2 Need and options considered

This chapter describes the need for the proposal and the alternatives that were considered in selection of the preferred option.

2.1 Strategic need for the proposal

The Princes Highway is the main north-south corridor on the NSW South Coast, and extends from Sydney to the Victorian border. It is a critical link for both passenger and freight transport along the south coast of NSW as there is no rail service past Bomaderry and as such is important to the region economically. The Princes Highway is a major route for tourism with high peak volumes on weekends and in holiday periods. The highway is a major commuter route between Bodalla, Narooma and Bega and it is also a local route for residents living in the smaller coastal and rural communities in the area.

The Princes Highway in the Dignams Creek area, typically experiences low volumes of traffic with an annual average daily traffic (AADT) of 1,600 vehicles. Traffic composition is about 85 per cent cars and 15 per cent heavy vehicles based on classified traffic counts undertaken by RMS.

The Princes Highway has a poor crash history in the Dignams Creek study area. Between the period, 2005 to 2010, there have been 21 crashes along the Dignams Creek section of the Princes Highway (refer to Figure 2-1). One crash was fatal, 11 crashes resulted in injury, and nine were non causality crashes. Currently the crash rate on the Princes Highway at Dignams Creek is 214.1 per 100 million vehicle kilometres travelled (MVKT). This is over seven times the typical casualty crash rate for this type of road in NSW, which is 30.4 crashes per 100 MVKT. The casualty crash rate is 132.6 per 100 MVKT, which is nearly 11 times the casualty crash rate for NSW of 12.2 per 100 MVKT. The predominant crash type is run off road on a curve (hit object), representing 67 per cent of the crashes. Contributing factors include speed (76 per cent) and wet road conditions (62 per cent).

The existing level of service (LoS) on the Princes Highway at Dignams Creek is LoS C which means that whilst there is typically a stable flow of traffic, most drivers are restricted to some extent in their freedom to select their desired speed and ability to manoeuvre within the traffic stream, due to the current substandard alignment. Following the completion of the proposal the LoS would improve to LoS B for at least 20 years post completion. This would mean a stable flow of traffic and that drivers have reasonable freedom to select their desired speed and ability to manoeuvre within the traffic stream.

In 2008 a coronial inquiry was undertaken by the NSW government in response to 15 fatalities on the Princes Highway. One of the findings included a recommendation that the NSW Government seek Australian Government funding to upgrade the Princes Highway between Victoria Creek and Dignams Creek. A series of progressive and ongoing upgrades to the Princes Highway have subsequently been undertaken by RMS and includes this proposal. The aim of the upgrades is to improve road safety, road geometry and alignment, creek and river crossings, and travel times on the Princes Highway.

As such, the poor crash history and the existing substandard road design are the key drivers behind the need for an upgrade of this section of the Princes Highway.
Upgrade of the Princes Highway, Dignams Creek

Figure 2-1 | Road safety crash history along the Princes Highway at Dignams Creek (2004 to 2009) (RMS 2011)
2.1.1 Relevant strategies and plans

The proposal would address objectives outlined in the NSW 2021: A Plan to Make NSW Number One, the NSW State Infrastructure Strategy 2012-2032, the NSW Long Term Transport Masterplan, the RMS 2012-2016 Corporate Strategy, the South Coast Regional Strategy 2006 – 2031 and the South East NSW Regional Action Plan. These have been discussed in further detail in the following sections.

NSW 2021: A Plan to Make NSW Number One

NSW 2021: A Plan to Make NSW Number One (Department of Premier and Cabinet, 2011), is a 10 year plan that provides goals and targets to rebuild the economy, provide quality services, renovate infrastructure, restore government accountability, and strengthen the local environment and communities. The proposal directly addresses several of the transport and infrastructure goals identified in the State Government’s plan including:

- Improving road safety.
- Reducing travel times.
- Investing in critical infrastructure.

To achieve the goal to reduce travel times for those travelling by car, bus or truck the State Government aims to ease transport congestion by improving the efficiency of the road network and through the delivery of road infrastructure that enhances and expands capacity on road corridors. To achieve the goal to improve road safety, the NSW Government aims to reduce fatalities to 4.3 per cent per 100,000 population in 2016 by carrying out road development, upgrades, maintenance and safety works that address crash risks.

The proposal would help to fulfil the NSW 2021 transport aims identified above by:

- Improving the horizontal and vertical alignment and removing a tight 90 metre curve.
- Improving the sign-posted speed of the road from 80 kilometres per hour to 100 kilometres per hour.
- Reducing the length of the Princes Highway by 0.2 kilometres.
- Improving site distance around bends through clearance of vegetation.
- Improving access for two properties which currently have poor sight distance and no road shoulders for acceleration and deceleration.
- Widening shoulders along the highway and providing increased and safer opportunities for cycling access.
- Removing trees and other hazardous objects from within the clear zone.
- Providing protected turning lanes at the intersection of the Princes Highway and Dignams Creek Road.

State Infrastructure Strategy 2012-2032

The NSW State Infrastructure Strategy 2012-2032 is a 20 year strategy that supports the delivery and funding of infrastructure projects. The strategy builds on the NSW Government’s existing public commitments and outlines a forward program for urban and regional projects and reforms across transport, freight, aviation, energy, water, health, education and social infrastructure. Infrastructure projects are categorised into six geographic regions. The proposal is located within the South Coast region. The upgrade of the Princes Highway is part of the 2012 – 2032 strategy (see Section 10.4.3, page 138).
NSW Long Term Transport Masterplan

The NSW Long Term Transport Masterplan (December 2012) is a 20 year plan that will guide the NSW Government’s transport funding priorities over the next 20 years. The Masterplan provides an overall framework for the development of NSW Government transport system, the delivery of services and the infrastructure that underpins them.

The Princes Highway (A1) is identified in the Masterplan as a major piece of road infrastructure in NSW. The aims of the Masterplan that are relevant for the Princes Highway are as follows:

- To make improvements to safety and capacity along the regional sections of the Princes Highway that will strengthen the existing coast connections between Nowra and Eden.
- To make the Princes Highway safer, specifically targeting trucks, black spots and school zones.
- To improve the maintenance of regional roads.

The proposal would meet these objectives as it aims to improve safety along a section of the Princes Highway at the Dignams Creek Road that has been identified as having a poor crash history. It would improve and strengthen the existing connection between Nowra and Eden and it would address maintenance issues identified for this section of the Princes Highway.

RMS 2012-2016 Corporate Strategy

The RMS 2012-2016 Corporate Strategy, defines RMS objectives and goals for the 2012 to 2016 period (RMS 2012). The main areas and strategies identified in the 2012 to 2016 corporate strategy that are relevant to the proposal are as follows:

- Travel - deliver key infrastructure to support the safe, efficient and reliable movement of people and goods.
- Asset - improve the quality of urban and rural State Roads, including seeing 93 per cent of State Roads meeting national road smoothness standards by 2016.
- Access - provide asset and access solutions that support the movement of freight in urban and regional areas.
- Safety - Deliver key safety related compliance schemes and programs of work to contribute to the safety and security of our networks.
- Customer - deliver our services by the most efficient, effective and secure methods to meet the needs of customers.
- Engagement - The NSW community and stakeholders are appropriately informed and consulted on road and maritime projects and issues.
- Engagement - Promote proactive relationships with key stakeholders through partnership and advocacy.
- Value for money - ensure the prudent identification and allocation of resources to deliver services to the community of NSW.
- Customer - ensure customer feedback, insights, complaints and inputs inform decision making to deliver improved customer service.
- Environment - Develop and deliver programs to see a reduction in emission impacts on the community.

Planning and delivery of the proposal would meet all of the strategies listed above. The improved horizontal and vertical alignment of the proposal, with a corresponding increase in the road design speed, would increase the efficiency and improve safety.
for road users along the Dignams Creek section of the Princes Highway which is a key piece of NSW road infrastructure managed by RMS. Early and ongoing consultation with stakeholders, including road users was sought during the development of the preferred option (refer to Chapter 5). Option analysis of 15 options was undertaken to identify the best performing option that was also considered a value for money solution (refer to Section 2.4.3).

South Coast Regional Strategy 2006 – 2031

The South Coast Regional Strategy (NSW Government, 2007) sets out the land use plans for the South Coast for 2006 to 2031 and incorporates the Eurobodalla and Bega Valley LGAs. The strategy identifies that the long and narrow geography of the region, extending more than 400 kilometres in length, is a challenge for linking regional businesses with potential markets and opportunities. The strategy recognises that the Princes Highway is a critical north-south link between Sydney, Wollongong and communities along the South Coast down to the Victorian border. Additionally, the strategy notes that the Princes Highway is the primary land transport route servicing the South Coast as the railway does not extend south of Bomaderry in the Shoalhaven LGA.

The proposal is consistent with the South Coast Regional Strategy as it would upgrade the Princes Highway, an important transport route in the region that would continue to connect communities, businesses and neighbouring regions. By improving land transport, including freight and tourism traffic, the proposal would also support economic development in the South Coast region.

South East NSW Regional Action Plan

In the South East NSW Regional Action Plan (NSW Government, 20012 the south east community identified clear priorities for future action including investment in infrastructure, in particular roads. One of the priorities for the plan is to deliver road infrastructure upgrades, this includes continuing planning for the upgrade of the Princes Highway at Dignams Creek (refer to pages 10 and 18 of the plan). The proposal would therefore fulfil one of the listed priorities for the plan.

2.2 Existing road and infrastructure

The proposal includes a 3.7 kilometre section of the Princes Highway at Dignams Creek, the intersection of Dignams Creek Road, the Dignams Creek Bridge and some property access roads leading into rural allotments and areas of National Park. The following is a description of the existing road and infrastructure components of the proposal. In some instances, road chainages for the proposal have been used and these are based on the distance in metres that the proposal is from Batemans Bay, which is the zero point for RMS chainages along this section of the Princes Highway.

The Princes Highway

The Princes Highway is the main coastal road connection between Sydney and Melbourne, and is known as Highway 1 on the national highway network. Compared to the Hume Highway the alternate inland route, the Princes Highway is not the shortest or most direct route between the two capital cities as it is has a large number of tight curves and slower design speeds. Consequently the Princes Highway has lower traffic volumes and is primarily a tourist route.
The Princes Highway at Dignams Creek is currently a two lane highway with one northbound and one southbound lane (refer to Plate 2-1). The section of the Princes Highway to be upgraded as part of this proposal was constructed in the early 1900s, with improvements made over time to Dignams Creek Bridge, and the highway’s road surface and alignment. The existing alignment of this section of the highway is characterised by a steep and winding grade (refer to Plate 2-2) that follows the east-west orientated ridge lines and spurs. The road inclines are steep with maximum grades up to 10.4 per cent and grades of six to eight per cent being common; refer to Figure 2-2.

The road has many tight curves with some having a radius of 80 metres which equates to a design speed of 50 kilometres per hour, well below modern, safe road design standards. This section of the Princes Highway is posted at 100 kilometres per hour; however there is 1.27 kilometres in the northern portion of the proposal area that is posted at 80 kilometres per hour.

An overtaking lane is present on the southbound lane of the Princes Highway around 50 metres south of the junction with Dignams Creek Road and extending up to 1.6 kilometres (refer to Plate 2-3). The overtaking lane occurs on a grade averaging nine per cent.

Lanes are generally 3.5 metres wide but narrow to 2.5 metres at the Dignams Creek Bridge. Shoulder widths vary between 0 metres and 2.5 metres however; the majority along the Dignams Creek section of the Princes Highway are less than one metre, which is below the Austroads road design standards. There are around 14 guard rails present along the Princes Highway including nine on the northern side of the highway and five on the southern side of the highway.

There are no medians, footpaths, longitudinal drainage, street lights or any other traffic management features along the Princes Highway. The pavement north of Dignams Creek is an in situ stabilised pavement and was resealed in the 2012/13 financial year. The pavement south of Dignams Creek was last resealed in 2010.
Figure 2-2 Topography along the existing alignment looking north to south (RMS 2011)
The Dignams Creek Bridge

The Princes Highway crosses Dignams Creek over Dignams Creek Bridge around 410 metres to the north of the junction with Dignams Creek Road (refer to Plate 2-4). Dignams Creek Bridge was constructed in 1936 and is currently listed on the RMS Section 170 heritage register as a local heritage item.

The bridge is a concrete beam bridge about 67.5 metres long with five spans and curving abutments. The central three spans of the bridge are continuous and an expansion joint separates each end span. The original railings have been replaced with a guard-rail that is continuous across the bridge and approaches, mounted on the bridge using plinths behind the kerb (refer to Plate 2-5).

The piers have two columns each (refer to Plate 2-6), with cross beams at low and headstock level. The abutments have vertical faces with return walls, with pier-like corner posts with rounded edges.

Plate 2-3 Southbound overtaking lane (Source: RMS)
Plate 2-4 Looking south across Dignams Creek Bridge (Source: RMS)
Plate 2-5 Guard rails along the western side of Dignams Creek Bridge (Source: RMS)
Plate 2-6 Dignams Creek Bridge piers (Source: RMS)
Dignams Creek Road

Dignams Creek Road is a rural two way road which when travelling north eventually turns into Reedy Creek Road. The intersection of Dignams Creek Road and the Princes Highway is around 25 kilometres south of Narooma and 50 kilometres north of Bega on the South Coast of NSW. There are no dedicated turning lanes from the Princes Highway into Dignams Creek Road for either northbound or southbound traffic (refer to Plate 2-7). Dignams Creek Road is sealed at the intersection and for around 370 metres to the north of the intersection where the road cover changes to graded dirt. There is no existing kerb and gutters, medians, footpaths, longitudinal drainage, street lights or any other traffic management features along the area of Dignams Creek Road included in the footprint of the proposal. A guard rail is present along the north-eastern edge of the intersection.

Plate 2-7 Intersection of the Dignams Creek Road and Princes Highway (Source: Google Earth Pro)

Public and private access roads

A graded dirt access track into Gulaga National Park is located about 200 metres from the southern extent of the proposal, on the eastern side of the highway (refer to Plate 2-8). The access road has no kerb and gutter. Another access track into Kooraban National Park is located at the top of Dignams Hill around 1.5 kilometres to the north of Dignams Creek Road, on the north-west side of the highway (refer to Plate 2-9). The access track is graded dirt/gravel with no kerb and gutter. A stockpile site is located adjacent to the highway as this point.

There are four unnamed private property access roads connected to the Princes Highway along the length of the proposal. These unnamed road accesses are comprised of unsealed, dirt roads with no kerb and gutters. The private property access road into number 9526 Princes Highway is currently located around 300 metres to the south of the northern extent of the proposal (chainage 95250) on the northbound side of the highway (refer to Plate 2-10). The private property access road into number 9523 Princes Highway is around 287 metres from the northern extent of the proposal on the southbound side of the highway (refer to Plate 2-11). Two fire trails which provide access to Kooraban and Gulaga National Parks and
private properties also exist at the southern end of the proposal on either side of the highway at chainage 98170. These access roads are around 55 metres from the end of the Stage 2 works.

Plate 2-8 Access road Gulaga National Park (Source: Google Earth Pro)  Plate 2-9 Access road Kooraban National Park (Source: Google Earth Pro)

Plate 2-10 Access into 9526 Princes Highway (Source: Google Earth Pro)  Plate 2-11 Access into 9523 Princes Highway (Pretty's) (Source: Google Earth Pro)

2.3 Proposal objectives
The main objectives of the proposal are as follows:

- To improve road safety.
- To provide a continuous 100 kilometre per hour travel speed environment.
- To improve economic efficiency including freight through improved alignment.
- To provide a well-engineered, safe and environmentally acceptable road transport facility.
- To provide a value for money project.

2.4 Alternatives and options considered
An iterative process of investigation and consultation has been undertaken on the proposal to determine a preferred option which best meets the proposal objectives whilst balancing the various technical, environmental, socio-economic and financial considerations. This process is summarised in Sections 2.4.1, 2.4.2 and 2.4.3 below.
Section 2.4.1 details the methodology RMS used to investigate a range of alignments of varying lengths in order to develop a proposal that best met the project objectives. Section 2.4.2 describes each of the options developed by both RMS and members of the Dignams Creek community. Section 2.4.3 analyses how the options performed against the project objectives and how RMS selected the preferred option.

2.4.1 Methodology for selection of preferred option

Five phases of options analyses were undertaken during the selection of the preferred option, commencing with an initial corridor study. The following is a general description of the methodology used in each of these five phases:

Preliminary assessment – corridor study

In response to the NSW Coronial Inquiry undertaken in 2008 into fatalities along the Princes Highway, RMS undertook a corridor study to identify road deficiencies along the Princes Highway (RTA 2010). The corridor study assessed a 9.2 kilometre section of the Princes Highway between Tilba Tilba and Dignams Creek. Inputs to the corridor study included the terrain, road design parameters, strategic costs, known geological features, existing high risk slopes, known ecological features and land acquisition costs. The study determined that the Dignams Creek portion of the road alignment could be developed as a discrete project to improve a section with an existing substandard alignment. The northern and southern tie in points for the upgrade at Dignams Creek were determined by the study as the majority of alignments generated had these as common points.

Options identified included a range of lengths as described below.

Phase 1 – Investigation of full length options including Options 1-3 and the do nothing option

Options 1-3 and the do nothing option were initially developed in response to the findings of the corridor study (RTA 2010 (refer to Section 2-4). Options 1-3 were full length options which realigned the Princes Highway for the entire study area. An options analysis workshop was undertaken in December 2010 which evaluated these options according to:

- The proposal objectives which during phase 1 were:
  - To achieve a crash rate reduction from the existing 179.6/100 Million Vehicle Kilometres Travelled (MVKT) to a figure less than the state average of 30.4/100 MVKT for rural 2 lane undivided roads with an auxiliary lane (RTA’s Road Environment Safety Update 22 – Rural Road Crash Rates by Road Stereotype).
  - To provide a continuous 100 kilometres/hour speed environment achieving current road design standards.
  - To reduce delays and improve economic efficiency through improved alignment.
  - To provide a well engineered, safe and environmentally acceptable road transport facility.
- The proposal design parameters (refer to Section 3.2.1).
- Information collected during consultation with key stakeholders (refer to Chapter 5).
- A comparison of each option’s performance against road safety, economic, environmental (including social), constructability and urban design criteria.
Phase 2 - Investigation of shorter options (options 4 - 9)

Phase 2 involved the investigation of potential shorter length options. The purpose of phase 2 was to identify potential options with reduced cost whilst still achieving road safety improvements and the other proposal objectives. The investigation focused on realigning the northern section of the corridor where the existing alignment is most deficient and crashes have been more severe. All six options developed during phase 2 would remove the tight radius bend located to the north of the Dignams Creek Bridge and would tie in to the existing Princes Highway at various locations to the south of the existing Dignams Creek Bridge with the exception of option 7 which utilised the existing bridge. All six options were assessed to determine if they could tie into a future stage 2 alignment.

A comparative analysis of the shorter options against the proposal objectives found that none of the options adequately addressed road safety and still entailed substantial costs to construct. All of the options were subsequently rejected by RMS (RTA 2010).

At the conclusion of phase 2, option 1 was identified as the best performing option and was placed on public display in December 2010 (refer to Chapter 5).

Phase 3 - Investigation of additional full length option (option 10)

Following the investigation of shorter options as described above, RMS undertook further investigations and developed a fourth full length option (option 10) which would reduce the volume of earthworks required to construct the alignment. This option was developed in an attempt to reduce the costs associated with the full length options and therefore provide better value for money whilst still achieving all other proposal objectives which the shorter options could not. This however did not achieve the cost savings required to make the proposal likely to obtain funding for construction. RMS therefore made a decision to investigate staged options which would improve value for money and would assist in obtaining funding for construction.

Phase 4 - Investigation of intermediate length options to include staging (options 11-13)

Phase 4 involved the investigations of intermediate length options that could be constructed in two stages. The first stage would involve addressing the key road safety issues in the northern end of the corridor and providing a longer term plan for future works at the southern end of the corridor. The investigations of staged options were undertaken to identify potential options that would achieve all proposal objectives and assist in obtaining funding for construction.

During Phase 4 the proposal objectives were modified to be the current proposal objectives (refer to Section 2.3). This included the addition of a new proposal objective to provide a value for money project.

In late 2011 to mid-2012 an additional three options were developed by RMS. These are described as option 11 (the yellow option), option 12 (the blue option) and option 13 (the purple option). These options were intermediate length options that targeted the realignment of around 2.8 kilometres of the existing Princes Highway from the common northern end of the study area extending south. A value management
workshop was held in March 2012 to assess these options. The assessment criteria used at this workshop to assess the options included:

- Environmental – minimise environmental impacts including ecology and heritage.
- Urban design – minimise the visual impact of the bridge, cuts and fills, the construction footprint and maximise the character and nature of the proposal.
- Road safety – reduce the number of crashes and crash severity.
- Design standards – extent of conformance with desirable design standards.
- Constructability – maximise the ability to efficiently and safely build and stage the proposal.
- Future asset management – minimise the cost of maintenance and maximise the ability to safely maintain.
- Private property impacts – minimise private property impacts.

The results of the comparative assessment were then evaluated against the estimated capital cost for the option to calculate the value for money score. The value management workshop identified option 13 as the best performing option according to the weighted assessment criteria. This was subsequently recommended as the preferred option (refer to Section 2.5). A concept design was then developed for the preferred option and placed on display in November 2012.

**Phase 5 - Community options (options 14 and 15)**

Following the display of the preferred option, the local community presented two alternative options as part of the submissions received. RMS undertook additional analysis on the two community options (options 14 and 15) against the proposal objectives and the preferred option. For further detail on the analysis refer to Section 2.4.2. The two community options were found not to perform as well as option 13 in terms of the proposal objectives, and hence option 13 was retained by RMS as the preferred option for the proposal.

**2.4.2 Identified options**

The following is a summary of the fifteen options identified during each phase of the option assessment. A figure showing the centreline for options 1-15 is provided in Figure 2-3.

**Do nothing option**

The do nothing option would result in the Princes Highway remaining in its current state as a two lane single carriageway road with an overtaking lane to the south of Dignams Creek Road. The existing horizontal and vertical alignment would remain unchanged and as such continue to operate with a substandard design. Normal road maintenance would continue to be undertaken.

**Full length options 1-3, 10**

The following is a discussion of the four full length options considered which include options 1 – 3 (refer to Figure 2-4) and option 10 (refer to Figure 2-5).
Upgrade of the Princes Highway, Dignams Creek

Figure 2-3 | Identified options (1-15)
**Option 1**

Option 1 would be located predominantly on the eastern side of the Princes Highway with a new bridge structure to be located downstream of the existing Dignams Creek Bridge. The new bridge structure would be 110 metres in length and 29 metres high, with large fill abutments required either side of Dignams Creek. The overall alignment would be 3.12 kilometres long and would be 323 metres shorter than the existing alignment. The horizontal alignment of option 1 would be comprised of four 600 metre radius curves which equates to a design speed of 110 kilometres per hour. This design would have a maximum grade of eight per cent. Option 1 had a strategic cost estimate of about $85 million. Further investigations into option 1 following its display as the preferred option, resulted in the lengthening of the bridge to 274 metres due to asset management issues and geotechnical concerns associated with the large fill abutment on a slope. Costs associated with the longer bridge resulted in the costs for the alignment increasing substantially above the initial strategic estimate.

**Option 2**

This option would predominantly be located to the northwest of the original Princes Highway alignment. At the northern end the new road alignment would initially divert to the southeast of the Princes Highway and then cross the existing highway at grade just north of the existing bridge over Dignams Creek. The alignment would then travel to the west of the existing alignment and would cross Dignams Creek upstream of the existing bridge structure. The bridge in option 2 would be 80 metres long and 15 metres high. Option 2 would then cross Dignams Creek Road but would be situated about seven metres above the existing road height. The overall alignment of option 2 would be 3.26 kilometres long and would be 180 metres shorter than the existing alignment. Option 2 would consist of four curves, the tightest being 460 metres which equates to a horizontal design speed of 100 kilometres per hour with a maximum grade of eight per cent climbing up Dignams Hill. Option 2 had a strategic cost estimate of $90 million.

**Option 3**

Option 3 would extend predominantly to the west of the existing Princes Highway with a bridge structure upstream of the existing bridge. The bridge would be 80 metres long and 10 metres high. Option 3 would cross Dignams Creek Road approximately 6.5 metres above the existing Option 3 would comprise four curves the tightest having a radius of 460 metres which equates to a horizontal design speed of 100 kilometres per hour, with a maximum grade of eight per cent. Option 3 would be 3.28 kilometres long, which is 163 metres shorter than the existing alignment. Option 3 had a strategic cost estimate of $75 million.

**Option 10**

Option 10 (refer to Figure 2-5) is a long alignment that uses the first two kilometres of the northern end of option 1 but realigns at the southern end to avoid impacts to Gulaga National Park and also substantially reduces the earthworks that were required in the section that travelled through Gulaga National Park. This option extends a further 300 metres than options 1 to 3 on the southern end and is 3.4 kilometres long. The northern end of option 10 would be located predominantly on the eastern side of the Princes Highway with a new bridge structure to be located downstream of the existing Dignams Creek Bridge.
Figure 2-5 | Option 10 (avoiding Gulaga National Park)

Upgrade of the Princes Highway, Dignams Creek
The new bridge structure would be 274 metres in length and 29 metres high, with large fill abutments required either side of Dignams Creek. Option 10 would be 319 metres shorter than the existing alignment. The horizontal alignment of option 10 would be comprised of five 600 metre radius curves which equates to a design speed of 110 kilometres per hour. This design would have a maximum grade of eight per cent. Option 10 had a strategic cost estimate of about $80 million.

Shorter options (options 4 - 9)

The following is a discussion of the six shorter options considered, which include options 4 – 9 (refer to Figure 2-6).

Option 4

This option consists of a long straight alignment across the Dignams Creek valley to the eastern side of the existing Princes Highway. The bridge structure would be located downstream, of the existing bridge and would be 110 metres in length, with large 2:1 spill through batters. Option 4 would have a horizontal design speed of 110 kilometres per hour. This option has a maximum grade of nine per cent on the southern side of the bridge where it ties into the existing alignment on a 240 metre radius curve. Option 4 would require substantial cut (200,000 cubic metres) and fill (280,000 cubic metres). Option 4 would be the longest of the six shorter alignments options considered in the Phase 3 assessment. As such the new alignment would be 1.72 kilometres long, which would be 356 metres shorter than the existing alignment. Option 4 would integrate with a future upgrade to the south of the alignment. Option 4 had a strategic cost estimate of about $50 million however similar to options 1 and 10 the cost of this option would increase due to the need to lengthen the bridge to reduce geotechnical and asset management concerns.

Option 5

The alignment for Option 5 would be predominantly located to the northwest of the existing Princes Highway. The northern end of the alignment would require substantial excavations to create a large cutting and would produce around 340,000 cubic metres of cut material. The bridge in option 5 would be upstream of the existing bridge on a horizontal curve and would be 80 metres in length. Option 5 would then cross Dignams Creek Road which is at grade. The overall alignment of option 5 would be 1.68 kilometres long and would be 135 metres shorter than the existing alignment. Option 5 equates to a horizontal design speed of 100 kilometres per hour with a maximum grade of seven per cent. Option 5 would not integrate with a future upgrade to the south. Option 5 had a strategic cost estimate of about $60 million.

Option 6

This option would be located predominantly on the eastern side of the existing Princes Highway with a new bridge structure to be located downstream of the existing Dignams Creek Bridge. The new bridge structure would be 110 metres in length, with large fill abutments required either side of Dignams Creek. The overall alignment would be 1.17 kilometres long and would be 250 metres shorter than the existing alignment with a 100 kilometres per hour design speed. Substantial cut and fill would be required for this option and the tie in points at each end are either undercut or filled over and would require considerable tie in work. This design would have a maximum grade of five per cent. Option 6 would integrate with a future upgrade to the south of the alignment. As this alignment is shorter in length it would cost less to construct than options 4 and 5.
Upgrade of the Princes Highway, Dignams Creek

Figure 2-6 | Options 4-9
**Option 7**

This option is the shortest of all the options considered and is 0.78 kilometres in length and is around 240 metres shorter than the existing alignment. This option only achieves an 80 kilometres per hour design speed due to the steep down grade into a tight 260 metre radius bend on the approach to the existing bridge. The existing bridge would continue to be used. Substantial cut is required for this option, with a maximum cut of around 29 metres in height. Consequently, it is anticipated that a large quantity of spoil would need to be moved off site. This is a low cost option as it has the shortest alignment and no bridge replacement is required. Option 7 would integrate with a future upgrade to the south of the alignment.

**Option 8**

This option would extend to the west of the existing Princes Highway with a bridge structure upstream (ie to the west) of the existing bridge. The new bridge would be 80 metres in length. Substantial cut and fill would however be required to enable this option to cross Dignams Creek Road at grade. The alignment would have a horizontal design speed of 100 kilometres per hour, with a maximum grade of eight per cent with the southern end tying into a 240 metre radius curve and consequently requiring an 80 kilometres per hour design speed. Option 8 would be 1.71 kilometres long, which is 36 metres shorter than the existing alignment. As option 8 is similar in length to options 4 and 5 it would have a similar cost. Option 8 would not integrate with a future upgrade to the south of the alignment.

**Option 9**

Option 9 would be the most western alignment of the six short options assessed in this phase of option analysis. A new bridge structure would be located upstream of the existing bridge and would be around 180 metres in length. The alignment would have a design speed of 100 kilometres per hour and a maximum grade of seven per cent. Option 9 is 1.29 kilometres long, which is 64 metres longer than the existing road alignment. Option 9 would be a high cost option due to the requirement of either a large bridge or two smaller bridges. Option 9 would integrate with a future upgrade to the south of the alignment.

**Intermediate length staged options (options 11-13)**

The following is a discussion of the three intermediate options considered, which include options 11 – 13 (refer to Figure 2-7).

**Option 11**

Option 11 (Yellow Option) would be 2.46 kilometres long and extend along the eastern side of the Princes Highway with a new bridge structure to be located downstream of the existing Dignams Creek Bridge. The bridge would be 274 metres in length. Substantial earthworks would be required, with a balanced cut and fill of around 340,000 cubic metres. The alignment would have a horizontal design speed of 100 kilometres per hour, with a maximum grade of nine per cent. Option 11 would decrease the length of the existing alignment by 331 metres but has a high cost, which is associated with the longer bridge. Option 11 had a strategic cost estimate of about $60 million.
Figure 2-7 | Options 11-13
Option 12

Option 12 (Blue Option) would be 2.42 kilometres long and extends along the eastern side of the Princes Highway with a new bridge structure to be located slightly downstream of the existing Dignams Creek Bridge. The bridge would be 290 metres in length. Substantial earthworks are required, with a balanced cut and fill of around 350,000 cubic metres. The alignment would have a design speed of 100 kilometres per hour, with a maximum grade of nine per cent. Option 12 would decrease the alignment length by 361 metres. This option would have a high cost due to the cost associated with the longer bridge and the large quantity of earthworks. Option 12 had a strategic cost estimate of about $65 million.

Option 13

Option 13 (Purple Option) would be 2.51 kilometres long and extends along the western side of the Princes Highway with the smallest cut volume (270,000 cubic metres) of the three phase 4 options. A new bridge structure would be located upstream of the existing Dignams Creek Bridge and would be around 91 metres in length. The alignment would have a design speed of 100 kilometres per hour and a maximum grade of nine per cent. Option 13 would decrease the alignment length by 279 metres and has a low cost associated with the short bridge. Option 13 had a strategic cost estimate of about $45 million.

Community options (Options 14 and 15)

The two additional options put forward by the community during the display period for the current preferred option are shown in Figure 2-8. Like the shorter options considered by RMS, these options would remove the very tight radius bend located to the north of the Dignams Creek Bridge. The length of these two options varies and both options would impact on Gulaga National Park. Both options can tie into a stage 2 component, which if constructed would impact on Koorabban National Park.

Option 14 – DCCG option

Option 14 consists of a long straight alignment across the Dignams Creek valley to the eastern side of the existing Princes Highway that would be around 1.7 kilometres long including work required to tie into the existing alignment. This option is very similar to the alignment for option 4 considered in the second phase of RMS option analysis. However, the northern end of the option 14 alignment would be around 15 metres to the south-east of the option 4 alignment, and the southern end of option 14 would be about 30 metres to the north-west of the option 4 alignment. The crossing point of Dignams Creek for option 14 would be within 15 metres of that identified for option 4. As such the bridge dimensions would be very similar for the two options. However, following further analysis RMS identified a preference to avoid the use of the large batters that were included in the design for option 4 due to asset management and geotechnical concerns with the large fill abutment on a slope. Consequently the bridge for option 14 would need to be about 250 metres long and about 20 metres high.

Option 14 would have a horizontal design speed of 110 kilometres per hour and a maximum grade of eight per cent on the southern side of the bridge where it ties into the existing alignment on a 240 metre radius curve. Option 14 would require substantial cut (190,000 cubic metres) and fill (355,000 cubic metres). As a result of the long bridge and large earthworks quantities, option 14 has a strategic cost estimate of about $65 million.
Upgrade of the Princes Highway, Dignams Creek

Figure 2-8 | Options 14-15