropical coastal floodplain forest (riparian forest) while Options 23 and 26 would cross areas of endangered ecological communities containing sub-tropical coastal floodplain forest (remnant eucalypts).
- All options would cross areas containing other native vegetation. Option 15 would have the longest section crossing such vegetation.
- It is also noted that Options 23 and 25 cross Elizabeth Island. This island may support roost habitat for flying-foxes.

Provide a project that fits sensitively into the built, natural and community context

- Option 15 requires the shortest length of new bridge and viaduct, whilst Option 25 requires the longest length.
- Option 23 requires the shortest length of new or upgraded approach road whilst Option 26 requires the longest length.
- Within Corridor 5, both the Grafton and South Grafton sides of the river are characterised by fairly regular parcel grid pattern geometry, consistent with larger-scale agricultural type uses. Option 25 is generally consistent with existing grid patterns. However, Options 15, 23 and 26 are not consistent with existing street patterns, with varying degrees of segmentation across parcels of land.

Minimise flooding impact caused by the project

- The length of the bridge structure across the Clarence River varies between 585 m (Option 26) and 775 m (Option 25).
- In Grafton, minor waterway crossings would be required for the route options crossing the Alumy Creek and the minor drainage line located between Alumy Creek and the Clarence River. All options traverse a significant length of floodplain, dominated by backwater inundation within the Great Marlow floodplain. An embankment design across this floodplain would result in significant flood impacts. To mitigate these impacts, viaducts are required for all options, with the required viaduct length increasing as options move downstream.
- In South Grafton, all options would connect to the Pacific Highway and traverse a significant length of floodplain. Flood flows within this floodplain are significant, flowing north from Alipou Creek towards Swan Creek. Embankments constructed within this floodplain would have the potential to result in extensive major flood impacts. Due to this, viaduct lengths are recommended for all options traversing this floodplain.

PRELIMINARY ROUTE OPTIONS REPORT

Part 3

8 Short-list of route options

This chapter describes the methodology followed for the selection of the short-list of route options to go forward for further engineering and environmental investigations and identifies the options selected.

8.1 Methodology for short-listing of route options

In June 2011, the *Feasibility Assessment Report* that described the assessment undertaken on the 41 suggestions identified following the community consultation from December 2010 to March 2011 was published.

25 preliminary route options in five strategic corridors were identified for further engineering and environmental investigation.

In August 2011, background papers on issues to consider when planning an additional crossing of the Clarence River at Grafton were published. The *Preliminary Route Options Report – Part 1*, (August 2011) describes the existing environment in Grafton and South Grafton and the issues and constraints relevant to an additional crossing. Community comments on Part 1 were received in August and were into the report, where appropriate.

In October 2011 the *Preliminary Route Options Report – Parts 1 and 2* was published. This report contains an assessment of the 25 preliminary route options against the issues and constraints identified in Part 1. The criteria used to assess the 25 preliminary options are based on the project purpose and objectives. Community comments on Parts 1 and 2 were received in October / November and were incorporated in this Preliminary Route Options Report –Final, where appropriate.

In November 2011, RMS organised a community and stakeholder evaluation workshop to consider the 25 preliminary route options within the five strategic corridors. The workshop outcomes were one of the inputs into the selection of the short-list of route options to go forward for further engineering and environmental investigations. The workshop is discussed in more detail in Chapter 8.2.3 below.

The outcomes of the evaluation workshop as well as wider community comment and the technical investigations have been inputs into the identification of the short list of options to go forward for further engineering and environmental investigations. The inputs are described in more detail in Chapter 8.2 below.

8.2 Inputs into selection of short-list of route options

The three key inputs into the selection of the short-list of route options for the additional crossing of the Clarence River at Grafton were:

- The findings of the technical investigations and specialist studies undertaken for the project (*Preliminary Route Options Report – Parts 1 and 2*).
- Feedback received from the community. Chapter 3 of this report documents the community involvement and feedback activities conducted since the announcement of the revised consultation process in December 2010. A report on the submissions received following the publication of the *Preliminary Route Options Report – Parts 1 and 2* in October 2011 is provided in Appendix 7.

- The outcomes from the 25 and 26 November 2011 community and stakeholder evaluation workshop as documented in Appendix 6.

8.2.1 RMS technical investigations and reports

These are the recent investigations and specialist studies undertaken for the project which are documented in Parts 1 and 2 of this report. They include the existing environment and constraints identified in Chapter 5 and the technical assessment of the preliminary route options as documented in Chapter 7.

8.2.2 Community consultation – submissions report

The community has provided feedback through the various community involvement activities carried out for the project. These community involvement activities are described in Chapter 3 and include community updates, staffed displays, forums, surveys, feedback sessions and invitations to comment on the *Preliminary Route Options Report – Parts 1 and 2*.

Feedback received from the community is documented in various feedback reports available on the project website, including:

- The Postal Survey December 2010 to March 2011 Feedback Report (RTA, April 2011).
- The Telephone Survey of Clarence Valley Residents Report (RTA, May 2011).
- The Online Business Survey Report (RTA, June 2011).
- Notes taken at various community meetings, workshops and presentations.

Community feedback received on the *Preliminary Route Options Report - Part 1* was received in August 2011 and is summarised in Appendix 3. Community feedback received on the *Preliminary Route Options Report - Parts 1 and 2* was received in October/November 2011 and is summarised in Appendix 7. Where relevant, the report has been amended to address community feedback received.

8.2.3 Community and stakeholder evaluation workshop

A community and stakeholder evaluation workshop was undertaken on Friday 25 November and Saturday 26 November 2011. The purpose of the two day workshop was to gain a shared understanding of which preliminary options within each corridor provide the best balance across social, environmental, economic, engineering and cost issues. The workshop participants, methodology and outcomes are documented in Appendix 6.

Community members were invited to nominate to participate in the workshop by completing a nomination form included in the October 2011 Community Update. Those who nominated were required to attend a briefing session on Tuesday 15 November and be either:

- A property owner, residential or business owner/tenant from Grafton, South Grafton, Clarenza or Junction Hill, or
- A regular bridge or river user.

At the close of the briefing session on Tuesday 15 November, those community members who nominated to participate in the workshop were requested to break up into groups based on their area or type of nomination (as described above), and self-select participants for the workshop. A reserve was also identified in case the selected participant was unable to attend the workshop.

Where nominees could not self-select a participant or participants from their group, names of those people wishing to participate in the workshop were placed into a box and a name or names was randomly selected by the briefing facilitator. No nominations were received from Clarenza.

An information pack that included the *Preliminary Route Options Report – Parts 1 and 2* (October 2011) was provided to the selected participants at the briefing.

Participants at the workshop on 25 and 26 November 2011 included eight community and seven stakeholder members. The group was made up of community participants from Grafton, South Grafton, Junction Hill, a road user from out of town and a river user. Community stakeholders included participants from the Clarence Valley Council, Department of Planning and Infrastructure, Grafton Chamber of Commerce and Industry, Grafton-Ngerrie LALC and the freight and public transport industries.

The workshop was lead by an independent facilitator. Roads and Maritime Services (RMS) and Arup project team members provided background information, technical advice and support to the workshop participants.

The group worked through the indicator results in *the Preliminary Route Options Report – Parts 1 and 2* (October 2011) to understand how the options performed against the project objectives within each corridor.

Workshop participants had the opportunity to put forward views based on the indicator results and their own knowledge and experience for discussion amongst to the group.

Options identified by the group as best performing within each corridor and recommended by the group to go forward for further consideration were:

- Corridor 1 – Option E (Cowan Street South Grafton to Villiers Street, Grafton).
- Corridor 2 – Option A (New bridge parallel to and immediately upstream of the existing bridge connecting Bent Street South Grafton and Fitzroy Street, Grafton).
- Corridor 3 – Option 11 (Existing Pacific Highway north of South Grafton to Fry Street, Grafton.
- Corridor 4 – Option 14 (Existing Pacific Highway north of South Grafton to North Street Grafton via Kirchner Street).
- Corridor 5 – Option 15 (Existing Pacific Highway north of South Grafton to Summerland Way north of Grafton, via Kirchner Street).

During the workshop issues and comments raised in the evaluation process were also recorded and are included in Appendix 6.

8.3 Selection of short-list of route options

As outlined in Chapter 8.2 above, the three key inputs into the selection of the short-list of route options for the additional crossing of the Clarence River at Grafton were:

- The findings of the technical investigations and specialist studies undertaken for the project (*Preliminary Route Options Report – Parts 1 and 2*).
- Feedback received from the community.
- Outcomes of the November 2011 community and stakeholder evaluation workshop.

The selection of the short-list of options included a Transport for NSW (TfNSW) and Roads and Maritime (RMS) workshop conducted on 5 December 2011.

Workshop participants were:

- Steve Arnold (Transport for NSW Principal Manager, Network Enhancement)
- Bob Higgins (RMS Project Director)
- Ed Scully (RMS Communications Manager)
- Phillip Vander Reest (RMS Network Services Development Program)
- Alison Nash (RMS Senior Environmental Officer)
- James Green (RMS Maritime)
- Ben Schnitzerling (Arup Project Director)
- Chris Clark (RMS Project Manager).

The workshop followed the same methodology used in the community and stakeholder evaluation workshop (refer to Appendix 6 for more details). A representative of Clarence Valley Council and RMS and Arup project team members provided background information, technical advice and support to the workshop participants.

The outcomes of the workshop were:

Corridor 1:

- The workshop concurred with the conclusion of the community and stakeholder evaluation workshop that Option E within Corridor 1 on balance performed best within the corridor and should go forward for further consideration as the option:
  - Performs better than Option F on overall travel efficiency across all modes of transport.
  - Performs marginally better in supporting economic development in South Grafton by providing better connectivity to South Grafton CBD.
  - Has a better alignment (less skew) for the bridge construction and flooding than Option F.

Corridor 2:

- The workshop concluded that on balance Option C was the best performing option within Corridor 2 and should go forward for further consideration as the option:
  - Performs well against all project objectives, including best or equal best against four of the five objectives.
  - Provides good traffic distribution and flexibility by providing alternative connections into Grafton and South Grafton.
  - Has a good long term outcome for network traffic efficiency.
  - Performs well for travel times as it provides an efficient connection for heavy vehicles to cross from South Grafton to Grafton.
  - Provides the best value for money of the options within this corridor.
  - Has the potential to perform even better if moved further from Alipou Creek and design refinements provide road safety improvements.
- The workshop also agreed to take the option within Corridor 2 recommended by the community and stakeholder evaluation workshop (Option A) forward for further consideration as the option:
  - Has the least impact on the environment particularly in the areas of noise, flooding, ecology and Aboriginal heritage.
  - Provides good value for money.

- Has potential to be refined to provide improved road safety and traffic efficiency outcomes. Opportunities to provide improved outcomes will be considered during the refinement of the concept design for the option.

Corridor 3:

- The workshop concurred with the conclusion of the community and stakeholder evaluation workshop that Option 11 within Corridor 3 on balance performed best within the corridor and should go forward for further consideration as the option:
  - Performs best or equal best against all project objectives.
  - Has the best traffic efficiency within the corridor.
  - Has the least impact on the environment particularly in the areas of flooding, urban design and property impacts.
  - Provides best value for money within the corridor.

Corridor 4:

- The workshop concurred with the conclusion of the community and stakeholder evaluation workshop that Option 14 within Corridor 4 on balance performed best within the corridor and should go forward for further consideration as the option:
  - Performs best or equal best against all project objectives.
  - Has the best traffic efficiency within the corridor.
  - Has the least impact on the environment particularly in the areas of ecology, flooding and Aboriginal heritage.
  - Provides best value for money within the corridor.

Corridor 5:

- The workshop concurred with the conclusion of the community and stakeholder evaluation workshop that Option 15 within Corridor 5 on balance performed best within the corridor and should go forward for further consideration as the option:
  - Performs best or equal best against all project objectives.
  - Was considered, overall, to perform clearly better than Options 23, 25 and 26.
  - Has the best traffic efficiency (including shortest travel times over existing bridge) of options within the corridor.
  - Has the least impact on the environment particularly in the areas of ecology, Aboriginal heritage, non-Aboriginal heritage and flooding.
  - Provides best value for money within the corridor.
  - Provides a better connection to Grafton CBD and Centenary Drive (Clarenza) than the other options within the corridor and has the shortest travel distance to South Grafton.

Both Option 14 in Corridor 4 and Option 15 in Corridor 5 connect to the existing Pacific Highway at the junction with Centenary Drive and cross the Clarence River at the same location to run along Kirchner Street to a new junction with the northern end of Prince Street. North of the junction, Option 14 connects into North Street whereas Option 15 continues through to the Summerland Way. Option 15 between the junction with Prince Street and the Summerland Way could be a future extension of Option 14.

8.4 Short-list of route options

The short-list of route options to be taken forward for further detailed technical and environmental investigations as part of the process of selecting the preferred option for the additional crossing are listed in Table 29 and presented in Figure 59.

Table 29: Short-list of route options.

Option	Location
E	Cowan Street, South Grafton to Villiers Street, Grafton
A	New bridge parallel to and immediately upstream of the existing bridge connecting Bent Street, South Grafton and Fitzroy Street, Grafton.
C	Junction of Pacific highway and Gwydir Highway, South Grafton to Pound Street, Grafton
11	Existing Pacific Highway north of South Grafton to Fry Street, Grafton.
14	Existing Pacific Highway north of South Grafton to North Street Grafton via Kirchner Street.
15	Existing Pacific Highway north of South Grafton to Summerland Way north of Grafton, via Kirchner Street

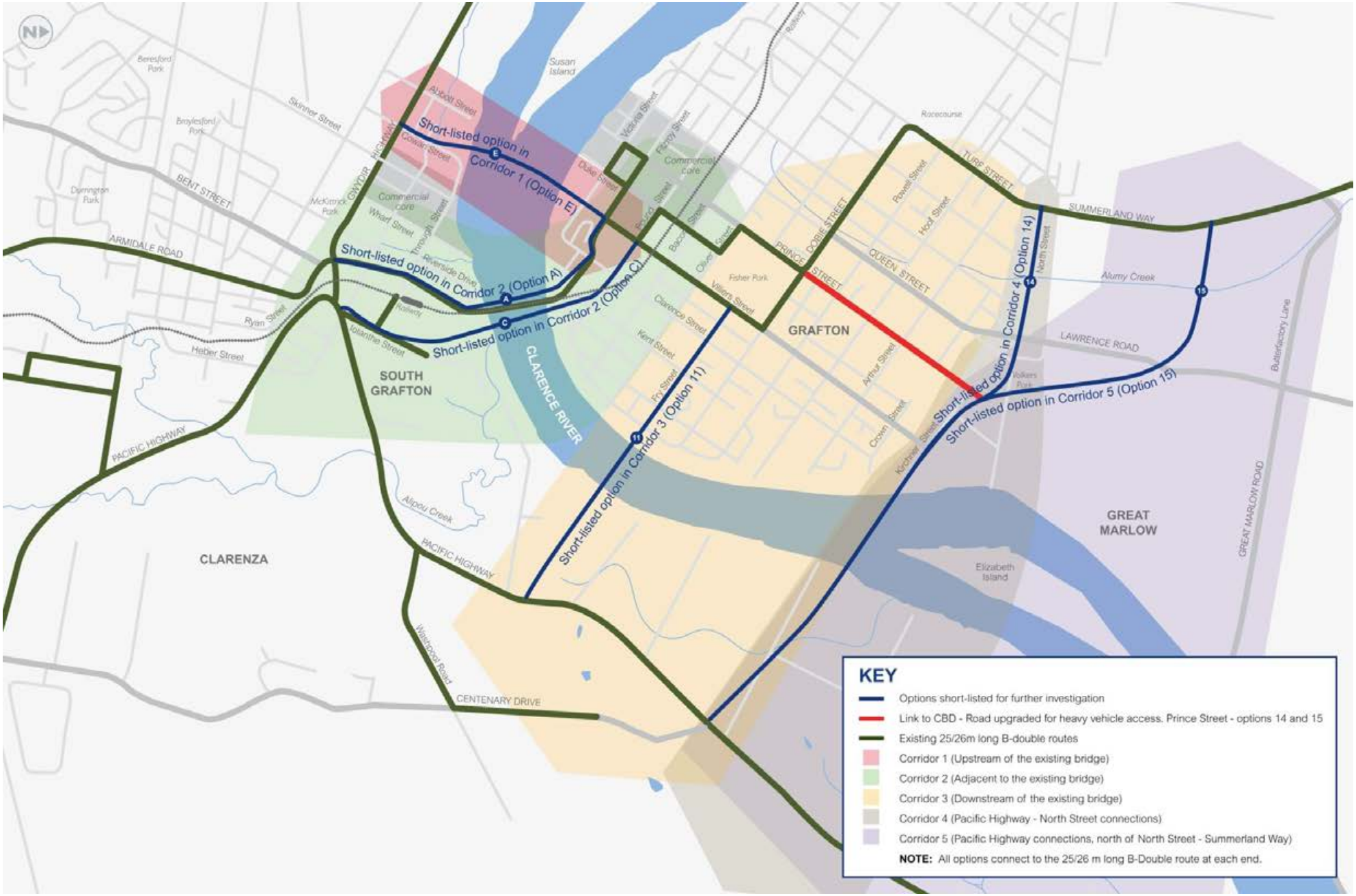

Figure 59: Short-list of route options.

9 Next steps

The process to identify a preferred location for an additional crossing is shown in the flow chart below. The timetable below is indicative only.

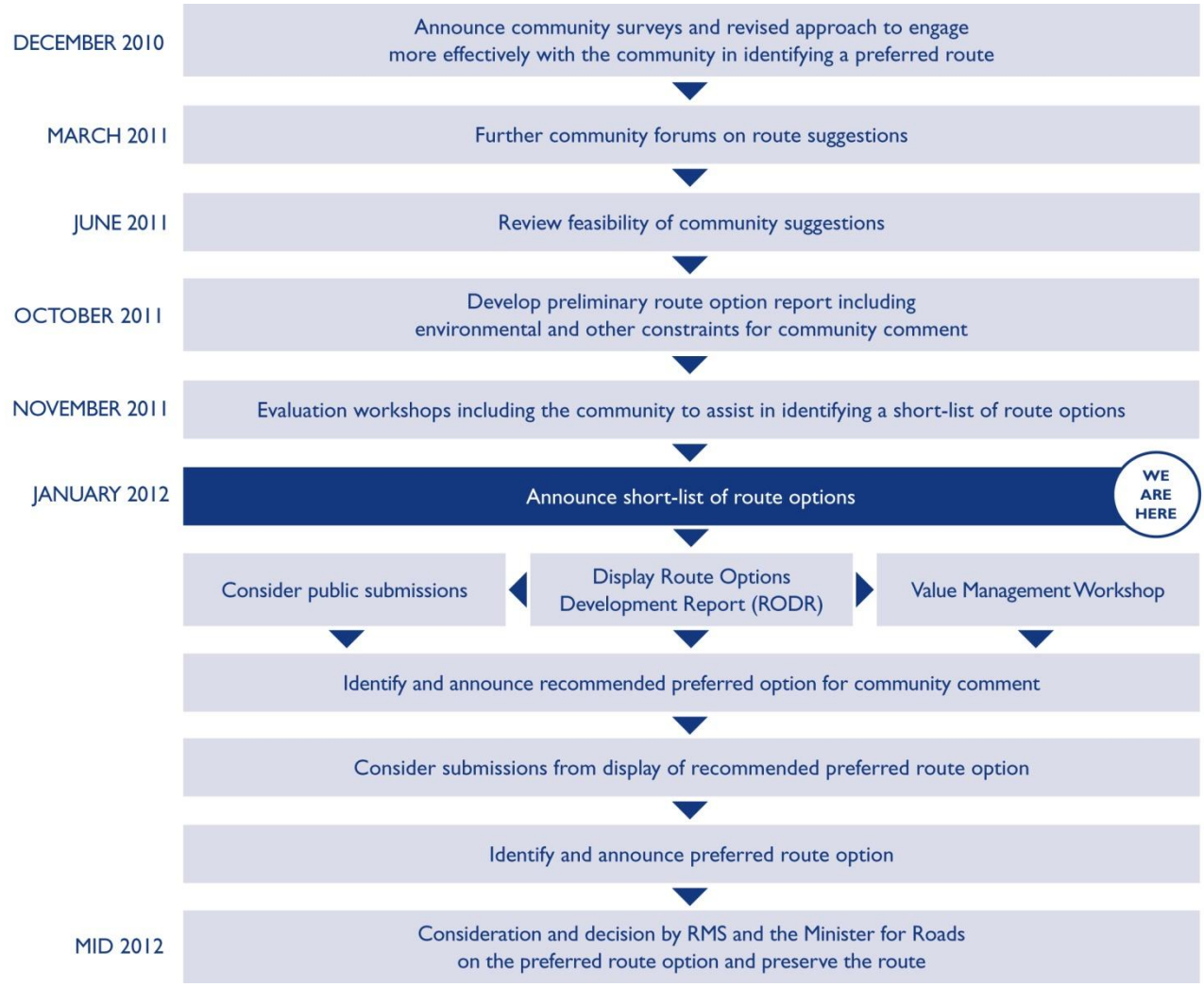

Figure 60: Process to identify a preferred location for an additional crossing as of January 2012

Following an announcement on the short list of options, further technical and environmental investigations will be undertaken to provide more detailed information on the relative performance of the options. The investigations will be reported in the *Route Options Development Report* (RODR).

When completed, the RODR will be displayed for community comment. Community comments received, together with the investigations undertaken and the outcomes of the Value Management Workshop will input into a decision on a recommended preferred option.

Feedback from the display of the recommended preferred option will be considered before a decision is made on the preferred location for an additional crossing of the Clarence River at Grafton.

9.1 Short-listing process

The method outlined below was adopted for the short-listing of the 41 preliminary route options and the identification of a recommended preferred option. The short-listing process comprises the following steps:

- Identify all preliminary route options.
- Group the preliminary route options into corridors. Assess the feasibility of these preliminary route options against key engineering and environmental considerations. Identify the preliminary route options that are not feasible, based on their obvious environmental and engineering impacts.
- Identify the best route option(s) within each of the corridors based on technical investigations and community input.
- Identify a recommended option from the route option(s) within each corridor based on further technical investigations, community input and a Value Management Workshop.
- Consideration of feedback from the display of the recommended preferred option before a decision is made on the preferred location.