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Route Optimisation Peer Review

Gerringong to Bomaderry Princes Highway Upgrade

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1 Scope of this report

1.1 Study brief

Connell Wagner has been commissioned by the NSW Roads and Traffic Authority (RTA) to undertake a peer review of the route optimisation process for the upgrade of the Princes Highway between Gerringong and Bomaderry. The scope of the peer review was developed by the RTA and includes the following items:

- The validity and comprehensiveness of the adopted project objectives.
- The appropriateness of the route optimisation process (including specialist investigation) adopted in developing the route options, with the major focus on the area surrounding the township of Berry.
- The validity and consistency of comments and scores recorded in both the route optimisation process and the validation workshop, again focussing on the area surrounding the township of Berry.
- The validity of the cost estimates for the displayed route options.
- The validity of cost estimates for the discarded Section B, Section C and Section B / C options.
- The validation workshop process and outcomes.
- The validity of "route reviews" resulting from the RTA's Major Projects Review Committee (MPRC), focussing on the area surrounding the township of Berry.

In undertaking the above tasks, Connell Wagner has subsequently been able to provide an independent assessment of the validity of the route options placed on public display in the November 2007 *Options display* brochure. Table 1.1 identified the objectives of this peer review process and the section of this report within which those objectives are addressed.

It is acknowledged that the next stage of the Gerringong to Bomaderry project will be the selection of a preferred option. The following will be considered when deciding on a preferred option:

- Outcomes of further investigations on physical impacts of the short listed options in relation to economic, environmental and community issues.
- Community and stakeholder comments on the short listed (displayed) options.
- Outcomes of value management workshops. These workshops will include participants from the community, government and technical areas. The workshops will assess the performance of each of the options against the project objectives. The workshops will identify other work / tasks required before a recommendation is provided to the Minister for Roads.

Table 1.1 Objectives of this Peer Review Report

OBJECTIVE	WHERE ADDRESSED
Consider the validity and comprehensiveness of the adopted project objectives.	Chapter 4
Consider the appropriateness of the route optimisation process adopted in developing the route options.	Chapter 6
Consider the validity and consistency of comments and scores recorded in both the route optimisation process and the validation workshop, focussing on the area surrounding the township of Berry.	Chapter 6
Consider the validity of the cost estimates for the displayed route options.	Chapter 5
Consider the validity of cost estimates for the discarded Section B, Section C and Section B/C options.	Chapter 5
Comment on the validation workshop process and outcomes.	Chapter 6
Consider the validity of "route reviews" resulting from the RTA MPRC, focussing on the area surrounding the township of Berry.	Chapter 6

2 Background to the project

2.1 Overview

Due to significant changes in land use and population, and a review of planning, traffic and safety conditions, the NSW Government has committed to upgrade the Princes Highway between Gerringong and Bomaderry. Maunsell Australia Pty Ltd was engaged by the RTA in December 2006 to undertake a *Route Options and Selection Study*, which has generated various route options that have taken into account information from previous studies and information generated from new studies. Prior to this current engagement, there have been several studies undertaken that focus on the upgrade of the Princes Highway in this area, including:

- Gerringong to Berry route evaluation study (1991).
- Value management study for a northern and a south-east bypass of Berry (1996).
- Environmental Impact Statement for a preferred (northern) corridor (1997).
- Quantm (computer generated) route options developed (2004/05).

There has been extensive community consultation undertaken for the project that has been ongoing since early 2006, encompassing the period prior to and during the development of the *Route Options and Selection Study* by Maunsell. Community consultation has included community workshops, displays, information sessions, meetings with interests groups and potentially directly affected property owners, ongoing quarterly community updates and establishment of a project office in Berry, operating two days per week.

An *Options Display* brochure was released to the community in November 2007 which identified a "short list" of seven possible route options between Gerringong and Bomaderry. The *Options Display* brochure provided summary details for each of the seven "short listed" options and also identified the process that would be undertaken in selecting a preferred option. In summary, the November 2007 *Options Display* identified the following:

- One short listed route identified for Section A (Mount Pleasant to south Gerringong) and it is therefore common to all options. This route is identified as the Red route.
- One short listed route identified for Section D (South Berry to Bomaderry) and it is therefore common to all options. This route is identified as the Purple route.
- Three short listed routes identified for Section B (South Gerringong to north Berry), the Pink, Green and Yellow routes.
- Two short listed routes identified for Section C (Berry Township bypass), the Blue and Orange routes.
- A Brown route was also identified that passes through Sections B and C (South Gerringong to south Berry).

The *Gerringong to Bomaderry Princes Highway Upgrade Options Display* brochure (November 2007) and the *Gerringong to Bomaderry Princes Highway Upgrade Route Options Development Report* (November 2007) were placed on public display from Monday 26 November 2007 until Friday 29 February 2008 at the following locations:

- Berry project office (Broughton Court).
- Kiama Council.
- Shoalhaven City Council.
- Kiama Fair Shopping Centre.
- Nowra Fair Shopping Centre.

During the display period there were also staffed displays, information sessions and a community / stakeholder workshop. The community was invited to provide written submissions to the *Route Options Development Report* (RODR) either via email or post.

Submissions to the community update indicate that a section of the community is opposed to the culling of options that bypass to the south of the township of Berry. It is also understood that a lobby group has been set up to promote consideration of a route to the south of Berry. In response to representations, the Minister has requested that a review of the process used in selecting the "short listed" options, and in particular a review of the rationale for removal of all options to the south of Berry.

2.2 Project timeline

2.2.1 Preliminary project activities

The upgrade of the Princes Highway in the area surrounding the township of Berry has been under consideration in various forms since the late 1960's when a road reserve in North Street was adopted as part of Shoalhaven City Council's LEP (for a bypass of Berry). In 2006 there was a Government announcement to examine a larger area between Gerringong and Bomaderry that incorporated other areas previously considered in a 1996 Berry Bypass study and a 1991 Gerringong to Berry route evaluation study). Table 2.1 provides an overview of the project development timeline.

Table 2.1 Project timeline

MONTH / YEAR	PROJECT MILESTONE
1981	Road reserve in North Street was adopted as part of Shoalhaven City Council's LEP (for a bypass of Berry).
1991	Gerringong to Berry route evaluation study (5 potential corridors).
June 1992	RTA completed a traffic origin and destination study for the Berry area (showed that approximately 70% of traffic passing through Berry would use a bypass route).
March 1996	A value management study conducted and recommendation was to consider two possible routes; a northern route (previously identified) and a new route to the south-east of Berry.
1996	Minister for Roads announced that the northern route was the preferred corridor for the Berry Bypass.
1997	A consultant was engaged to prepare an Environmental Impact Statement (EIS) on a preferred corridor (government decided to defer finalising the EIS).
2004 / 2005	Quantm (computer generated) route options developed (recommended a number of feasible routes for further analysis based on a significant level of engineering and economic analysis, but limited field work).
March 2006	Announcement to examine a larger area between Gerringong and Bomaderry (incorporated areas previously considered by the 1996 Berry Bypass study and the 1991 Gerringong to Berry route study).
March 2006	Community update (invitation for community input).
May 2006	Workshop meeting (presentation to community).
September 2006	Community update (process / steps in preferred option selection)
December 2006 to November 2007	Route optimisation process including: ▪ Determination of a long list of options ▪ Preparatory assessments(environmental specialist reports) ▪ Route options development workshop ▪ Route options validation workshop(selection of short-listed options) ▪ Consideration of short listed options by the MPRC ▪ Refinement of short-listed options
January 2007	Community update (notification of Maunsell as preferred consultant).

MONTH / YEAR	PROJECT MILESTONE
February 2007	3 x Community information sessions (Gerringong, Berry and Bomaderry).
April 2007	Community update (status of the options development process).
April 2007	Interest Group Workshop
July 2007	Community update (status of the options development process).
August 2007	Specialist consultant presentations to community (Ecology, flooding and drainage, Aboriginal and non-Aboriginal heritage, traffic and transport and geology and soils).
August 2007	Presentation to the RTA MPRC
November 2007	Display of short-listed options.
Current	Draft options submissions report.

This report focuses on the various activities that have occurred in the period between the commencement of the route optimisation process and the commencement of the public display of the RODR.

2.3 Overview of the route optimisation process

The route optimisation process involved the following key steps:

- Determination of a long list of options based on an engineering software package – Quantm and additional assessments using basic engineering design principles.
- Refinement of Quantm generated options.
- Preliminary cost estimation.
- Undertaking specialist environmental/planning investigations.
- A three day workshop involving the RTA, project team and specialists.
- A one day validation workshop involving mostly the same people from the three day workshop.
- Review by RTA's internal MPRC.
- Public display of short-listed options.

Details on each step of this process are discussed in the sections following.

3 Methodology for this peer review

3.1 Conduct of this peer review

3.1.1 Site visit

Connell Wagner staff undertook a site visit with a representative of the contractor's project team and the RTA's project manager to familiarise themselves with the site and further discuss aspects of the route optimisation process.

3.1.2 Contractor and RTA meetings

In undertaking the peer review, there have been three meetings held with the contractor to clarify various aspects of the optimisation process and information presented within the RODR and supporting documentation.

There have been two meetings held with the RTA Southern Region project staff during the peer review period.

3.1.3 Information review

An initial and ongoing task has been the review of available literature relevant to the RODR. This has included review of specialist reports, workshop notes and critical analysis of workshop findings. There has been ongoing contact with the contractor and the RTA to request clarification on existing information and to request additional information on the optimisation process.

3.2 Limitations of the review

Our review has been to focus on the appropriateness and consistency of application of the chosen methodology and approach to the route optimisation process and in particular to address the fundamental question of whether the exclusion of a southern route near Berry from the short list of route options was based on sound methodology. It has not included the preparation of any specialist technical studies, nor attempted to re-assess any aspects of the route optimisation process from "first principles", nor any new investigations. Our review has not included a review of community submissions to the RODR.

3.3 Our naming approach to the route options

With focus essentially on various routes for a bypass of Berry, this peer review concentrates on Section C and Section B/C long-list options. Separation of the study area into four parts and the various long list options for the project are illustrated in Figure 7.2 of the RODR. During the options development process there have been several descriptors allocated to the various route options. Table 3.1 describes the long list options considered as part of this review process and the various other descriptors these options have had, including the descriptors adopted for this review. We note it does not necessarily include all the options, only those which are explicitly referred to in this report.

Table 3.1 Options descriptions

APPENDIX A OF THE RODR	REVIEW REPORT DESCRIPTION	PUBLIC DISPLAY DESCRIPTION	OTHER DESCRIPTIONS
SECTION B			
C-E-G-H-J-O-Q-S (base)	B 00 (base case)		
C-F-I-N-R-S (west)	B 01		2C, Harley Hill
C-E-G-H-J-O-Q-S	B 10	Pink route	2A
C-E-G-H-K-M-Q-S	B 13	Green route	2B, north saddle option
C-F-I-tunnel-P-Q-S(west)	B 14	Yellow route	2E, south saddle option
SECTION C			
S-U-X-(Q. Str.)-BB-DD (base)	C 00 (base case)		
S-U-Z1-DD	C 1		
S-U-Z2-BB-DD	C 2	Blue route	3A
S-U-Y-BB-DD	C 3		3B
S-T-W-Y-BB-DD	C 4		
S-U-X-(N-Str)-BB-DD	C 5	Orange route	3C
S-T-W-X-(N-Str)-BB-DD	C 6		
S-U-X-AA-BB-DD	C 7		
S-U-X-AA-CC-DD	C 8		
S-T-V-CC-BB-DD	C 9		
S-T-V-CC-DD	C 10		
S-T-V-AA-CC-BB-DD	C 11		
SECTION B / C			
C-E-G-H-J-O-Q-S-U-X-(QStr)-BB-DD	BC 00 (base case)		
C-F-I-N-R-T-W-X-(N Str)-BB-DD (west)	BC1		
C-F-I-N-V-W-X-(N Str)-BB-DD (west)	BC2	Brown route	Route 2/3D west
C-F-I-N-V-W-X-(N Str)-BB-DD (east)	BC3		Route 2/3D east
C-F-I-N-V-W-AA-CC-DD (east)	BC4 east		
C-F-I-N-V-CC-DD (east)	BC5		

4 Project objectives

4.1 Process for the development of project objectives

The project objectives are presented in Figure 7.1 of the RODR and are:

- Improved road safety.
- Improved efficiency of the Princes Highway between Gerringong and Bomaderry
- Support regional and local economic development.
- Provide value for money.
- Enhance potential beneficial environmental effects and manage potential adverse environmental impacts.
- Optimise the benefits and minimise adverse impacts on the local social environment.

It is understood that there are no formal project objectives for the upgrade of the Princes Highway as a whole. The project objectives and the critical criteria for the project were developed initially by the consultant and provided to the RTA project team for review. This process was undertaken early in the options development process so as to inform the specialist consultants prior to the route options development workshop. Figure 7.1 of the RODR notes that for a route option to be considered as a short-listed option it must conform to the identified critical criteria.

From discussions with the project team it is understood that as part of the overall process in developing project specific objectives for the Gerringong to Bomaderry project, the project objectives developed for the Pacific Highway Upgrade Program were referenced

4.2 Review of the project objectives and critical criteria

4.2.1 Project objectives

The project objectives developed are consistent with similar highway development / planning projects and are considered appropriate and sufficient for this project. The objectives address the key aspects of functionality (ie. “fit for purpose” engineering requirements) as well as relevant sustainability considerations including environment, social and economic outcomes.

4.2.2 Critical criteria

For any quantitative options assessment process, it is desirable to identify the performance criteria for each objective so that it can be applied as systematically and objectively as possible in the rating of each option. Performance criteria provide the set of “rules” for determining the ratings. For this project, the performance criteria (in this case - “critical criteria”) were identified and are described in detail in Figure 7.1 of the RODR.

It is considered that the critical criteria satisfactorily address the range of key issues likely to be encountered by a linear infrastructure project of this scale within the context of the study area setting and also that they are appropriately aligned with the abovementioned project objectives.

We understand that the application of the criteria would be strengthened at the next stage of the option evaluation process by specific identification and incorporation of quantitative information where possible and relevant. For example, relevant road lengths, travel times, engineering features (radius curves, grade, etc.) as well as numerous key environmental characteristics such as hectares of vegetation removal, hectares of agricultural land affected, number and areas of property affected/acquired.

5 Cost estimates

5.1 The validity of cost estimates for the displayed route options.

5.1.1 Review method

Our planned method of review was as follows:

(a) Broad overview / random check on the rates & quantities used for the 7 displayed options.
(b) Spot check on the probabilistic estimate calculation.

5.1.2 Key findings and comments

(a) Broad overview / random check on quantities & rates used for the 7 displayed options

We have done a broad overview of the rates and quantities and found that these are generally in the right order. For those major items where in our opinion, the rates differed from what we opined to be appropriate, we have carried out further checks to see the effect on the total costs on randomly selected options 1 & 4 as follows:

(i) Earthworks:
The assumptions made in calculating the rate for cut to fill have led to rates in the region of $23/cu.m. In our opinion, for projects involving large earthwork quantities, the rate could come down to as low as $10/cu.m., depending on quantities, feasibility of using scrapers, distance of haul, etc., which would become clearer when the design becomes more refined. A quick check revealed that adoption of a rate of $15/cu.m. for cut/fill quantities led to an increase in the difference between the final costs of Options 1 & 4 as follows:

Estimates as presented:	Option 1 - $555M; Option 4 - $550M (Diff. = $5M)
Estimates using $15/cu.m. for cut/fill:	Option 1 - $542M; Option 4 - $536M (Diff. = $6M)

This difference would be inconsequential given the stage of the cost estimation.

(ii) Drainage Items:
A reality check on the total amount for drainage items as a percentage of the total cost gives figures in the order of 10%. In our opinion, this figure would be in the order of 5% for large rural projects such as G2B. We trust that this would be the case when the design becomes more refined. As the cost of drainage items in all 7 options are in the same order, we do not believe that any change in the assumptions would lead to any change in the order of the final costs of the options.

(iii) Bridges:
According to the Preliminary Concept Cost Estimate Report, Super T girders have been assumed for bridges with total span more than 100m. Adopting a width of 21m for 4 lane bridges, we have assumed Super T girders used for all bridges with areas in excess of 2,100 sq.m. In our opinion, at current market rates, the cost of Super T girder bridges would be in the order of $4,100/sq.m., whereas the rates used in the estimates appear to be in the range $3,000 - $3,500/sq.m. When we substituted a rate of $4,000/sq.m. for bridges over 2,100 sq.m. in Options 1 & 4, the order reversed and the results were as follows:

Estimates as presented:	Option 1 - $555M; Option 4 - $550M (Diff. = -$5M)
Estimates using $4,000/sq.m:	Option 1 - $586M; Option 4 - $591M (Diff. = +$5M)

This difference would be inconsequential given the stage of the cost estimation.

(iv) Pavement:
In our opinion, the rate used for 135mm of AC20 ($60/sq.m.) could be low and $75/sq.m. would be more appropriate under the current market conditions. We substituted this rate in Options 1 & 4 and the results were as follows:

Estimates as presented:	Option 1 - $555M; Option 4 - $550M (Diff. = $5M)
Estimates using $75/sq.m.:	Option 1 - $566M; Option 4 - $561M (Diff. = $5M)

This difference would be inconsequential given the stage of the cost estimation.

(v) Tunnels:
In our opinion, the cost of tunnels included in options 2, 3, 5 & 6 could be over-estimated by around $10M. This difference, however would not affect the order of costs.

In summary, we are satisfied that the basic cost estimates for the short-listed options have been done thoroughly and that the above differences should not greatly affect the final basic costs, as the majority of the differences would balance each other.

(b) Spot check on the probabilistic estimate calculation

We have verified that the probabilistic estimates have been carried out in a professional manner using @Risk with 5,000 iterations and appropriate probabilistic distribution functions. We independently carried out spot checks for Options 1, 2, 3 & 7 and arrived at results similar to those presented.

The P90 figures give contingencies in the order of 35%, which is at the lower end of the RTA recommended range of 35% – 70% for strategic estimates. When we trialled the @Risk simulations for the risk registers of the above options with a different probabilistic distribution function to that used in the estimate, the overall contingencies were in the range of 49% – 51%.

It must be stressed however, that the decisions on the use of different probabilistic distributions are very subjective and one distribution function cannot always be assumed as better than another, especially when dealing with risks which may not eventuate or may occur without having the maximum anticipated effect.

5.2 The validity of cost estimates for long list of route options.

5.2.1 Method

Our planned method was to:

(a) Review the method of calculation of costs for the long list options in Spreadsheet "G2B working cost estimate A6.xls".
(b) Work out the cost of base case from the costs for the short lengths along the various routes shown in Fig. 7.2 – Long List of Route Options and compare the costs of options in Sections B, C & B-C presented in Appendix A of the RODR.

5.2.2 Key findings and comments

(a) Review the method of calculation of costs for the long list options in Spreadsheet "G2B working cost estimate A6.xls"

According to the RTA's consultant, a long list cost spreadsheet was used as an interactive tool to illustrate cost related issues for route options to the workshop attendees. The spreadsheet provided the length, pavement cost, earthworks cost, and bridge cost for each option.

The costs used for comparing different routes have been based on the following three components:

(i) Cut & fill quantities of earthworks derived from MX model and assuming rates of $6/cu.m. of cut & $10/cu.m. of fill.
(ii) A flat rate of $2,000/m for pavement.
(iii) A flat unit rate of $800,000 per bridge.

(b) Work out the cost of base case from the costs for the short lengths along the various routes shown in Fig. 7.2 – Long List of Route Options and compare the costs of options in Sections B, C & B-C presented in Appendix A of the RODR

It is understood that the workshop process illustrated that cost was related to segment length and was further influenced by the number and size of structures or exceptionally large cuts or fill requirements. The spreadsheet costs were developed to a point where the workshop attendees would have a level of confidence to make their judgements. Only the relative cost for each combination of segments assessed was reported (ie. no absolute costs).

In addition to the preliminary cost estimates, project risks were also considered in the assessment against the value for money objective. Project risks included constructability, risk to programme, potential construction problems (ie. soft soil, acid sulphate soil, construction access etc).

In order to carry out a reasonably accurate comparison of costs of the different options in Sections B, C & B/C, further information was obtained from Maunsell and the costing of each of the short lengths used in the option analysis was first done. Where no information was available we made certain logical assumptions such as (a) the cost varying proportionately to the length along a route in a similar terrain (b) cost of tunnels used in the long list option study is reduced from the cost derived for the short list options by the same proportion as that for earthworks, etc.

We then computed the costs of the different options in Sections B, C & B/C presented in Appendix A of the RODR. Our derived costs are presented in Appendix A to this report.

Our key findings regarding our review of the preliminary cost estimates for the long-list options (Sections B, C and B/C) is as follows:

- Each long list option originally comprises a number of “segments”.
- Costs appear to have been developed at the 3-day workshop stage for some but not all “segments”.
- The costs developed for the 3-day workshop stage were for comparative purposes only and bore no relationship to actual costs. This is considered appropriate for a comparative analysis.
- The relative cost calculation in the spreadsheet however, contained an error in that the bridge costs were directly added to earthworks cost per metre + pavement cost per metre.
- The cost estimates for the 3-day workshop stage included only earthworks, structures (ie. bridges) and pavement. This was applied consistently to all segments and hence the relativities are considered appropriate.
- Cost estimates at the 3-day workshop stage for bridges were on a fixed cost per unit basis without regard to bridge length or complexity. Thus any option which had many bridges would be relatively under priced to options with few or no bridges. We do not consider that this approach is appropriate given the potential variation in the number of structures for options identified.
- The proportion of cost applicable to earthworks and pavement appears to be inconsistent with the more detailed cost estimates undertaken for the public display options.

- The cost estimates reviewed at the 3-day workshop appear to be based on the costed segments plus a qualitative estimate for the missing and/or part segment to make up a full option.
- Additional and more robust cost estimation appears to have been done at the validation workshop stage but for only the short-listed options (refer Appendix B).
- The additional cost estimates undertaken for the short-listed options were incorporated in Appendix A of the RODR. Hence the short-listed options have statements about costs relative to the base in percentage terms (ie. construction cost of B13 is 25% higher than the base). No such quantitative information is available for the non-short-listed options.
- Apart from the incomplete segment costs, no further cost estimation appears to have been undertaken for any option (Section C or Section BC) that bypassed Berry to the south on the basis that they were all eliminated at the 3-day workshop.

Based on our review of the above, the preliminary construction cost estimates provided at 3-day workshop stage appear to have been derived from an incomplete and in some areas inappropriate (ie. fixed bridge costs) assumptions.

The limited objective cost information available at the 3-day workshop stage appears to have been rectified at the validation workshop stage with additional cost estimates undertaken for the short-listed options. Whilst this additional cost information generally substantiates the statements in Appendix A to the RODR with respect to the short-listed options it is difficult to comment on whether the statements are equally as robust for the non short-listed options.

From our own costing exercise (refer Appendix A), using the original (though arguable inappropriate) 'segment' costs would put the cost estimate of options to the south of Berry within the same relative order as the options to the north of Berry. In particular all BC options appear cheaper than many of the short-listed Section B and Section C options when combined. However we accept that the accuracy of the original segment costs in this instance is poor particularly in regard to the underestimation of bridge structures (ie. fixed costs per bridge).

An equally (if not more) important issue for this stage of the value for money evaluation would be project risks. Whilst Appendix A of the RODR provides some information on this aspect, we believe it also to be most applicable to only the short-listed options. We have since sought advice from the RTA's consultant to obtain a more comprehensive understanding about project risks for each long-list option. This supplementary advice is also provided in Appendix B.

Our review indicates that the project risks identified by Maunsell appear to relate essentially to soft soil and acid sulphate soil issues. For Section B and Section C, the information provided does not expand significantly on the information provided in Appendix A of the RODR and essentially relates to cost issues rather than project risks. For Section BC, the issues identified relate to soft soil and acid sulphate soils, large sections constructed off-line (and hence delays to realisation of benefits), remaining lengths of existing Highway for maintenance, and major creek crossings.

It appears that B/C options were discarded primarily on issues associated with project risks. However we note that the additional cost estimates undertaken for Option BC2 at the validation workshop stage put it to be some $109 M cheaper than the most expensive (but nonetheless short-listed) combination of Section B plus Section C (ie. Yellow plus Blue route). This could imply that other BC options may also be cheaper than the short-listed Section B and Section C particularly taking into account the cost relativities of the Section BC options as identified in Appendix A of this report. We note that the current cost difference based on refinements and consideration of project risk is now $70M. Whilst we accept that there appears to be a number of project risk issues associated with BC options, we believe that an assessment of these risks against the potential cost savings needs to be further considered before discarding.

6 The route optimisation process

6.1 Overview of process

The overall process and methodology for highway options development and assessment as adopted for this project is broadly consistent with established good practice. The approach has included appropriate and necessary elements and steps such as:

- Definition of the need for the project.
- Development of objectives to guide the project development and assessment process.
- Definition of project limits (or 'end points') and the study area.
- Consideration of relevant biophysical and socio economic constraints relevant to both the study area and the route development, supported by numerous specialist investigations.
- Identification and development of a long list of route options based on sound highway planning and engineering principles.
- Preliminary assessment using multi criteria techniques and culling of less well performed options to achieve a sensible and reasonable short list of options for detailed evaluation.

While this overall approach and the methods used are generally quite appropriate, there are some aspects that have proved to be of limited value.

Most notably, we believe that the base case method used for the comparative assessment of options was unnecessarily complicated. This is attributed to the fact that the base case option as defined was recognised as not being a realistic or feasible scenario. For it to then be the reference case against which each option was compared is problematic. While this general approach can be useful it offered little advantage in this situation.

Another aspect of the approach that we believe complicated the assessment relates to the route sections. Breaking a study area into sections is a common and quite acceptable practice, but in this case, the judgement relating to definition of sections B and C is considered problematical. These sections do not correspond well with a location or line where there is a strong converging of route options. In these circumstances we believe the extents or limits of the sections are somewhat arbitrary and it would have been better had they been left as one consolidated section.

Further discussion on these aspects is provided below.

6.2 Development of the long list of options

6.2.1 Process for selection of the long list of options

Studies on route alignment options for the study area date back to 1990 including the Gerringong to Berry route evaluation study (1991), a value management study (1996) and an EIS for a preferred Northern Berry bypass (1997). A specialist engineering investigation was undertaken in 2004/2005 using a software package called Quantm.

The Quantm package identified a number of alignments based essentially on engineering and cost grounds. These routes then underwent an analysis by the project team to identify any fundamental flaws and to identify other possible routes. Again this analysis was essentially on engineering and cost grounds and considered issues such as conforming road geometry, balancing of earthworks, reducing size of cuts and fills, providing perpendicular bridge crossings and avoiding poor ground conditions. The long-list routes were then overlaid onto basic environmental constraints maps for interrogation.

6.2.2 Peer review comment and findings

General

The long-list of options was essentially determined on engineering criteria including the outputs of the preceding route development work using the Qantum software. Section 7.1 of the RODR outlines the process undertaken in determining the long list of options. The description of this process as outlined in the RODR is confirmed through literature review.

Whilst it is acknowledged that the environmental constraints were considered, the approach was primarily a reactive one. That is, the pre-determined engineered options were assessed against the identified environmental constraints. We believe that a supplementary and beneficial approach could have been to proactively generate options from an environmental planning constraints process and then test the engineering feasibility. This could have yielded a useful consolidated view of other relevant constraints and opportunities for road planning and productively contributed to the identification of potential corridors. This approach may have assisted in comparing the corridors along with the engineering criteria preferences and could possibly have resulted in earlier culling of less suitable options.

Notwithstanding, given the:

- extent of previous studies dating back to 1990,
- nature of the landuse and the terrain,
- significant number of long-list options and permutations generated by Quantm and considered in the workshop process,
- referral to environmental constraints maps generated and,
- approach to include specialist environmental investigations later in the process,

it is considered that in retrospect, the approach undertaken was appropriate and reasonable for this stage of the route option process and is unlikely to have yielded very different options.

In the specific context of bypasses to the south of Berry we believe that the Qantum process generated a sufficient number and variation of possible options to be considered valid for the long-list evaluation.

Selection of permutations of identified corridors

The development of the long list of options essentially involved the combining of corridors from each section of the study area. Whilst not each and every permutation was identified for assessment for reasons of manageability, we believe that the extent of combinations that were identified provides a reasonable and appropriate representation of the possible options

Identification of interchanges

An important consideration for any bypass of Berry would be the requirement for maintaining access to the town centre. Earlier studies had identified the need for off and on ramps at Kangaroo Valley Road and another interchange south of the township.

Whilst it is appreciated that resolution of interchange(s) locations and configuration is necessarily ongoing, it is considered important that the key features and impacts of a likely interchange location be considered as far as possible in the overall assessment. For some options there is a common junction with the local road network and the interchange location would be essentially the same, but for other options the interchange location and

impacts could be a key differentiator. It is noted that the opportunity for interchanges were identified in the option analysis but the impacts were not assessed and compared as part of the review process.

Whilst not critical to this stage of the assessment, we believe that issues associated with interchanges would be an important aspect for consideration at the next stage of the option evaluation process.

Definition of the base case

The base case developed for the Project consisted of an upgrade along the existing highway alignment to four lanes. The base case was the reference against which all options were compared and "rated". The base case for Section B and Section C included lengths where the base case was a hypothetical scenario and acknowledged to be non feasible (eg. Foxground and Queen Street in Berry). In other words, there was no actual base case solution involving existing road upgrade that satisfactorily met the project objectives for road safety/efficiency. It was also given a rating of three regardless of its performance.

We believe there was no strong rationale for including a non-feasible and hypothetical base case for comparative assessment of options. Indeed we would suggest such approach introduced unnecessary complexity into the comparative assessment process. Further, there is limited information provided in the documentation about the base case and it is unclear whether the base case was developed to the same degree of design and whether it met similar design criteria as other options. There is also little if any information relating to an estimate of cost for the base case.

Notwithstanding, as the issue would apply consistently across all options, re-definition of a base case is unlikely to materially affect the final short listing of options.

6.3 Specialist Technical Inputs

Preparatory assessments were undertaken for each of the "long list" options in order to inform the decision making process at the subsequent Route Options Development Workshop phase (see below). The preparatory assessments focussed on 18 identified specialist investigations categories. The specialist responsible for each investigation category was required to:

- Provide an assessment against the project objectives.
- Identify preliminary "negotiable" and "non-negotiable" issues (refer Section 6.4.2 of this report).
- Identify preliminary discards of route options.
- Identify preliminary route preferences.

We have reviewed the robustness of the preparatory assessments and found it to be generally comprehensive and adequate in the context of informing the Route Options Development Workshop phase. Details of this review are provided in Appendix C.

It is recognised that the extent of specialist studies has been essentially desk-top with selected site specific investigations on sensitive issues. This approach is considered applicable and consistent with the extent of studies typically undertaken at this stage of the route evaluation process. Whilst there have been some inconsistency in the application of some of the specialist findings the key results appear to have been applied reasonably consistently throughout the route optimisation workshop process and adequately reflect the information provided within the specialist report.

6.4 Route options development workshop

6.4.1 Process for route option identification – three day workshop

This stage of the route optimisation process commenced with the long list of options as refined by Maunsell (refer Section 6.2 above). The long-list was broken up into four sections comprising (from north to south) Sections A, B, C and D. Section C was through the township of Berry. For some options there were no convenient joining points between Section B and C and hence a combined Section B/C was also created.

The long-list of options was then reviewed by specialists in preparation for a three day workshop (see below). Some 18 specialist investigation categories were identified (refer Appendix C).

The initial assessing and short listing of feasible route options was then carried out at the three day workshop (held in May 2007) which included participation by the RTA, the project team and specialists. At the workshop the specialists summarised their preparatory work. The workshop provided an opportunity for participants to understand issues arising from all specialist studies enabling a balanced assessment.

For each section (ie. A, B, C, D and B/C) every option was then rated in-turn on how it impacted (comparatively) on the six project objectives namely:

- Improved road safety.
- Improved efficiency of the Princes Highway between Gerringong and Bomaderry.
- Support regional and local economic development.
- Provide value for money.
- Enhance potential beneficial environmental effects and manage potential adverse environmental impacts.
- Optimise the benefits and minimise adverse impacts on the local social environment.

For each of the project objectives "critical criteria" (or performance indicators) were identified. The critical criteria formed the base criteria against which the options were "rated". A simple comparative rating exercise was undertaken relative to the base case. The base case was defined as the upgrade of the existing road to two lanes in each direction and conforming geometry (desirable minimum vertical and horizontal alignment). As noted above for Sections B, C and BC the base case was only theoretical, that is, there was no base case option.

It is noted that this scoring system at the three day workshop was different to the "final" scoring system as presented in Appendix A of the RODR. The scoring system used at the three day workshop and the final scoring system are shown in Table 6.1 below.

Table 6.1 Scoring systems relative to the base case

CATEGORY	THREE DAY WORKSHOP	FINAL SCORING SYSTEM
Significantly better than base	+ 2	5
Moderately better than the base	+ 1	4
No better/ No worse than the base	0	3
Moderately worse than base	- 1	2
Significantly worse than base	- 2	1
Non-negotiable	- 3	0

The scores presented in Appendix A of the RODR were retrospectively updated from the original scoring system to the final scoring system for exhibition of the RODR. This updating essentially involved the simple addition of three to all the original scores. For example an original score of minus two would have a final score of one. For the purposes of the discussion below we have referred to the "final" scoring system as presented in the RODR.

For some objectives, combinations of specialist categories were applicable (ie. performance criteria relating to different outcomes) and the workshop included debate to determine an agreed collective response. For example an option may (under the same objective) have had a low score from a heritage specialist but a high score on flora/fauna. If this was the case, debate occurred in the workshop environment to agree on how the option should rate overall relative to that particular project objective.

The three day workshop produced a provisional short-list of route options and identified issues that required further analysis.

6.4.2 Review and findings

Representation at the Workshop

The workshop was attended by representatives from the RTA, the Maunsell project team and associated specialist consultants. It was the intention that community interests would be represented in the decision making process by the relevant specialist consultants (ie. noise specialist, social economic specialist etc.). There were no community representatives at the three day workshop.

Documentation

We have not cited a formal document and / or report on the outcomes of the three day workshop, including the workshop ratings of each option apart from the original workshop working sheets. The working sheets provide some commentary on the critical criteria for each project objective for route options within all sections. Also included on these workshop working sheets are the results of the scoring process at the workshop.

Scoring Process

The post validation workshop worksheet scores were compared with the final scores as presented in Appendix A to the RODR. From our comparison we make the following observations with regard to Section C and Section B/C options:

- It is recognised that a number of the Section C scores identified in the original three day workshop worksheet were "refined as part of the overall review and sanity check". Whilst the transparency of the refinement process would be assisted through the provision of information that accounts for these changes, we have reviewed these refinements and conclude that they would not materially affect the final short-listing outcomes.
- We have not been able to access a workshop worksheet relating to Option C11.
- We have not been able to access workshop worksheets for Options BC2, BC4 or BC5. Notes accompanying the final tables imply that these options were a result of refinement of "Route 3".
- The workshop worksheets (three-day and validation) do not identify a 'non-negotiable" (ie. a score of 0) on the value for money objective for any Section B/C option. That is, the options were not discarded at the workshops. However according to Appendix A of the RODR, three of the B/C options were discarded on this basis.

Base case – fixed rating and theoretical

As previously discussed, all route options were compared against the base case. The base case was identified as the upgrading of the existing highway to two lanes in each direction with conforming design geometry.

For all project objectives, the base case was given a fixed rating of three (ie. the middle score in an available range from one to five) irrespective of its relative impact on any / all of the project objectives. By setting the base case with a fixed rating in this manner, the ability to distinguish between options was reduced as it only allowed an option to score two points higher or two points lower even if the relative performance between options suggested that a bigger rating separation (say a five point spread) should have applied. This may have reduced the ability to distinguish separate options which in some cases may be substantially better than the base case but not necessarily better or worse than each other.

By way of example, the objective of "support regional and local economic development" and "optimise the benefits and minimise adverse impacts on the local social environment" can be considered. The base case for Section C would involve the introduction of four lanes through the township of Berry on the existing highway alignment. This would require the removal of all parking along the main street of Berry and associated changes to property access, severance, requirements for noise barriers etc which in tandem with a range of adverse aesthetic and amenity impacts could have a potentially devastating impact on the town – hence why it was only considered as hypothetical. However, this base case scores a three on both these objectives. If the base case with this impact can score a three then arguably all other options (ie. when compared with this base case) would presumably need to score at least a four if not a five (ie. significantly better than the base) on both these objectives – again relative to the base. This was not the case, with some options scoring much worse than the base. We believe that this approach/conclusion is difficult to reconcile.

Definition of "non-negotiable" for value for money

The evaluation process included the concept of "non-negotiable" outcomes. Should any option be identified as having a 'non-negotiable" impact it scored a 'zero' for the relevant project objective. The option needed only to be scored a 'zero' on one project objective for it to be eliminated from further consideration.

A "non-negotiable" was identified for several options on the 'value for money' objective in Section B and Section B/C. However, there is no clear definition of what constitutes a "non-negotiable" condition for that project objective, apart from it being significantly worse than the base case. As described above, the base case was hypothetical and was actually acknowledged to be non feasible in some sections. It is therefore difficult to conclude whether the elimination of any option on this basis (and in comparison to a non feasible base) can be justified.

Non-negotiable' for the value for money objective and a theoretical base-case.

For the 'value for money' project objective (essentially a function of cost, constructability and project risk), the issue of 'non-negotiable' is compounded when an unrealistic base case is used. That is, if the base case is unrealistic then there can be no cost on which to compare and/or discard any option. Thus for any route option to score a "non-negotiable" on value for money (when there is no realistic base case) is problematic.

Section B/C

The composite Section B/C was created as some of the options had no convenient or common junction between the separate Section B and Section C. Breaking a study area into sections is a common and quite acceptable practice, but in this case, the judgement relating to definition of sections B and C is considered problematical. These sections do not correspond well with a location or line where there is a strong converging of route options. In these circumstances we believe the extent or limits of the sections are

somewhat arbitrary and it would have been better had they been left as one consolidated section. Furthermore there was no subsequent assessment of the Section BC against any combination of the individually assessed Section B and Section C options so it was not possible to determine how the BC sections compared.

Another issue for Section B/C is that three out of the five options identified were discarded on the 'value for money" objective. We understand that this was not necessarily based on costs but also on construction and overall project risks. The comments presented referred to "ground conditions" and "bridge structures" and staging issues due to soft soils. The *Preliminary Geotechnical Report* prepared by Coffey Geotechnics (Appendix B to the RODR) identifies the presence of soft holocene deposits (soft soils) in several areas of the study area including the extremities of the floodplain or in localised areas (e.g. wet low lying areas, paleochannels). The Coffey report notes that the extent of soft soils will need to be assessed at much closer intervals if a route over the flood plains is considered (refer Appendix C, p. 13 to this report). It is acknowledged that the issue of soft soils may be a significant project risk for route options that traverse across the floodplains.

As noted in Section 5.2, additional cost estimates undertaken for BC2 indicates that other BC options may be substantially cheaper than combinations of short-listed Section B and Section C options. An assessment of these possible substantial costs savings against project risks does not seem to have been clearly factored in the assessment of Section B/C options and hence there does not seem to be a strong justification for discarding at this stage of the route optimisation process.

6.5 Validation workshop

6.5.1 Process of validation workshop

Following the three day workshop a provisional short list of route options were identified along with issues that required further detailed analysis. A one-day "validation" workshop was held (August 2007) with the same attendees to closer examine the provisional short list and review the findings.

Based on information contained in an internal RTA document (undated) the outcome of the validation workshop was the removal of three options and the inclusion of a new option as detailed below.

Removal of Option C3 (otherwise referred to as Option 3B).

This option was removed on the basis of significant additional land acquisition costs and comparatively poor performance on the local social environment.

Removal of Option B1 (otherwise referred to as Option 2C).

This option was removed on the basis that a route along the eastern side of the railway would have a considerable higher cost than a route on the western side due to acid sulphate and soft soil conditions.

Removal of Option BC2 and BC3 (otherwise referred to as Option 2/3D).

This route was originally considered as two routes either side of the railway line. The route on the eastern side was considered unacceptable consistent with the reasons described above. The route on the western side was also discarded on the basis of its impact on the physical and social environment.

Inclusion of Option B4 (otherwise referred to as Option 2E).

This option was originally discarded on the basis of the need to expose the Eastern Gas Pipeline. However it has since been confirmed that tunnelling under the pipeline was possible. Subsequently the route which included an alignment to the west of the railway line was included.

Based on the three day workshop and the outcomes of the validation workshop, a final score was given to all the options on each objective.

6.5.2 Review and findings

Availability of documentation

Similar to the three-day workshop we have not cited any formal reports or documentation on what was provided to participants going into the validation workshop nor a specific report on the outcomes of the workshop.

However we have reviewed the workshop working-sheets which provide evidence of how the scores were changed. Information on the reasons for discarding three routes and including one new option are also described in an internal document (undated). Based on the information we have reviewed, including the workshop sheets, internal documents and emails, there appears to be reasonable and adequate documentation on the process followed.

Consistency in the rating scores

Appendix A to the RODR represents the combined outcome of the three day workshop and the one day validation workshop. Our review of this document has identified the following issues that require further consideration by the project team:

- The scores do not appear to be applied consistently on all options. For example C5 and C6 were scored differently but had exactly same comments in relation to efficiency and social objectives.
- For some options (refer Appendix D), quantitative information is provided but for some other options on the same objective there is only qualitative information.
- For some options (refer Appendix D), mitigation strategies are identified, but for others there are no mitigation strategies.

Further details are provided in Appendix D.

6.6 Major projects review committee

6.6.1 Process for major projects review committee

The results of the route optimisation process (Appendix A of the RODR) were presented to the RTA MPRC. A concern was raised by the MPRC about the rejection of Option B/C2 (otherwise referred to as 2/3D west or the Brown route) on value for money grounds when a more expensive Section B option B14 (otherwise referred to as Option 2E) had been retained following the validation workshop (see above). In addition, this option was considered potentially desirable as it would form a combined transport corridor (with the existing rail line), and also gave the community a range of options that fully encompassed the study area. Accordingly, the option was recommended for short listing despite its initial lower scoring after the workshops.

6.6.2 Peer review comment and findings

The process for inclusion of this option is considered adequate and appropriate as it would provide the community with a more diverse range of options for consideration. The original rationale for excluding this option was that it would not rate higher than the base case. As previously indicated, the base case for this section was theoretical and we contend that option exclusion on such grounds is problematic.

As discussed in Section 6.2, we believe that the issues considered in the MPRC review of this option could equally apply to other B/C options. For instance, an optimised variation of B/C 4 with a route to the west of the railway line could have also been considered for the same reasons outlined in the MPRC process.

6.7 The displayed short-listed options

6.7.1 Process for display of short-listed options

The final stage of the process to date was to present the short-listed options to the public for comment. To assist interpretation the options were given colour identification. A summary of the displayed options and the relationship to the processes described above is presented in Table 6.2 below.

Table 6.2 History of publicly displayed short listed options

3-DAY WORKSHOP	VALIDATION WORKSHOP	MPRC	PUBLIC DISPLAYED ROUTE
Option A1 (1A)	Option A0	Option A0	Red
Option B1 (2C)	Discarded		
Option B10 (2A)	Option B10 (2A)	Option B10 (2A)	Pink
Option B13 (2B)	Option B13 (2B)	Option B13 (2B)	Green
	Option B14 (2E)	Option B14 (2E)	Yellow
Option C2 (3A)	Option C2 (3A)	Option C2 (3A)	Blue
Option C5 (3C)	Option C5 (3C)	Option C5 (3C)	Orange
Option C3 (3B)	Discarded		
Option BC2 (2/3D)	Discarded	Option BC2 (2/3D)	Brown
Option D1 (4A)	Option D1 (4A)	Option D1 (4A)	Purple

6.7.2 Review and findings

The options presented in the public display material adequately reflect the outcomes of the three day workshop, the validation workshop and the MPRC process. We note that the ratings for each option presented in Appendix A to the RODR were converted from a scale of minus three to plus two to a scale of one to five. In this process the rating for the base case was converted from zero to three.

As noted above the original scoring system was changed for the purposes of public exhibition of the short-listed options. We believe that this change is cosmetic and had no material impact on the route option selection process

6.8 Conclusions

Our review has identified some anomalies with respect to the route optimisation process. In particular the use of an unrealistic/hypothetical base case, and no comparison of the BC section with the combination of Section B and Section C. We believe that the combination of these factors would have reduced the robustness of discarding Section B/C options at this stage of the route optimisation process.

We have also identified a number of discrepancies in reviewing the information provided in Appendix A of the RODR. The consultant has advised that most of these discrepancies can be explained in that information provided at the 3-day and validation workshop was not fully captured into the comments in Appendix A of the RODR. In addition there were some transcribing errors. On review of the comments by the RTA's consultant, we believe that the discrepancies (with the possible exception of the issues relating to value for money) would not have a major impact on the selection of the short-listed options.

7 Summary, conclusions and recommendations

7.1 Summary of key findings

A summary of our findings against the scope of the peer review are as follows:

Validity and comprehensiveness of the adopted project objectives.

We believe that the project objectives are valid and comprehensive.

The appropriateness of the route optimisation process adopted in developing the route options, with the major focus on the area surrounding the township of Berry.

Overall the process and methodology for highway options development and assessment as adopted for this project is broadly consistent with established good practice and has included the appropriate and necessary key elements and steps. It has involved a number of comprehensive workshops and specialist inputs which we believe are sufficient and appropriate for this stage of the route evaluation process.

Based on the information provided, we have identified two key issues:

- The identification of an unrealistic base case and associated compounding complexities in comparing options against it.
- No comparison of Section B/C with the combined impacts of individually assessed Section B and Section C

With respect to individually assessed options in Section C (the area surrounding the township of Berry), we believe that overall, these issues would not necessarily favour or adversely impact on any particular option (ie. would apply equally across all options) and hence is unlikely to result in a fundamental change to the identification of the short-listed options. However, we believe that the combination of these factors has reduced the veracity of the decision to discard Section B/C options at this stage of the route optimisation process.

The validity and consistency of comments and scores recorded in both the route optimisation process and the validation workshop, again focussing on the area surrounding the township of Berry.

Our review has identified some anomalies with the scores recorded in the route optimisation process. Again we do not believe that overall this would materially favour or adversely impact on any particular options given the equal application to options north or south of Berry. The outcome would likely be to rank more options above the base case, but the relativities between the options are unlikely to change significantly.

It is considered that for Section C (as an individual section), the northern options would continue to be ranked as superior to the southern options by an appreciable degree. However, for Section B/C, we believe that elimination of options based on poor value for money (which included an option with a southern bypass of Berry) cannot be supported based on the information reviewed.

The validity of the cost estimates for the displayed route options.

We believe that the estimates of basic cost for the displayed options have been done in great detail. In our opinion, the derived rates for some of the major items such as earthworks and bridges could be different to the current market rates applicable to large scale projects, but the overall difference in the basic estimates would not be significant due to the balancing of the pluses and minuses. We noted that the final P90 values

using @Risk simulations have been carried out in a professional manner and that the resulting contingencies are in the order of 35%, which is at the lower end of the RTA recommended range of 35% – 70% for strategic estimates. We also found that using a different probabilistic distribution for the costs of risks in the risk registers gave P90 figures which translated into contingencies in the order of 50%.

The validity of cost estimates for the discarded Section B, Section C and Section B / C options.

The preliminary construction cost estimates provided at the 3-day workshop stage appear to have been derived from incomplete and in some areas inappropriate (ie. fixed bridge costs) assumptions. This has been rectified at the validation workshop stage with additional cost estimates undertaken for the short-listed options. This has provided some retrospective confidence with the short-listed options; however none included a bypass to the south of Berry.

Using the original 'segment' costs would put the cost estimate of options to the south of Berry within the same relative cost as the options to the north of Berry. However we accept that the accuracy of the original 'segment' costs in this instance is poor particularly in regard to the underestimation of bridge structures (ie. fixed costs per bridge).

Notwithstanding we note that the additional cost estimates undertaken for Option BC2 put it to be some $109M cheaper than the most expensive (but nonetheless short-listed) combination of Section B plus Section C (ie. Yellow plus Blue route) indicating that other BC options may also be cheaper than combinations of the individually short-listed Section B and Section C. We note that the current cost difference based on refinements and consideration of project risk is now $70M. Whilst we acknowledge that a number of significant project risk issues have been identified with the BC options, we believe that an assessment of these risks against the apparent substantial costs savings needs further consideration.

The validation workshop process and outcomes.

The validation workshop is considered adequate and appropriate. However, we would recommend that a more rigorous approach to documentation of inputs and outcomes be implemented for future similar workshops so as to improve the transparency and logic of the process used to make any changes during and post workshop.

The validity of "route reviews" resulting from the RTA's Major Projects Review Committee (MPRC), focussing on the area surrounding the township of Berry.

The route reviews by the RTA appear robust. We note the outcomes of this review have also been consistent with our own review in that it also re-introduced a Section B/C option for short-listing on not dissimilar grounds as identified in our review.

7.2 Conclusions and recommendations

Our review indicates that the overall process and methodology for highway options development and assessment as adopted for this project is broadly consistent with established good practice and has included the appropriate and necessary key elements and steps.

While this overall approach and the methods used are appropriate, there are some aspects that we believe have proved to be of limited value, notably the base case method used for the comparative assessment of options and the judgement relating to definition of sections B and C. We have also identified a number of other technical issues; however we do not believe that individually nor cumulatively these would invalidate the overall process undertaken to date and the identification of the short-listed options.

A number of issues have been identified regarding costs and the associated value for money objective. Notably, the preliminary cost estimates prepared for the 3-day workshop were based on a combination of incomplete segment costs, part subjective estimation and on preliminary project risks. Whilst it is not expected that detailed costs would be undertaken at this stage, more complete and consistent quantitative data to capture relativities of costs would have strengthened the robustness at this stage of the assessment. Whilst this was ultimately rectified with supplementary and complete cost assessments for the validation workshop, it was primarily confined to the short-listed options - none of which considered an option with a bypass to the south of Berry.

We would expect that the costs of any option to the south of Berry is likely to be greater (if not significantly greater) than any northern option given the extent of structures and the associated project risks (ie. flooding during construction, soft soils etc) when considered in isolation of the total project (ie. as an individual Section C option). However this relative cost premium could be reduced when considered as a total project (ie. if combined with an option in Section B).

Whilst we acknowledge that a number of significant project risk issues have been identified with the combined Section BC options as identified, we believe that an assessment of these risks against the potential costs savings compared with the current short-listed options needs further consideration.

To improve the veracity of the short-listing process we would recommend further evaluation be undertaken of a BC option that includes a southern bypass of Berry. We would recommend that more robust cost estimates and project risk identification be undertaken for this option consistent with the assessment undertaken for the short-listed options. Similarly, the overall rating of this option (against the project objectives) should be undertaken by comparing it with the combined impact of the worst but short-listed options in Section B and Section C.

APPENDIX A: Connell Wagner segment costs based on the same methodology used by Maunsell

1. SECTION B

SECTION	Dist.(m)	Pavement Cost	Earthworks	Bridges	Totals
C-E	600	1,200,000	375,617	0	1,575,617
E-G	4,355	8,710,000	2,713,834	800,000	12,223,834
G-H	900	1,800,000	763,256	0	2,563,256
H-J	1,076	2,152,000	912,516	0	3,064,516
J-O(1)	1,487	2,974,000	3,111,520	800,000	6,885,520
J-O(2)	1,978	3,956,000	2,546,186	800,000	7,302,186
O-Q	1,929	3,858,000	3,172,392	0	7,030,392
Q-S	1,600	3,200,000	2,540,369	800,000	6,540,369
C-F	1,198	2,396,000	997,900	800,000	4,193,900
F-I	2,551	5,102,000	9,609,800	0	14,711,800
I-N	2,067	4,134,000	3,737,308	0	7,871,308
N-R	1,300	2,600,000	1,420,779	0	4,020,779
R-S=0.57xN-U	2265	4,529,220	2,475,007	800,000	7,804,227
F-G	1,277	2,554,000	1,924,745	0	4,478,745
H-L	1,668	3,336,000	2,579,772	0	5,915,772
L-N	1,374	2,748,000	2,561,568	0	5,309,568
I-L	878	1,756,000	5,146,032	0	6,902,032
L-P	1,527	3,054,000	4,462,606	0	7,516,606
P-S	2,550	5,100,000	3,332,281	800,000	9,232,281
P-Q	1,269	2,538,000	1,556,834	800,000	4,894,834
H-K	500	1,000,000	2,555,885	0	3,555,885
K-Q	3,070	6,140,000	15,693,133	800,000	22,633,133
H-M	1,580	3,160,000	3,632,311	0	6,792,311
M-Q	2,291	4,582,000	4,494,124	1,600,000	10,676,124
G-M	3,198	6,396,000	8,447,094	0	14,843,094
K-M	1,192	2,384,000	2,740,326	0	5,124,326
D-J	4,355	8,710,000	13,239,526	1,600,000	23,549,526
C-F	1,198	2,396,000	997,900	800,000	4,193,900
F-I	2,551	5,102,000	9,609,800	0	14,711,800
I-L	878	1,756,000	5,146,032		6,902,032
L-Tunnel-P*	1,527	3,054,000	4,462,606	7,000,000	14,516,606

* Tunnel cost assumed $35M/Lane Km and reduced by a factor of 7 , which is derived from the costs of earthworks in long list options & shortlisted options estimates

OPTIONS

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	C-E-G-H-J-O-Q-S	C-F-I-N-R-S (West)	C-F-I-N-R-S (East)	C-F-G-H-L-N-R-S	C-E-G-H-L-N-R-S	C-F-I-L-P-S	C-E-G-H-L-P-Q-S	C-E-G-H-K-Q-S	C-E-G-H-M-Q-S	C-E-G-M-Q-S	C-E-G-H-J-O-Q-S	C-E-G-H-K-M-Q-S	D-J-O-Q-S	C-E-G-H-K-M-Q-S	C-F-I-Tunnel-Q-S (West)	C-F-I-Tunnel-Q-S (East)
C-E	1,575,617				1,575,617		1,575,617	1,575,617	1,575,617	1,575,617	1,575,617	1,575,617		1,575,617		
E-G	12,223,834				12,223,834		12,223,834	12,223,834	12,223,834	12,223,834	12,223,834	12,223,834		12,223,834		
G-H	2,563,256			2,563,256	2,563,256		2,563,256	2,563,256	2,563,256		2,563,256	2,563,256		2,563,256		
H-J	3,064,516										3,064,516					
J-O(1)	6,885,520															
J-O(2)											7,302,186		7,302,186			
O-Q	7,030,392										7,030,392		7,030,392			
Q-S	6,540,369						6,540,369	6,540,369	6,540,369	6,540,369	6,540,369	6,540,369	6,540,369	6,540,369	6,540,369	6,540,369
C-F		4,193,900	4,193,900	4,193,900		4,193,900									4,193,900	4,193,900
F-I		14,711,800	14,711,800			14,711,800									14,711,800	14,711,800
I-N		7,871,308	7,871,308													
N-R		4,020,779	4,020,779	4,020,779	4,020,779											
R-S=0.57xN-U		7,804,227	7,804,227	7,804,227	7,804,227											
F-G				4,478,745												
H-L				5,915,772	5,915,772		5,915,772									
L-N				5,309,568	5,309,568											
I-L						6,902,032										
L-P						7,516,606	7,516,606									
P-S						9,232,281										
P-Q							4,894,834								4,894,834	4,894,834
H-K								3,555,885				3,555,885		3,555,885		
K-Q								22,633,133								
H-M									6,792,311							
M-Q									10,676,124	10,676,124		10,676,124		10,676,124		
G-M										14,843,094						
K-M												5,124,326		5,124,326		
D-J													23,549,526			
C-F																
F-I																
I-L															6,902,032	6,902,032
L-Tunnel-P*															14,516,606	14,516,606
TOTALS	**39,883,504**	**38,602,014**	**38,602,014**	**34,286,248**	**39,413,054**	**42,556,619**	**41,230,289**	**49,092,094**	**40,371,512**	**45,859,038**	**40,300,170**	**42,259,412**	**44,422,473**	**42,259,412**	**51,759,541**	**51,759,541**
TOTALS ($M)	39.9	38.6	38.6	34.3	39.4	42.6	41.2	49.1	40.4	45.9	40.3	42.3	44.4	42.3	51.8	51.8
RANK		2.0	2.0	1.0	2.0	5.0	4.0	8.0	3.0	7.0	3.0	5.0	6.0	5.0	9.0	9.0

2. SECTION C

SECTION	Dist.(m)	Pavement Cost	Earthworks	Bridges	Totals
S-U	576	1,152,000	914,533	0	2,066,533
U-Z1	2,244	4,488,000	3,360,540	800,000	8,648,540
Z1-DD	4,963	9,926,000	6,600,678	1,600,000	18,126,678
U-Z2	2,244	4,488,000	3,360,540	800,000	8,648,540
Z2-BB	3,416	6,831,552	2,875,894	2,400,000	12,107,446
BB-DD	1,022	2,044,000	860,467	800,000	3,704,467
U-Y	2,011	4,022,000	3,794,030	0	7,816,030
Y-BB	3,718	7,436,000	0	0	12,107,446
S-T	846	1,692,000	1,228,169	0	2,920,169
T-W	1,327	2,654,194	1,113,186	0	3,767,379
W-Y	1,079	2,158,000	1,543,864	800,000	4,501,864
U-X	2205	4,410,000	3,049,302	0	7,459,302
X-N Str-BB-DD	4,622	9,244,000	3,383,086	800,000	13,427,086
W-X	654	1,308,000	706,660	800,000	2,814,660
X-AA	1,313	2,626,000	276,800	800,000	3,702,800
AA-BB	2,400	4,800,000	1,782,615	800,000	7,382,615
AA-CC	840	1,680,000	538,960	0	2,218,960
CC-DD	1,979	3,958,000	1,610,296	0	5,568,296
T-V*	600	1,200,000	600,000	0	1,800,000
V-CC*	3,944	7,888,000	3,944,000	0	11,832,000
CC-BB*	1,600	3,200,000	1,600,000	800,000	5,600,000
V-AA* **	3,874	7,748,000	3,874,000	1,600,000	13,222,000

* Used a rate of $1000/m for earthworks, which is approx. average for other sections
** 2 Bridges assumed in this section.

OPTIONS

	0	1	2	3	4	5	6	7	8	9	10	11
	S-U-X-Q Str-BB-DD	S-U-Z1-DD	S-U-Z2-BB-DD	S-U-Y-BB-DD	S-T-W-Y-BB-DD	S-U-X-N Str-BB-DD	S-T-W-X-N Str-BB-DD	S-U-X-AA-BB-DD	S-U-X-AA-CC-DD	S-T-V-CC-BB-DD	S-T-V-CC-DD	S-T-V-AA-CC-BB-DD
S-U	2,066,533	2,066,533	2,066,533	2,066,533		2,066,533		2,066,533	2,066,533			
U-Z1		8,648,540	8,648,540									
Z1-DD		18,126,678										
U-Z2												
Z2-BB												
BB-DD			3,704,467	3,704,467	3,704,467			3,704,467		3,704,467		3,704,467
U-Y				7,816,030								
Y-BB				12,107,446	12,107,446							
S-T					2,920,169		2,920,169			2,920,169	2,920,169	2,920,169
T-W					3,767,379		3,767,379					
W-Y					4,501,864							
U-X	7,459,302					7,459,302		7,459,302	7,459,302			
X-N Str-BB-DD	13,427,086					13,427,086	13,427,086					
W-X												
X-AA								3,702,800	3,702,800			
AA-BB								7,382,615				
AA-CC									2,218,960			2,218,960
CC-DD									5,568,296		5,568,296	
T-V*										1,800,000	1,800,000	1,800,000
V-CC*										11,832,000	11,832,000	
CC-BB*										5,600,000		5,600,000
V-AA* **										0		13,222,000
TOTALS	**22,952,921**	**28,841,751**	**14,419,540**	**25,694,476**	**27,001,325**	**22,952,921**	**20,114,634**	**24,315,717**	**21,015,891**	**25,856,636**	**22,120,465**	**29,465,596**
TOTALS ($M)	23.0	28.8	14.4	25.7	27.0	23.0	20.1	24.3	21.0	25.9	22.1	29.5
RANK	5	8	1	7	8	5	2	6	3	7	4	9

2. SECTION B/C

SECTION	Dist.(m)	Pavement Cost	Earthworks	Bridges	Totals
C-F	1,198	2,396,000	997,900	800,000	4,193,900
F-I	2,551	5,102,000	9,609,800	0	14,711,800
I-N	2,067	4,134,000	3,737,308	0	7,871,308
N-R	1,300	2,600,000	1,420,779	0	4,020,779
R-T	2,108	4,215,484	1,768,001	0	5,983,485
T-W	1,327	2,654,194	1,113,186	0	3,767,379
W-X	654	1,308,000	706,660	800,000	2,814,660
X-N Str-BB-DD)	4,622	9,244,000	3,383,086	800,000	13,427,086
N-V	4,000	8,000,000	2,289,190	0	10,289,190
V-W	874	1,748,000	500,188	0	2,248,188
W-AA*	3,000	6,000,000	1,878,484	0	7,878,484
AA-BB	2,400	4,800,000	1,782,615	800,000	7,382,615
BB-DD	1,022	2,044,000	860,467	0	2,904,467
AA-CC	840	1,680,000	538,960	800,000	3,018,960
CC-DD	1,979	3,958,000	1,610,296	0	5,568,296
V-CC* **	3,944	7,888,000	3,944,000	2,400,000	14,232,000

* Used a rate of $1000/m for earthworks, which is approx. average for other sections
** 3 Bridges assumed in this section.

OPTIONS

	1	2	3	4	5
	C-F-I-N-R-T-W-(X-N Str-BB-DD) (West)	C-F-I-N-V-W-(X-N Str-BB-DD) (West)	C-F-I-N-V-W-(X-N Str-BB-DD) (East)	C-F-I-N-V-W-AA-BB-DD (East)	C-F-I-N-V-CC-DD (East)
C-F	4,193,900	4,193,900	4,193,900	4,193,900	4,193,900
F-I	14,711,800	14,711,800	14,711,800	14,711,800	14,711,800
I-N	7,871,308	7,871,308	7,871,308	7,871,308	7,871,308
N-R	4,020,779				
R-T	5,983,485				
T-W	3,767,379				
W-X	2,814,660	2,814,660	2,814,660		
X-N Str-BB-DD)	13,427,086	13,427,086	13,427,086		
N-V		10,289,190	10,289,190	10,289,190	10,289,190
V-W		2,248,188	2,248,188	2,248,188	
W-AA*				7,878,484	
AA-BB				7,382,615	
BB-DD				2,904,467	
AA-CC					
CC-DD					5,568,296
V-CC* **					14,232,000
TOTALS	**56,790,397**	**55,556,132**	**55,556,132**	**57,479,952**	**56,866,494**
TOTALS ($M)	56.8	55.6	55.6	57.5	56.9

APPENDIX B: Key project risks and supplementary cost estimates provided by Maunsell.

	Connell Wagner identifier	Later short list identifier and revised cost as reported at the validation workshop	Construction and operational risks influencing 'Value for Money' criterion (at Route Options W'shop)	Construction and operational risks influencing 'Value for Money' criterion (at Validation W'shop)	Score reported in RODR App A
Section B	B 00				
	B 01		40% greater than base case. Double the cost of the North Saddle route. Many culverts likely for flood relief adjacent to rail line. Significant soft soil treatment likely adjacent to rail line has capital cost, construction risk, and operational costs and risks. Long section to be constructed off-line before benefit realised. Interation with Eastern Gas Pipeline. Significant length of existing highway remaining for community to fund.	40% greater construction cost than base case.	1
	B02			60% greater construction costs than the base case. Skewed bridge structures required to cross railway line twice in flat terrain. Challenging structures required with significant environmental risk to Crooked River wetlands and Foys Swamp. Many culverts likely for flood relief adjacent to rail line. Significant soft soil treatment likely adjacent to rail line has capital cost, construction risk, and operational costs and risks. Long section to be constructed off-line before benefit realised. Interation with Eastern Gas Pipeline. Significant length of existing highway remaining for community to fund.	0
	B03		Significant length of existing highway remaining for community to fund.		2
	B04		Significant length of existing highway remaining for community to fund.		2
	B05		Need to traverse south saddle (nodes L-P) in cut through EGP. Relocation costs and construction risk / inconvenience associated with EGP considered prohibitive. (Note tunnel on similar alignment considered at Validation W'shop).		0
	B06		Need to traverse south saddle (nodes L-P) in cut through EGP. Relocation costs and construction risk / inconvenience associated with EGP considered prohibitive. (Note tunnel on similar alignment considered at Validation W'shop).		0
	B07		1 km tunnel between K&Q		1
	B08				1
	B09		Deep colluvial soils on side slopes of Toolijooa Ridge. This route climbs the side of the ridge requiring stabilising of land slips.		1
	B 10	Pink $235.71M	Utilises significant amount of existing highway - value for money benefit.	Utilises existing highway as much as possible - benefit in terms of 'value for money'.	3
	B11		Very deep cut (57m) at Willow Vale.		0
	B12				
	B 13	Green $338.11M	Large cut. Slightly more e/works than the base case.	20% greater construction costs than base case.	2 (with tunnel) (1 without tunnel)
	B 14	Yellow $388.06M		50% greater construction costs than base case - largely due to tunnel.	1
	B15			60% greater construction costs than the base case - largely due to poor ground conditions.	0

	Connell Wagner identifier	Later short list identifier and revised cost as reported at the validation workshop	Construction and operational risks influencing 'Value for Money' criterion (at Route Options W'shop)	Construction and operational risks influencing 'Value for Money' criterion (at Validation W'shop)	Score reported in RODR App A
Section C	C 00 (base)				
	C 01		Potential conflict with EGP.		2
	C 02	Blue $156.04M		No significant difference in construction costs compared to the base case.	2
	C 03			12% greater construction costs than base case - influenced by land acquisition.	1
	C 04		More creek crossings. 27m cut between W&Y.		1
	C 05	Orange $154.71M	Utilises significant amount of existing highway - value for money benefit.	No significant difference in construction costs compared to the base case.	4
	C 06		Multiple creek crossings. Section of existing highway remaining for community to fund.		2
	C 07		Two rail crossings. Additional flood relief structures required.		1
	C 08		Two rail crossings. Additional flood relief structures required.		1
	C 09		Additional flood relief structures required. Likely soft soil and acid sulphate soil issues between Broughton Mill Ck and node CC. Two rail crossings.		1
	C 10		Very large bridge to cross Broughton Mill Ck. Two rail crossings. Additional flood relief structures required.		1
	C 11		Two bridges to cross Broughton Mill Ck. Two rail crossings. Additional flood relief structures required.		1
Section B/C	BC 00 (base)				
	BC 01 [when married to X-(NStr)-BB-DD]		Many culverts likely for flood relief adjacent to rail line. Significant soft soil treatment likely adjacent to rail line has capital cost, construction risk, and operational costs and risks. Long section to be constructed off-line before benefit realised. Interation with Eastern Gas Pipeline. Significant length of existing highway remaining for community to fund.		1
	BC 02 [when married to X-(NStr)-BB-DD]	Brown (when later linked to Sect C during Validation W'shop) $435.36M	Many culverts likely for flood relief adjacent to rail line. Significant soft soil treatment likely adjacent to rail line has capital cost, construction risk, and operational costs and risks. Long section to be constructed off-line before benefit realised. Interation with Eastern Gas Pipeline. Significant length of existing highway remaining for community to fund.	12-15% greater construction costs than the base case.	1
	BC 05		Skewed bridge structures required to cross railway line twice in flat terrain. Challenging structures required with significant environmental risk to Crooked River wetlands and Foys Swamp. Many culverts likely for flood relief adjacent to rail line. Significant soft soil treatment likely adjacent to rail line has capital cost, construction risk, and operational costs and risks. Long section to be constructed off-line before benefit realised. Interation with Eastern Gas Pipeline. Significant length of existing highway remaining for community to fund. Two crossings of the rail line. Likely additional flood relief structures. Likely soft soil / acid sulphate soil issues. Two crossings of Broughton Mill Ck.		0

	Connell Wagner identifier	Later short list identifier and revised cost as reported at the validation workshop	Construction and operational risks influencing 'Value for Money' criterion (at Route Options W'shop)	Construction and operational risks influencing 'Value for Money' criterion (at Validation W'shop)	Score reported in RODR App A
	BC04		Skewed bridge structures required to cross railway line twice in flat terrain. Challenging structures required with significant environmental risk to Crooked River wetlands and Foys Swamp. Many culverts likely for flood relief adjacent to rail line. Significant soft soil treatment likely adjacent to rail line has capital cost, construction risk, and operational costs and risks. Long section to be constructed off-line before benefit realised. Interation with Eastern Gas Pipeline. Significant length of existing highway remaining for community to fund. two crossings of the rail line. Likely additional flood relief structures. Likely soft soil / acid sulphate soil issues.		0
	BC 03			60% greater construction costs than the base case - largely due to poor ground conditions.	0

Appendix C: Review of specialist input to the route optimisation process

C1. Approach taken

Chapter 7.0 of the RODR discusses the process undertaken to develop the route options from a "long list" to a "short list". Preparatory assessments were undertaken for each of the "long list" options in order to inform the decision making process at the subsequent Route Options Development Workshop phase. The preparatory assessments focussed on 18 identified specialist investigations categories. The specialist responsible for each investigation category was required to:

- Provide an assessment against the project objectives.
- Identify preliminary "negotiable" and "non-negotiable" issues (refer Section 6.3.2 of this report).
- Identify preliminary discards of route options.
- Identify preliminary route preferences.

This section provides a review of the preparatory assessment process relative in the context of informing the Route Options Development Workshop phase..

C.2 Review of specialist investigation categories

Community and government agency involvement

In considering the extent to which community input informed the selection of the route options "short list", the following documentation has been reviewed:

- Chapter 3 of the *RODR* (2007).
- *Gerringong to Bomaderry Princes Highway Upgrade Consultation Report* (2006).
- The RTA's Gerringong to Bomaderry website.
- Route options development workshop notes.

Seven community engagement objectives for the project are identified in Section 3.1 of the *RODR*, which include the need to "ensure an open, accountable and transparent community engagement process". The community and government agencies have provided input into the route optimisation process via:

- Community information days and workshops at Bomaderry, Berry and Gerringong (May 2006).
- Planning focus meeting (September 2006)
- Interest group workshop (April 2007).
- Meetings with Kiama and Shoalhaven Councils
- Aboriginal Focus Group meetings
- Quarterly release of community updates.
- Media release and ongoing newspaper advertisements.
- Specialist information sessions (August 2007)
- Community contact methods (freecall project information line, project email address, "have your say" forms and letters).
- Project website (approx 3,300 visits since February 2007).
- Display of the "short listed" options (November 2007 to February 2008).

Section 3.11.2 of the RODR indicates that based on contact with the project team, the community can be separated into four specific groups, with by far the largest group being "potentially affected property

owners and occupiers". The five most common issues raised by the community with regard to the route options selection process are identified in Section 3.11.3 of the RODR as:

- Road safety and traffic issues
- Real estate and property values and property acquisition concerns.
- Flooding and drainage issues
- Terrestrial ecology

It is noted that whilst there was no community representation at the Route Options Development Workshop or the "validation" workshop the presence and influence of the specialist consultants (including those preparing the socio-economic impacts report) would be considered a form of community representation.

It is considered that the community involvement process to date, in conjunction with the route optimisation process has been reasonably comprehensive.

Social-economic

Survey or study method

Maunsell prepared a *Preliminary Social Economic Impacts Report* to provide an initial overview of potential social and economic impacts and identification of key social impacts which have been considered during the route optimisation process.

The following tasks were undertaken in preparation of the *Preliminary Social Economic Impacts Report*:

- A desk-top study of maps, photographs, and other relevant data sources including previous studies and Australian Bureau of Statistics 2001 census data.
- Review and summary of demographic profile at strategic and study area levels.
- Review and summary of economic activity along the route.
- A number of site inspections along the route.
- Community and stakeholder consultation.

The report identifies the following limitations to the report, including:

- Latest census data is now five years old. New data expected to be released post publication of the RODR.
- Impact assessment can not be completed or mitigation measures identified at this route selection stage.

The report discusses the social economic profile of the wider area local government area as well as the more specific study area, outlines community assets in the study area, summarises the social and economic impacts raised in the previous studies and categorises and assesses the various potential social and economic impacts relating to the highway upgrade.

The *Preliminary Social Economic Impacts Report* recognises the various potential positive social impacts (in particular those related to safety, tourism, employment and economic development) associated with the project. The negative social economic impacts, however, are the focus of the report as they can then be adequately addressed during the ongoing / future design processes.

Survey results

The report discusses in detail various demographic aspects related to SEIFA index figures for both Kiama and Shoalhaven LGAs for a number of key variables including social-economic advantage / disadvantage, economic resources and education / occupation.

Population, employment type household structure and income levels are identified for the three major towns within the study area (Gerringong, Berry and Bomaderry), which indicate that the social-economic profile of the northern (centred on Gerringong) and central (centred on Berry) sub-areas differ from the southern (Bomaderry) sub-area. This is also reflected in an analysis of the business types within the study area, which found that many of the business located in the Gerringong and Berry areas are focussed on supporting the tourism industry as well as the second home and retirement markets, whereas, an assessment of the Bomaderry list of businesses revealed a higher proportion of manufacturing and blue collar type employment activities.

From a review of previous route options studies in the area, a broad range of social economic impacts have been consistently identified, including visual amenity, property impacts, rural lifestyle/ amenity, pollution / air quality and operational impacts.

The report indicates that it is critical to understand how the route options perform in regard to the following issues, which have the potential to change the structure of the community and the manner in which it may respond to the project:

- Community identity and interaction.
- Amenity impacts.
- Road related impacts.
- Economic (local and regional).
- Community and special social group needs.
- Impacts of acquisition.

The considerations required to address the key potential social impacts during the route selection process (listed above) are discussed in Table 8.1 of the *Preliminary Social Economic Impacts Report*. It is recognised in the report that some of the project considerations will be conflicting in their suggested outcomes. The key objective of the proposed upgrade of this section of the Princes Highway is for it to be developed in a way that is ecologically sustainable and achieves the optimum balance of community, environmental, engineering and economic interests.

Application to route optimisation process

Social economic issues cover many if not all of the project objectives considered within the route options workshop process and are influenced in some way by either the economic and / or social impacts of the various route options at a local or regional level.

From a review of comments provided in Appendix A to the RODR for Section C and Section B/C route options, it is considered that the social and economic issues identified within the *Preliminary Social Economic Impacts Report* have been applied to all options.

Flooding and drainage

Survey or study method

A *Preliminary Flooding and Drainage Report* was prepared by Maunsell as Appendix K to the RODR. It includes an assessment of both surface water and groundwater. The surface water assessment focuses on preliminary drainage impacts, floodwater extent, water depths and potential flood impacts and

constraints associated with route options. The groundwater assessment local and regional hydrogeology, including groundwater abstraction and identifies constraints and risks of groundwater conditions on road construction and long term stability.

The level of detail of the report was considered by Maunsell to provide sufficient input to the route options development process only, with more detailed assessment such as flood inundation periods and velocities to be undertaken for the concept design of the preferred route. With regard to groundwater, the report indicates that from the limited piezometric data and variable stratigraphy of the study area it is not possible to accurately determine groundwater divides and aquifer geometry and that additional boreholes, piezometers and monitoring would be required once the preferred route is selected to better define groundwater conditions.

The report identifies the various main drainage watercourses and floodplain areas within the study area, and provides a summary of available information on these areas through a review of available literature. It is not stated whether anything other than a literature review has been undertaken for this report.

Preliminary flooding and drainage assessments were undertaken for the critical 1 in 100 year Annual Recurrence Interval (ARI) event for the major watercourse crossings within the study area. Flooding and drainage investigation of the existing historical flood patterns and assessment of the proposed routes was undertaken to develop an understanding of the potential impact of the route option alignments. Additional flood modelling (using the one-dimensional steady HEC-RAS model program) was undertaken where flood data was required to complete the study.

The report notes an ongoing review to ascertain what allowances if any, need to be made to cater for global warming and climate change. The report notes that there is potential for further flooding and hydrological analysis based on changes to criteria for sea level and rainfall frequency and intensity.

Survey results

As a result of the study, preliminary flood extent and levels were produced for the 1 in 100 year ARI event. This preliminary information was used when determining preliminary road embankment levels and watercourses crossing requirements for the route options.

With regard to flooding, and focussing on Section C, the report indicates that crossing Broughton Creek to the south of Berry would require bridge structures and culverts between 600m and 2500m in length, depending on the crossing location. To the north of Berry, Broughton Mill Creek and Bundewallah Creek are relatively narrow and well defined, requiring bridge lengths typically between 60m and 120m, and/or culverts.

Groundwater considerations for Section C include low probability acid sulphate soils and soft soils to the south and east of Berry, following the southern floodplain of Broughton Creek. This area also has a relatively shallow water table and is considered as a likely groundwater discharge area.

Application to route optimisation process

The 1 in 100 year ARI event levels were included on relevant constraints mapping. The report results indicate that there would be an increased need for bridge structures within areas influenced by the 1 in 100 year ARI event.

Concentrating on the consideration of flooding and drainage for Section C and Section B/C route options, commentary regarding the number of creek crossings required by a route option is common. With regard to the “value for money” objective, it would appear that this comment contributes negatively to the “score”. Whether this comment contributes positively or negatively to the “score” when identified

in the “enhance potential beneficial environmental effects and manage potential adverse environmental impacts” objective, and whether it relates to flooding and drainage or aquatic and / or terrestrial habitat is unclear.

For route options C5, C6, BC1, BC2 and BC3, it is noted in commentary in Appendix A to the RODR that the route provides an opportunity to mitigate some of the flooding through Berry. This comment is related to route options that pass along North Street and is applicable to the “support economic and regional development” project objective.

For route options C9, C10 and C11, the need for flood mitigation is identified as a factor in allocating these options with a low score (one) for the “provide value for money” project objective.

It is not evident to what extent the assessment has considered climate change and associated sea level rises. It is important that this be addressed in the next stage of the assessment.

Urban and visual landscape

Survey or study method

EDAW AECOM undertook a landscape constraints analysis of the study area to assist in the route options development process. The method used for the analysis included the evaluation of three main factors influencing the likely landscape, being land cover, slope and visibility. By combining these three factors in a geographical information system, a broad picture can be gained of the likely visual impact of the road at any point in the study area. These three factors were then considered in the context of the cultural and landscape setting to inform the urban and regional design strategy.

The method for identifying visual constraints is discussed in Section 3.5 of the report and indicates that numerical values were assigned to the each of the component constraint levels (land cover, slop, visibility), then combined to produce an overall “visual constraint value”.

It is noted that a specific “Princess Highway Urban Design Framework” does not yet exist; however objectives outlined in the preliminary urban and regional design strategy are derived from and are closely aligned with the RTA’s overall philosophy and policies towards urban design published in the *Beyond the Pavement* series.

The urban design objectives specifically tailored to the project are seen to apply at the route options development stage insofar as they relate to the potential location of the upgraded highway.

Survey results

- Landscape constraints analysis

The report discusses the landscape and built form context of the study area, with particular emphasis on the NSW South Coast having a constant interaction of ocean and beach, rocky headland, costal plain and escarpment and mountain ranges and the existing highway being an “experience and element that is layered into this landscape”.

The report indicates that the largest human influence on the landscape within the study area has been the agricultural practices that have occurred since European settlement. Much of the study area has been heavily cleared and utilised for agricultural purposes, mainly grazing. The report also identifies the rural backdrop, waterways and forested hills as key landscape elements.

Cultural landscape elements are discussed, which focuses on an overview of the towns of Gerringong, Berry and Bomaderry, their “structure” and relationship with the existing highway alignment. The

existing road user journey is also discussed, identified as an important reference point against which the route options and ultimately the preferred highway upgrade option are assessed.

The landscape constraints analysis is represented graphically in Figure 3.4 of the *Preliminary Urban and Regional Design Strategy*. In summary, the report indicates that the highest level of constraint is associated with the steeper forested parts of the study area, while the urban areas of Berry and the edges of Gerringong and Bomaderry are also of high constraint due largely to the sensitivity of the land use. The lowest levels of landscape constraint are identified as occurring in relatively flat rural areas.

- Urban design framework

A specific framework has been developed for the project based on the principles of the RTA's document *Beyond the Pavement*. This framework comprises a series of objectives and principles, identified in Chapter 4 of the report, that reflect the particular requirements of the project. The objectives seek to develop an upgraded highway that meets functional and engineering criteria in addition to respecting the environment in which it is situated. The objectives that make up the urban and regional design framework for the upgrade are:

- Provide a flowing highway alignment that is responsive and integrated with the natural landscape.
- Protect the natural systems and ecology of the corridor.
- Protect and enhance the heritage and cultural values of the corridor.
- Respect the communities and towns along the highway.
- Provide an enjoyable, interesting highway with strong visual connections to the Pacific Ocean, immediate hinterland, and mountains to the west.

Application to route optimisation process

Urban and landscape design issues were considered within two project objectives, "optimise the benefits and minimise adverse impacts on local social environment" and to a lesser extent "support regional and local economic development". All route options within Section C of the study area included the comment "impact of the route on the rural character of the area" for the "optimise the benefits and minimise adverse impacts on local social environment" project objective..

Other comments relating to urban and landscape design for Section C route options as presented in Appendix A to the RODR include "high visual impact and removal of connectivity between landscape forms" (routes C5, C6, C8 and C11). This comment is seen to relate to routes along North Street (routes C5 and C6) or routes immediately to the south of Berry (route C8 and C11). The opportunity for a bridge structure immediately east of Berry forming a "landmark, gateway to Berry" is identified route options C5 and C6; however they are also identified as having a high visual impact. This comment applies similarly to routes BC1, BC2 and BC3.

Commentary for all Section B/C options is interpreted as negative with regard to urban and landscape issues, most of which focus on the township of Berry. Comments include significant visual impacts and removing the connection between Berry and the landscape. Routes BC1, BC2 and BC3 score "significantly worse" than the base case, which implied that the visual impacts would be worse than a theoretical upgrade of the existing highway to four lanes through Berry itself.

Overall, it is considered that the information provided within Appendix C to the RODR is generally reflected within the comments included in Appendix A of the RODR. The consistency of application of these issues to the scoring against objectives can not be commented upon as there is no information available regarding criteria upon which each project objective was scored.

Aboriginal and European heritage

Survey or study method

Navin Officer Heritage Consultants (Navin Officer) were engaged to identify the potential for Aboriginal and European heritage items and areas within the study area to assist the process of selecting a preferred route option for the project. The heritage assessment was identified as preliminary only and was focussed on literature and heritage database reviews, reviewing maps of known sites, and provision of a predictive model for Aboriginal and European heritage sites within the area.

Fieldwork was limited to reconnaissance inspections of selected areas within the broad study area only. The report notes that no attempt at systematic or comprehensive survey was attempted and no new Aboriginal sites were recorded as a result of the reconnaissance inspections; however some potential European archaeological deposits were recorded.

Survey results

- Aboriginal heritage

The report indicates that there are four places of known or reported historical and cultural Aboriginal significance and 22 recorded Aboriginal archaeological sites (identified from previous studies) within the study area. Most of these sites were identified as a result of assessment work done for the eastern gas pipeline.

A predictive model of potential Aboriginal archaeological sites within the study area is provided in Section 5.4 of the report which identifies riparian corridors within the study are as of high archaeological sensitivity. Lower lying areas including the estuary and wetland margins are considered of moderate archaeological sensitivity, while spurs and ridgelines are considered to have a low to moderate level of sensitivity.

- European heritage

Section 6.2 of the report indicates that after removal of duplications from the various heritage registers and schedules, there is a total of 34 historical heritage items in the vicinity of the study area. The report goes on to state that due to the paucity of detailed information contained in several of the heritage schedules, the findings of this desktop review need to be confirmed through contact with the relevant organisations and, as necessary, ground truthing in the field.

In addition to the 34 historical heritage items recorded on statutory and non-statutory heritage schedules, 142 items were identified in the *Shoalhaven City Council Heritage Study 1995-1998* as being within the study area and as warranting heritage recognition. Approximately eighty five percent of those are within, or in the immediate vicinity of, the Berry Town precinct and are identified as having local heritage significance. Approximately five percent are identified as of regional heritage significance and approximately ten percent are *Provisional Listings* that require further research to verify their level of heritage significance.

Kiama Municipal Council, in its draft LEP amendment for heritage items, has identified fourteen additional items to the 34 identified on formal heritage registers or schedules. All of these fourteen items have been identified as of local heritage significance.

Section 6.3 of the report discusses potential European archaeological sites within the study area. It sates that no potential archaeological historical heritage places within the Gerringong to Bomaderry study area have been identified. It also notes that as with above ground historical heritage places there is expected to be a considerable number of such below ground archaeological sites/deposits within the study area.

Application to route optimisation process

The key areas assessed as part of the review of Aboriginal and European Heritage were the area surrounding the township of Berry and the riparian corridors within the study area. These were identified as the most sensitive area for European and Aboriginal heritage respectively.

With regard to Section C of the study area, route options that pass though node 'X' and / or close to Berry itself are identified in the workshop findings included in Appendix A of the RODR as impacting on European heritage items / areas. It is difficult however, to ascertain the level of influence the impact has on the overall score for the project objective ("enhance potential beneficial environmental effects and manage potential adverse environmental impacts").as there are many other environmental factors that contribute to the scoring.

From a review of the workshop findings in Appendix A to the RODR it is considered that the level of heritage significance seems to be considered and that "indicatively" the scoring generally reflects the combined impact to a heritage item with the identified heritage significance of that same item.

Given the generally "desktop" level of assessment undertaken, generally only areas of high heritage sensitivity have been identified and considered in the relevant route option discussions (ie. Pullman Street area for 'node X' and the state heritage listed Berry train station for 'node AA').

Land use and property impacts

Survey or study method

- Land use

The *Preliminary Land Use Issues Report* has been prepared based on a number of different data sets and includes a site inspection and review of:

- Aerial photography.
- Internet directories.
- Agricultural land classifications.
- GIS data provided by Kiama and Shoalhaven Councils, MapData and Maunsell Pty Ltd.
- Gerringong to Bomaderry Planning Focus Meeting.
- *State Infrastructure Strategy 2006-2007 to 2015-2016*.
- *South Coast Regional Strategy* and *Illawarra Regional Strategy*.
- Other Council plans and strategies.

Land ownership information was verified by comparing the Department of Lands data with information provided by councils, with any discrepancies verified by the RTA Property Services. The report indicates that where particularly sensitive issues arise during the route selection process, the land use data will be ground-truthed, including (as necessary) contact with the land owner(s), and/or tenants.

The report identified various State, Regional and Local settlement and development strategies and provided an overview of each. Planned and future land uses were discussed at the Planning Focus Meeting with the Department of Planning and Kiama and Shoalhaven Councils present.

It is noted in the report that due to the size of the study area, once a preferred route is selected, the individual ownerships within or near any route will be considered in more detail.

- Property impacts

A *Preliminary Property Impacts Report* (Appendix O to the RODR) was developed based on the short listed route options only. The report clarifies the definition of directly versus indirectly affected properties

and the issues likely to be of concern for owners affected by either of these property impact types. Management measures are discussed broadly in reference to the two property impact types (direct or indirect impact) and reference is briefly made to the property acquisition process.

Survey results

- Land ownership

Land ownership maps were developed as part of the report and it is noted in Section 4.2 of the report that land ownership places constraints on the potential for some lands to be developed as part of the upgrade. Constraints identified include impacts to productive agricultural land, reduction in the size of land holdings such that they could not be sub-divided and the acquisition of "urban land".

Land ownership was identified as a key issue for route selection at Toolijooa (numerous medium and small land holdings and varied boundary alignments), along the railway line (as an opportunity – an existing corridor with a relatively straight and flat alignment) and in urban areas.

- Agriculture

Agriculture is the predominant land use in the study area, in terms of land area. In addition to traditional agricultural uses, the study area includes horticultural activities and alternative uses of agricultural land, including for organic farming and vineyards. Potential impacts to agriculture include fragmentation of productive agricultural land and a reduction in land resource values associated with severance of property and "highway edge effects".

- Rural living and commerce

"Rural living and commerce" refers to non-agricultural land uses in rural land areas. Such uses include rural residential dwellings, hotels / motels, retail, bed and breakfast accommodation and other similar land uses. Attractions for guests in bed and breakfasts include the scenery and the serenity while visual exposure and easy access are key economic drivers for motels / hotels.

Rural residential development comprises low density or isolated rural dwellings. Rural dwellings are generally scattered throughout the study area with little or no clustering. Key issues in relation to rural residential dwellings include impact on lifestyle and setting, property acquisition, increased noise and vibration (contributing to reduced amenity), visual impacts and access.

- Tourism

The report indicates that tourism is an economic asset for the region. The study area is particularly popular for weekend trips for tourists from Sydney and that tourism is playing an increasingly important role in the region.

- Future development

Of note within the report is the identification the *Huntingdale Estate and Graham Park Land Release Area* and *The Arbour, Berry Retirement (seniors living) Development* as two significant residential developments in the vicinity of Berry, both of which have current development consent from Shoalhaven City Council. The report subsequently states that "because these two large parcels of land are subject to existing development consent for subdivision, there is limited potential for establishing a new alignment for the Princes Highway to the south-west of Berry".

The report also considers the following other land uses within the study area:

- Community uses - particular reference made to the David Berry Hospital.
- Open spaces - playgrounds, showgrounds and sportsgrounds.
- Commercial / industrial - key commercial centres in the region are in the Berry town centre, Old Creamery Lane and on the Princes Highway in Bomaderry.
- Infrastructure - Utilities (including the Eastern Gas Pipeline and Sydney to Melbourne fibre optic cable), South Coast railway line and existing roads.

Application to route optimisation process

- Land use

The key areas assessed as part of the review of land use included the area surrounding the township of Berry. A variety of land use aspects have been looked at through the workshop process and with regard to Section C of the study area, route options have varying influences depending on land use type.

The issue of land use has been primarily considered and scored against the "support regional and local development" objective. Route option C1 scores a zero or "non-negotiable" for this project objective with comments perceived to have a heavy weighting towards land use issues. Impacts of route option C1 were identified as including property severance (including to a vineyard), impacting on a planned residential estate (the *Huntingdale Estate and Graham Park Land Release Area*) and not being consistent with local and state planning policies and planned urban development. The impact to the residential estate is assumed as the non negotiable issue here. If so, this is consistent with the information provided in Appendix M to the RODR.

There are some minor inconsistencies identified with regard to property severance and impacts to property boundaries as a result of route options. An example is route option C2 where the comment with regard to property severance includes a note that the alignment generally matches property boundaries ("score" of 4), however Section 8.3.3.3 of the RODR states that "for much of its length, the Blue route does not match existing property boundaries, which increases the impacts of severance caused by land acquisition". From the limited information available it must be assumed that commentary as stated within Appendix A to the RODR is accurate.

Overall, it is considered that the information provided within Appendix M to the RODR is reflected within the comments included in Appendix A of the RODR. The consistency of application of these issues to the scoring against objectives can not be commented upon as there is no information available regarding criteria upon which each project objective was scored.

- Property impacts

The report focuses on the seven short listed options only, identifying the number of potentially directly and indirectly affected properties "by route option" (Refer Appendix B to the *Preliminary Property Impacts Report*).

Comments in Appendix A to the RODR for Section C route options identify property severance and the minimisation of property acquisition within the "support regional and local economic development" objective. It is unclaer whether this relates to private properties, agricultural properties or both. Further, from a review of available information it can only be assumed that the level of detail provided in the *Preliminary Property Impacts Report* was also available for consideration at the workshop for other long list options.

Noise and vibration

Survey or study method

Bassett Consulting Engineers were engaged to identify, in a general sense, the relative impact of upgraded or new roads in various localities within the study area and to integrate noise assessment and mitigation into the route options development process. The *Preliminary Traffic Noise and Vibration Assessment Report* indicates that the assessment was carried out in accordance with and reference to the Department of Environment and Climate Change (DECC) document *Environmental Criteria for Road Traffic Noise* (ECRTN).

Based on a lack of design at the long list stage, the *Preliminary Traffic Noise and Vibration Assessment Report* identifies that it is only possible to conduct an indicative assessment of potential impacts, including:

- A review of existing information to assess potential high noise impacts.
- Identify locations that may require a level of noise mitigation to be incorporated into the design.
- Conduct a desktop assessment of long list route options.
- Provide general, study area-wide noise management recommendations with regard to preferred offset distances or other mitigation measures to meet ECRTN noise goals for new roads.

Unattended noise monitoring using automated noise loggers was carried out at eleven locations within the study area between 8 February and 19 February 2007. Short term attended monitoring (using a hand held noise monitoring device) was also conducted and a description of the acoustic environment at each location was documented. Noise monitoring locations were selected so as to enable the characterisation of the currently experienced noise environment across the whole study area, in locations both near the existing Princes Highway and in areas that are distant from the existing road.

Classified traffic volume counting was undertaken concurrently to the noise monitoring (12 to 28 February 2007) by an independent consultant to assist with the verification and calibration of the noise model.

Noise levels were calculated at each receiver for the entire study area using SoundPLAN software, which implements the Calculation of Road Traffic Noise (CoRTN) algorithm.

The *Preliminary Traffic Noise and Vibration Assessment Report* identifies statutory criteria (noise goals) relevant to the project and also discusses “perceptual impact” at receivers (the perceived increase or decrease in noise levels) where the change in distance between the existing route and the proposed route is calculated and then correlated with the subjective change in noise levels.

Survey results

The *Preliminary Traffic Noise and Vibration Assessment Report* indicates that without considering noise mitigation measures such as shielding, the minimum offset distance was calculated to be approximately 250m between “new” roads and residential receivers (which can be reduced substantially with the introduction of noise mitigation measures).

The report then identifies that for rural locations the perceived impact of a new route may be significantly higher than an upgrade of an existing route and that from a noise perspective a new route in a rural area, away from the existing alignment, would only be beneficial overall if a significant number of receivers experience an individual benefit.

With regard to Berry as an urban example, the report states that a bypass of a township may provide a significant enough benefit to a large enough number of residences within that town, to outweigh potential detrimental affects of noise increases in the rural areas.

The report notes that noise mitigation measures will be investigated in detail once the preferred route has been identified and the location of potentially affected receivers is known.

Application to route optimisation process

This review focuses on the noise related comments to Section C and Section B/C route options in Appendix A to the RODR. Noise issues have been allocated to the "optimise the benefits and minimise adverse impacts on local social environment" project objective. It is noted that commentary relating to noise levels is presented in terms of a percentage reduction or increase (or no change) in noise levels compared to the base case, which is more a quantitative consideration than for other specialist investigation categories. However it was not possible to ascertain from the available documentation how these percentage increases or decreases were calculated.

Noise levels are not discussed for option C4. No noise improvement is identified for options C5 and C6, and further discussion is included for these options regarding the requirement for "well designed noise walls". There is no mention of requirements for well designed noise walls for any other Section C route options. An improvement in noise levels is identified for route options C8, C9, C10 and C11 (which pass to the south of Berry), although the percent improvement is not identified.

For Section B/C options, commentary relating to noise for all options is limited to "the route runs through an area which currently is not affected by significant road noise" and / or "no improvement in noise levels and well designed noise mitigation measures will be required".

From the information available, the extent of influence noise has had on the scoring of both the Section C and Section B/C route options is unclear. Notwithstanding this point, it is considered that the noise issue has been applied reasonably consistently to all route options (noting the quantification of the change in noise for route options C1 to C3 only).

Terrestrial ecology

Survey or study method

Biosis Research Pty. Limited (Biosis) were engaged to investigate potential terrestrial flora and fauna issues to assist the process of selecting a preferred route option for the project. Section 3.1 of Appendix G to the RODR indicated that the study involved the following three key stages:

- Desktop study involved gathering and reviewing existing information.
- Field surveys (at 31 sites) consisting of 100.5 hours of flora survey effort, 33 hours of fauna survey effort and 533 equivalent trap nights was undertaken to ground-truth information obtained during the desktop examination and to gather additional data from parts of the study area selected for further investigation.
- Assessment of the relative conservation significance of areas across the study area informed by constraints mapping. The conservation significance of flora and fauna within the study area was primarily assessed according to Commonwealth (EPBC Act) and NSW (TSC Act) legislation.

The following limitations were recognised in the development of the Biosis report:

- Field investigations for this study were carried out over a single sampling period.
- Site access issues including limitations imposed by land owners on survey techniques or survey times and duration or, in some cases, a refusal of access.

It is recognised that the report provides a "snapshot" of the species present within the study area due to the single survey effort; however the survey method is considered sufficiently robust to inform the route optimisation process.

Survey results

Fifteen plant communities were identified within the study area. None of those plant communities form part of an EPBC Act listed Endangered Ecological Community (EEC). Seven of the fifteen plant communities form part of an EEC listed on the TSC Act. Three threatened flora species were recorded in the study area and ten threatened plant species were identified as have potential habitat within the study area.

Fauna habitat was discussed based on the results of survey efforts at the 31 survey sites and indicated that across the study area habitat quality varied from poor to good. Ten threatened fauna species were recorded within the study area during the survey. The threatened species identified are highly mobile and have large home-ranges (ie. bat and bird species).

No areas of critical habitat for flora or fauna have been declared within the study area under either the EPBC Act or TSC Act. Also of importance is the presence of habitat corridors, with the potential corridor vegetation along Broughton Creek and Toolijooa ridge defined as of very high conservation significance by Biosis.

Application to route optimisation process

The key area assessed as part of this review was the area of very high conservation significance along Broughton Creek and Toolijooa ridge. This area is located within Section B and section options that passed through this area were G-M-Q, H-M-Q and H-K-M-Q (route options B8, B9, B11).

The workshop findings included in Appendix A of the RODR indicate that any option that passed through this area was discarded based a "non negotiable" score of zero for the "*enhance potential beneficial environmental effects and manage potential adverse environmental impacts*" project objective. The exception to the above was route option B13 (the green route) that was developed to include a tunnel instead of a large cut through this area.

The key survey results identified within the Biosis report are considered to have been applied consistently throughout the route optimisation workshop process and reflect the information provided within the specialist report by Biosis.

Ground conditions

Survey or study method

Coffey geotechnics (Coffey) were commissioned to carry out geotechnical investigations and was also asked to provide preliminary acid sulphate soil and preliminary contamination assessments of the study area. A subsurface investigation program was undertaken to characterise the subsurface conditions over a range of terrain types within the study area. The subsurface investigation comprised borehole drilling (20), electric piezocone probes (15), test pits (30), piezometer installation in boreholes (11), soils sampling and laboratory testing. A review of other subsurface investigations was also undertaken.

The majority of the test pits, boreholes and piezocones were positioned in road reserves either adjacent to the Princes Highway or in laneways off the highway. Test locations on private property occurred mainly in the low lying areas in order to gain subsurface information for route options developed for these areas.

It is noted that the ground condition report identifies some limitations to the investigation. Coffey identify that:

- The study area has experienced long periods of dry weather and groundwater and soil moisture levels are considered to be generally lower across the region than results indicate.
- Access problems such as soft ground conditions for drilling rigs.
- Localised flooding during investigation works.

Coffey indicated that the above limitations resulted in some areas that potentially contain deposits of soft, compressible soils could not be tested.

From a review of the borehole, test pit and piezone site plan it is noted that there was one borehole (5%), one test pit (3%) and one piezone test (7%) undertaken in the area south of Berry.

Survey results

Given the wide spacing between test holes and the complexity of floodplain depositional sequences and the bedrock stratigraphic units, Coffey anticipates that future investigations would identify a more complex arrangement of geotechnical units.

Section 6.3 of the Coffey report discusses the various soil units identified within the study area and provides an indication of their distribution. Estuarine, alluvial, colluvial and residual soil units are identified as present within the study area. Reference to Figure 6.1 of the Coffey report indicates that alluvial and estuarine soil units dominate the area south of Berry.

A review of piezometer results indicated that wells positioned on the elevated ridgelines had standing groundwater occurring at depths between 3.3m and 7.0m below ground surface with slow groundwater recharge rates. The piezometers on lower ridgelines had standing groundwater at depths between 3.5m and 4.5m below the ground surface with continuous recharge. The piezometers on the alluvial floodplains and low lying estuarine floodplains recorded groundwater levels of between 0.4m and 2.5m below the ground surface with continuous rates of recharge at most locations.

Deep soft soils may occur in the extremities of the floodplain within the study area or in localised areas (e.g. wet low lying areas, paleochannels). The location of these soft soil deposits is shown generally in Figure 5.2a, Figure 8.1 and Figure 8.2 of Appendix B to the RODR. In Figure 8.1, areas mapped as 'high risk areas' for encountering acid sulphate soil on this map are generally indicative of areas underlain by soft, compressible soils. In Figure 8.2, these risk areas have been correlated with an approximate thickness of soft soil. The Coffey report notes that the extent of soft soils will need to be assessed at much closer intervals if a route over the flood plains is considered.

Areas identified as having a high risk of encountering soft, potentially compressible soil deposits relevant to Section C and Section B/C includes:

- The Crooked River floodplain, east of Toolijooa Road, south of the current Princes Highway and southwest of Gerringong.
- The Broughton Creek floodplain east of Berry, and
- The Shoalhaven River / Broughton Creek floodplain, between Berry and Bomaderry (generally lying to the south or east of the current South Coast railway line).

In relation to bank stability, the presence of soft soils relates directly to the allowable height of embankments. Coffey indicate that in areas where the estuarine soils are essentially encountered at or very close to the current ground surface, embankment height would be limited to less than two metres.

Coffey further state that staged construction of embankments over soft soils should be considered to avoid stability issues.

Settlement analyses have been performed for embankments constructed on an assumed soil stratigraphy for a range of soft soil thicknesses. Coffey indicate that soft soils are most likely to be encountered in 'high risk' acid sulphate soil areas and also note that only a relatively small proportion of the total study area (estimated as less than 5% to 10%) is assessed to be potentially underlain by significant thicknesses (greater than one metre) of soft, compressible soils.

Tunnelling options have been identified for some route options and the Coffey report indicates that (with the limited data available at this stage) it is not possible to determine if a tunnel would be located in the Kiama tuff or Berry formation geological unit. Notwithstanding, the report indicates that both rock types are high strength with widely spaced jointing and are considered suitable for tunnelling.

Application to route optimisation process

The key areas assessed as part of this review were those of high and low risk acid sulphate soils (as identified in Figure 5.1 of the RODR) and the areas of approximated soft soils as identified in Figure 8.2 of Appendix B to the RODR. From review of these figures the areas of risk relative to Acid Sulphate Soils (and therefore soft soils) are the low lying areas of Toolijooa (along the South Coast Railway) and to a lesser extent those areas to the south of Berry.

The low lying areas of Toolijooa are located within Section B and section options that pass through this area typically include C-F-I-N-R-S (route options B1 to B5, B14 and B15). The workshop findings included in Appendix A of the RODR indicate that route options B1 to B5, B14 and B15 score poorly (between zero and two) for "value for money" with comments for all including reference to construction staging requirements and a potential negative impact on program due to soft soil treatments.

Further analysis indicates that any option passing through C-F-I scores a one (significantly worse than base case) or a zero (non-negotiable - discard) for value for money. It is noted that for route options that pass through C-F-I (B1, B2, B5, B14 and B15) there is no reference to high risk Acid Sulphate Soils (which are identified in the Coffey report as indicators of soft soils).

There are five Section C route options that pass to the south of Berry (C7 to C11). Route option C11 is the only option of the five passing south of Berry where soft soils are referenced and this option scores a one for the value for money objective.

The key results identified within the Coffey report are considered to have been applied consistently throughout the route optimisation workshop process and generally reflect the information provided within the specialist report by Coffey.

Traffic and road safety

Survey or study method

A *Preliminary Traffic Assessment Report* has been prepared as part of the route options development process and is included as Appendix D to the RODR. Initially the various strategic and reference documents reviewed as part of preparation of the report are identified and discussed, including:

- *Princes Highway safety review.*
- *State infrastructure strategy: NSW 2006-07 to 2015-16.*
- *Illawarra regional strategy.*
- *Draft South Coast regional strategy: 2006-31.*

The *Preliminary Traffic Assessment Report* reviews the current local and regional traffic and transport conditions, analyses and reports on crash data for the existing route and considers future traffic conditions and traffic forecasts. The information provided has been presented as a result of a detailed assessment of existing traffic data and additional traffic surveys (classified turning counts at key intersections and origin-destination (OD) surveys) undertaken during February 2007. The location of these surveys is identified in Figure 6.1 of the *Preliminary Traffic Assessment Report.*

Future traffic conditions were assessed using TRACKS, a strategic transport modelling package.

Survey results

The report identifies the existing highway within the study area as primarily one lane in each direction with a number of winding sections and limited overtaking opportunities. Discussion of existing highway conditions focuses on key intersections (all except two within the study area are "uncontrolled" or "priority"), speed limits (existing speed limit of the highway varies significantly) and overtaking opportunities (eight within the study area).

The report discusses existing traffic volumes, identifying daily and seasonal variations in traffic volumes as well as averaged travel speeds at various points within the study area. The level of service (LoS) of intersections is identified, which highlights that the LoS at all intersections identified is 'C' or 'D' using both 2003 annual average daily traffic (AADT) volumes and predicted 2007 AADT volumes.

The report identifies the traffic accident history of the existing highway and discusses crash rates per kilometre and crash costs. It also indicates that the Princes Highway is experiencing an approximate growth of 3.0 per cent per annum based on the change in land use within the region.

Application to route optimisation process

- Traffic and transport

Section 8.1 of the *Preliminary Traffic Assessment Report* indicates that the following traffic and transport objectives and criteria were discussed during the route optimisation workshop process:

- Improve road safety and safety of town accesses.
- Improve travel time between Wollongong and Nowra.
- Ability to accommodate 25-metre B-double trucks.
- Ability to provide interchanges near Berry and Gerringong.
- Provide controlled access.

Analysis of the comments provided to Section C route options in Appendix A to the RODR indicates that "route specific" consideration has been given to traffic and transport factors, albeit qualitative rather than quantitative consideration. Travel time has been considered as a function of route length and / or provision of a higher speed environment. A reduction in congestion and elimination of pedestrian conflicts through Berry has been identified for all options as no alignments pass through the town. There does not appear to be any differentiators relating to traffic and transport considerations for Section C route alignments.

The application of scores relating to the "improve road safety" and "improve efficiency of the Princes Highway between Gerringong and Bomaderry" project objectives is considered to be consistent and is concluded not to be a determining factor in the determination of the short listed route options.

- Road safety audit

A road safety audit (Appendix R to the RODR) was carried out on the short listed route options only. As such that report has no direct influence on the selection of the short listed options and is therefore not considered further here.

C.3 Conclusions

It is recognised that the extent of specialist studies has been essentially desk-top with selected site specific investigations on sensitive issues. This approach is considered applicable and consistent with the extent of studies typically undertaken at this stage of the route evaluation process. Whilst there have been some inconsistency in the application of some of the specialist findings the key results appear to have been applied reasonably consistently throughout the route optimisation workshop process and adequately reflect the information provided within the specialist report.

APPENDIX D: Potential issues identified in the rating tables in Appendix A of the Route Options Development Report

The discussion below is based on our review of information as provided in the *Route Options Workshop Findings* (Appendix A of the *Route Options Development Report*) with respect to Section C and B/C. It compares the comments as provided in the Tables with the rating/scores.

It does not attempt to review issues as identified/assessed but rather the process and the consistency of the application and logic. For example we have assumed that all comments as stated are correct.

D.1 Workshop worksheets

We have reviewed the scores on the workshop worksheets and compared them with the final scoring table and make the following observations.

Section C

A number of the scores identified at the worksheet were "refined as part of the overall review and sanity check". Whilst the transparency of the process would be assisted with information that accounts for these changes, we have reviewed these refinements and conclude that they do not materially affect the final short-listing outcomes.

We have not been able to access a workshop worksheet relating to Option C11.

There is an mathematical error in the summation of the scores for Option C2 (Blue route). The actual score is reflected in the final rating tables and therefore has no impact on the decision making process.

Section B/C

A number of the B/C options assessed at the workshop appear to stop east of Berry and therefore would appear as incomplete options for this Section. Other B/C options include sections west of Berry so it is unclear how these options were compared consistently.

We have not been able to access workshop worksheets for Options BC2, BC4 or BC5. Notes accompanying the final tables imply that these options were a result of refinement of "Route 3". We have been unable to locate a definition of Route 3.

The most notable issue is that the workshop worksheets (3-day and validation) do not identify a "non-negotiable" on the value for money objective for any Section B/C option, however three of the B/C Options were discarded on this basis according to Appendix A of the RODR. This rationale requires review and explanation.

D.2 Possible scoring issues

Section C

Relevant project objective: *Improved Road Safety*

OPTION	ISSUE
C5	Note additional comment about eliminating traffic through Berry identified. It is presumed this applies equally to ALL options.
C6	Unclear why C6 scores lower than others- C9 also has an 8% grade between node S and T but scores a '5'. No other differences identified

OPTION	ISSUE
C7	Refers to straighter road? How does minimum horizontal radius compare Not clear why grade separated crossing of rail relates to road safety issue.
C9	Rates as a 5, yet has issues which appear to be worse than most others. Note appears to be the same as C11 which scores a 4.
C11	Appears same as C9/C10 but scores 4.

Relevant project objective: Efficiency

OPTION	ISSUE
C4	Scores lower than C1-C3 on the basis of the term "longer". A more quantitative assessment would have assist in this decision to lower score.
C5	The term "slightly longer" used. But scores higher than C4.
C6	Exact same comments as C5 but score lower.
C7	New term "no significant difference". Unclear how this compares to "longer" or "slightly longer" as described for other options.
C9	Route is "longer" unclear as to how much.
C10	Route is "longer" unclear as to how much.
C11	Route is "longer" unclear as to how much but appears to be shorter than C9/C10.

Relevant project objective: Local/regional impact

OPTION	ISSUE
C1-C11	The base case is for 4 lanes through the township of Berry. Whilst it is acknowledged that this is theoretical only, the methodology adopted is to compare all options with the base case. In this case it is difficult to accept that any other option could be worse than the base case on the local/regional economy than having 4 lanes through the town.
C1	Score of "0". The impact on the "planned residential estate" appears a dominating influence. It is assumed therefore that the "residential estate" is a "non-negotiable".
C2	Comment with regard to property severance includes a note that the alignment generally matches property boundaries ("score" of 4), however Section 8.3.3.3 of the RODR states that "for much of its length, the Blue route does not match existing property boundaries, which increases the impacts of severance caused by land acquisition
C4	Score of "1" appears low based on the comments provided. Comments say "does not support rural/farming" – but unclear whether others do support.
C5	Comments refer to many positive attributes – unclear whether positives also apply to other options. Appears to distinguish itself better than others but with no deduction for any impacts.
C6	Apart from impact on some "smaller lots" appears to be at least as good as C5 and yet rates significantly lower than C5 (note C5 also impacts on "smaller lots").

Relevant project objective: Value for money

OPTION	ISSUE
C2	Appears to be better than C1 but scores the same.
C3	Introduces % to base criteria -not used for all other options. Refers to land acquisition costs twice.

OPTION	ISSUE
C5	No comparison with the base case. Term "cost effective" used not clear how this has been determined. Was it the cheapest?? No other option refers to cost effectiveness.
C6	No comparison with the base case. Appears similar to C5 but rates 2 points lower. Very low score seems inconsistent with comments. Difference appears to be cost of bridge structure over Broughton Mill Creek, but this also applies to C5 which scored much higher.
C7/C8	Comments imply better than C9-C11 but scores the same.

Relevant project objective: Environmental

OPTION	ISSUE
C1	Exact same "comments" as C2 but scores lower. Appears better than C7 which has same score.
C2	Appears from comments to be the best but not reflected in the scoring.
C5	Appears from comments to have greater impacts than C1 to C3 particularly on heritage matters yet scores the same. Note also no improvement to air quality.

Relevant project objective: Social

OPTION	ISSUE
C1-C11	The base case is for 4 lanes through the township of Berry. Whilst it is acknowledged that this is theoretical only, the methodology adopted is to compare all options with the base case. In this case it is difficult to accept that any other option could be worse than the base case on the issue of social impacts than having 4 lanes through the town. In particular the noise and air pollution issues, community amenity and severance of Berry would be considered to be potentially substantial.
C3	Comments appear to be the same if not more positive than C1/C2 but rates lower.
C4	Noise impact not specified but is specified on other options. Question whether issue of "perception" is valid for a technical assessment.
C5	Refers to mitigation measures – no other options have similar comments. Overall comments appear less positive than C1-C3 yet rates equal or better.
C6	Exactly the same comments as C5 but scores 2 instead of 4.
C9-C11	All have exactly the same comments but score 3, 2, and 3 respectively.
C10	See C9-C11.

Section B/C

Relevant project objective: Local/regional impact

OPTION	ISSUE
BC4/BC5	Not clear in the comments what distinguishes these apart.

Relevant project objective: *Value for money*

OPTION	ISSUE
BC3/4/5	Use of unrealistic base case is considered problematic at this stage in discarding these options without more quantitative support.

Relevant project objective: *Environmental*

OPTION	ISSUE
BC2	"Comments" appear similar if not better than BC1 but scores lower.
BC5	"Comments" appear similar if not better than BC1 but scores lower.

D.3 Summary

We have noted a number of discrepancies in reviewing the information provided in Appendix A of the RODR. The consultant has advised that most of these discrepancies can be explained due to information provided at the workshop that was not fully captured into the comments in Appendix A of the RODR. In addition there were some transcribing errors. On review of the comments by the RTA's consultant, we believe that the discrepancies would not have a major impact on the selection of the short-listed options.