PACIFIC HIGHWAY PLANNING STUDY BETWEEN NARARA AND LISAROW

MULTI CRITERIA ANALYSIS WORKSHOP REPORT

NOVEMBER 2012
Pacific Highway Narara to Lisarow route selection
Background

Roads and Maritime Services (RMS) has investigated route options to identify the best performing route for the Pacific Highway between Narara and Lisarow. This is the fourth and final stage of an overall strategy to upgrade the Pacific Highway between the F3 Freeway at Ourimbah and Narara.

Four route options were short-listed and have been publically displayed in March, April and May of 2012 for community comment.

As part of the planning study, RMS has completed a Route Options Summary Report (ROSR) outlining the investigations undertaken to that date and the process by which the four viable route options were selected.

As part of the consultation process RMS undertook a number of staffed displays and community meetings to provide information to the community to assist in making comment.

From 9,000 Community Update brochures distributed to letterboxes within the study area, RMS received approximately 350 community feedback forms from residents, local businesses and local government agencies. This represents an approximate 4% return rate.

A Value Management Workshop (VMW) was undertaken on 18 and 19 July 2012. The VMW was an independently facilitated workshop and identified by a small margin the Red route Option (A+X) as being the highest ranked option, taking into account the weighting and criteria as they were developed during that workshop.

Following on from the VMW RMS undertook a technical workshop and this report is the outcome of that workshop.
Workshop Participants

The technical workshop was held on 21 August 2012 at the Ettalong Beach War Memorial Club.

Participants at the workshop were as follows:

Joel Rosendahl  Contract Project Manager *(Bowditch Consulting)*  
Craig Leckie  RMS Network Manager  
Glenn Weymer  RMS Central Coast Manager  
Adam Hillard  Contract Lead Designer *(Hillard Civil)*  
Paul Tansi  RMS Project Management Office – Facilitator  
Suresh Surendran  RMS Senior Project Development Manager  
Colin Nunn  RMS Manager Development, North  
Terry Gibbs  RMS Project Services Manager  
Renae Martin  RMS Senior Environmental Officer  
Tom McKenna  RMS Manager Technical Projects  
Carolyn Donnelly  RMS Environmental Officer  
Greg Jackson  RMS Urban Designer  
Geoff Russell  RMS Geotechnical Scientist  
Ron Cunningham  RMS Communications & Business Support Manager  
Hayley Kelman  RMS Communications Officer  
Steve Grey  WMA Water – Flooding Specialist  
Scott Linton  RMS Graduate – Development  
Jai Reddy  RMS Project Development Manager
**Scope of Project**

The scope of the project is defined as a route planning study being Stage 4 of the Pacific Highway upgrade between Narara Creek Road, Narara and Ourimbah Street, Lisarow. Stage 3 runs between Glen Street, Ourimbah and Ourimbah Street, Lisarow and is currently in the detailed design phase.

Fifteen initial route options were identified that could potentially meet the project objectives of improved safety for motorists, cyclists and pedestrians, increased traffic capacity, accessibility, minimising impacts and providing value for money. The Route Options Summary Report (ROSR – March 2012) details all these items and describes the analysis undertaken to assess each of them, and ultimately shortlist four viable options.

The project generally follows the main northern railway corridor, through the Narara Valley. There is a large floodplain in the southern section of the study area, Narara Valley Flood Plain which all options will be required to cross. The route currently crosses the main northern railway at two locations – and these crossings will be required in each of the four viable options.

The four options generally follow two corridors, being:

- The existing Pacific Highway corridor on the eastern side of the Main Northern Railway, and;

- The Narara Valley corridor (includes the Local Environmental Planning corridor) on the western side of the Main Northern Railway along Narara Valley.

Each corridor contains two options, and these are shown in the diagrams below.
Comparison of Narara Valley Corridor Route Options

Note: Some route options have sections that follow the same alignment, where this occurs the colours overlap.

KEY
- RED OPTION
- LIGHT BLUE OPTION
- STATE ROAD
- OTHER KEY ROAD
- MAIN NORTHERN RAILWAY
- RAILWAY STATION
- STUDY AREA

Options use the zone 5(d) listed road corridor in council plans

Manne Road/Pacific Highway major intersection treatment

Railway Crescent/ Pacific Highway major intersection treatment

For more information visit www.rms.nsw.gov.au

Pacific Highway Narara to Lisarow route selection
All options have been strategically costed between $490 million and $575 million. Specifically, the two existing highway corridor options; Pink and Grey are $500 million and $490 million respectively – while the two Narara Valley Corridor options; Red and Blue are strategically costed at $575 million and $515 million respectively. It should be noted that during subsequent phases when more information is obtained these costs would ultimately alter.
Workshop Methodology

The workshop is a collaboration of technical expert inputs into a process with the view to identify the best performing option.

The process involves determining appropriate criteria, using the project objectives as reference, to differentiate between options. A weighted pairs comparison was then used to weight each of these criteria in order of significance.

Each option is then scored against each of these criteria (using a scale between 1 and 7). This score is then multiplied against the weighting, and a weighted score allocated. The weighted scores are then summed, and the option with the highest total score is the highest ranked option.

This score was then divided by the total project estimate for each option, which gives a value ratio. The project with the highest ratio is then deemed as the best performing option.

A Monte-Carlo simulation was also used as a sensitivity analysis to test where the criterion score was not completely agreed upon by the group. The Monte-Carlo simulation enables a range to be given for an individual score, and the simulation produces a result that shows how often each option was ranked highest. This gives greater confidence in the results.

Details on Monte-Carlo simulation can be found at: http://www.palisade.com/risk/monte_carlo_simulation.asp
Information Presentations

Presentations (by the relevant technical experts) were delivered on the specialist investigations undertaken for the route options planning study. Some of these investigations were a combination of earlier assessments previously undertaken by Hyder Consulting (originally contracted to assess strategic alignments) and more recent studies undertaken by various technical contractors to RMS.

A brief description of each of the presentations is given below. The full presentations are attached as Appendix A to this report. There were some presentations that were not delivered due to that criterion not receiving any weighting, as they did not discern between route options (Capacity for local network, Property Impact, Flooding Impact), however, they have been included in this report for information.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>Described the nature and extent of traffic congestion for the existing Pacific Highway during peak periods, and the growth anticipated into the future. The need for traffic capacity increase was confirmed through this presentation.</td>
</tr>
<tr>
<td>Noise</td>
<td>Described the Wilkinson Murray P/L simplified method - which allowed quantitative comparison of the exposure of developments to road traffic noise in order to satisfy RMS requirements. The results of this method were presented.</td>
</tr>
<tr>
<td>Environment</td>
<td>The topics of landscape, soil, waterways, connectivity, threatened flora and fauna, significant species, trees and potential contamination were discussed during this presentation.</td>
</tr>
<tr>
<td>Accessibility</td>
<td>This presentation outlined the benefits and/or dis-benefits for each of the four options by way of looking closely at average distance travelled along the current alignment vs. each of the potential alignments for particular trip catchment areas along each route option</td>
</tr>
<tr>
<td>Property Impact</td>
<td>A description of the numbers of potentially whole and partially affected properties for each of the four route options was provided (as shown in the March 2012 Community Update)</td>
</tr>
<tr>
<td>Flooding Impact</td>
<td>A description of how the design is to provide no worsening of flood conditions was provided. The number of additional houses affected was used as the defining measure – and according to the flooding expert – the difference between all four options was minimal.</td>
</tr>
<tr>
<td>Business Impact</td>
<td>This presentation outlined the results from the RMS commissioned Business Impact</td>
</tr>
<tr>
<td><strong>Social Impact – Severance and Cohesion</strong></td>
<td>Assessment – which concludes that options on the existing Pacific Highway were beneficial for local businesses and jobs, and the options on the west options had negative impacts to businesses and jobs.</td>
</tr>
<tr>
<td><strong>Community &amp; VMW</strong></td>
<td>This presentation outlined the results from the RMS commissioned Social Impact Assessment. It outlines some of the results and conclusion that were found in this report.</td>
</tr>
<tr>
<td><strong>Community &amp; VMW</strong></td>
<td>This presentation outlined the process RMS undertook with regard to the community input and outlines the results of the feedback received.</td>
</tr>
</tbody>
</table>
Evaluation of Options

Evaluation Criteria

Prior to the workshop the project team developed a list of criteria that was understood to represent the project objectives and, in addition, allow differentiation between the options (based on the technical studies undertaken).

It was noted that, although safety is unanimously recognised as being of high importance, all options are designed to the relevant Australian Standard (AUSTROAD and RMS Road Design Guide) and consequently there was thought to be no distinguishable or significantly measurable difference between the options with regard to safety. As such, safety was not used as an evaluation criterion.

The Criteria presented were:

Maximise the CAPACITY of the through road network

Maximise the CAPACITY of the through road network

Typically related to operational capacity: by using VHT (vehicle hours travelled), this is a measure of capacity of the network

After all the evaluation criteria were presented and the definitions defined, the workshop as a group questioned whether this criterion should be used to differentiate between options. The discussion centred on the issue of: if all options meet a 20 year design life – and the difference between the options is what is to be measured – this criterion would consistently be ranked lower than all the other criteria, and hence should not be used. After much discussion – and the fact that all options were similar anyway – it was decided not to continue using this criterion.

Greater ACCESSIBILITY for the local road network

Estimated distance and number of trips required to serve each 'local precinct' and compare to the existing situation to identify the difference in vehicle kilometres of travel

Minimise impact on the natural ENVIRONMENT

Assess for each option how much Ecologically Endangered Community (EEC) it will disturb or divide: Determine if the option would potentially disturb / remove any threatened Fauna

Minimise Traffic NOISE

Determine which option has the least likelihood of noise impact on surrounding land uses

Pacific Highway Narara to Lisarow route selection
<table>
<thead>
<tr>
<th><strong>Reduce SEVERANCE and Increase Cohesion</strong></th>
<th>Using the Social Impact Assessment, determine which option has the least severance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reduce PROPERTY Impact</strong></td>
<td>Number of total acquisitions as a result of both the road footprint and flooding</td>
</tr>
<tr>
<td><strong>Reduce BUSINESS Impact</strong></td>
<td>Using the Business Impact Assessment, we can determine which options have the least impact on businesses</td>
</tr>
<tr>
<td><strong>Greater Benefits from STAGING</strong></td>
<td>The ability to gain tangible traffic improvements after each individual construction stage</td>
</tr>
<tr>
<td><strong>Ease of CONSTRUCTION under traffic</strong></td>
<td>Ease of construction under live traffic; including aspects of geotechnical risk</td>
</tr>
<tr>
<td><strong>VMW &amp; Community Consultation</strong></td>
<td>Results of VMW Community Consultation undertaken to date</td>
</tr>
</tbody>
</table>

The participants then discussed at length the merit of including the VMW and community consultation activities as criteria in this workshop.

The question raised was: to include VMW and community consultation as criteria and rank them (also, the question of how to weight it appropriately was raised); or to keep them entirely separate from this workshop (leave it as a stand alone assessment) and present the results of each the VMW and the Technical Workshop to the Major Project Review Committee?

It was decided to keep the two workshops separate. The group acknowledged there would be the possibility that the two workshops could yield different results. If this were the case, the differences would need to be summarised and reported before presenting one option (the best performing option) to the Major Projects Review Committee for recommendation to the NSW Minister for Roads and Ports.
Weighting Criteria – Weighted Pairs

Weighted pairs, (or paired comparison) process is a technique used to work out relative importance for different criteria. The project team, prior to the workshop undertook a weighted pairs assessment based on 10 criteria which they had chosen as being project objective related; and this was presented to the workshop participants. The rankings from that original assessment are summarised below and the actual table can be found in Appendix B.

The group then had some discussion and debated the merits of each of the criteria.

As a result of the group discussion, the following weightings were accepted.

<table>
<thead>
<tr>
<th>CRITERION</th>
<th>WEIGHTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater Accessibility for Locals</td>
<td>8%</td>
</tr>
<tr>
<td>Less Environmental Impact</td>
<td>23%</td>
</tr>
<tr>
<td>Less Traffic Noise</td>
<td>15%</td>
</tr>
<tr>
<td>Less Urban Severance</td>
<td>12%</td>
</tr>
<tr>
<td>Less Property Impact</td>
<td>0%</td>
</tr>
<tr>
<td>Less Business Impact</td>
<td>19%</td>
</tr>
<tr>
<td>Greater Benefits from Staging</td>
<td>19%</td>
</tr>
<tr>
<td>Less Disturbance during Construction</td>
<td>4%</td>
</tr>
</tbody>
</table>

It was identified that property impact was not weighted higher than any of the criterion shown, and ultimately the weighting resulted in 0%. This means that the property impact would not be used in the rankings.

Ranking the Options: without cost

Each option was ranked without using cost as a criteria – this is to ensure that all options are scored on their respective merit rather than have cost influence the decision.

A rating between 1 and 7 was used to rank each option. The scale used is shown in the table below.

<table>
<thead>
<tr>
<th>Rating level</th>
<th>Rating Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly beneficial (HB)</td>
<td>7</td>
<td>Major positive impacts resulting in substantial and long-term improvements or enhancements of the existing environment.</td>
</tr>
<tr>
<td>Moderately beneficial (MB)</td>
<td>6</td>
<td>Moderate positive impact, possibly of short-, medium- or longer-term duration. Positive outcome may be in terms of new opportunities and outcomes of enhancement or improvement.</td>
</tr>
</tbody>
</table>
Slightly beneficial (SB) 5 Minimal positive impact, possibly only lasting over the short-term. May be confined to a limited area.

Neutral (N) 4 Neutral—no discernible or predicted positive or negative impact.

Slightly detrimental (SD) 3 Minimal negative impact, probably short-term, able to be managed or mitigated, and will not cause substantial detrimental effects. May be confined to a small area.

Moderately detrimental (MD) 2 Moderate negative impact. Impacts may be short-, medium- or long-term and impacts will most likely respond to management actions.

Highly detrimental (HD) 1 Major negative impacts with serious, long-term and possibly irreversible effects leading to serious damage, degradation or deterioration of the physical, economic or social environment. Requires a major re-scope of concept, design, location, justification, or requires major commitment to extensive management strategies to mitigate the effect.

Each score was then multiplied by the relevant weighting to give a weighted score for each criterion. The weighted scores for each option were then summed to give a total weighted score.

The scores are shown in the table below.

<table>
<thead>
<tr>
<th>CRITERION</th>
<th>Weighting %</th>
<th>RED</th>
<th>BLUE</th>
<th>PINK</th>
<th>GREY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximise ACCESSIBILITY</td>
<td>8</td>
<td>3</td>
<td>4.5</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>Minimise ENVIRONMENT</td>
<td>23</td>
<td>1.25</td>
<td>3.25</td>
<td>2.25</td>
<td>1</td>
</tr>
<tr>
<td>Minimise TRAFFIC NOISE</td>
<td>15</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Reduce SEVERANCE</td>
<td>12</td>
<td>4</td>
<td>3.5</td>
<td>2.5</td>
<td>2.75</td>
</tr>
<tr>
<td>Reduce BUSINESS IMPACT</td>
<td>19</td>
<td>2.5</td>
<td>2.5</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Greater BENEFITS from STAGING</td>
<td>19</td>
<td>2.5</td>
<td>3.25</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Ease of CONSTRUCTION</td>
<td>4</td>
<td>4.5</td>
<td>4.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>TOTAL WEIGHTED SCORE</td>
<td></td>
<td>2.66</td>
<td>3.33</td>
<td>3.53</td>
<td>2.68</td>
</tr>
</tbody>
</table>

The workshop identified that the Pink option (existing Pacific Highway and Manns Road) as being the highest ranked option.

Monte Carlo simulation enables a range to be given instead of a fixed score for each option. This provides a sensitivity analysis.
The following is a definition of what the Monte Carlo simulation is and how it works.

“Monte Carlo simulation performs sensitivity analysis by building models of possible results by substituting a range of values—a probability distribution— for any factor that has inherent uncertainty. It then calculates results over and over, each time using a different set of random values from the probability functions. Depending upon the number of uncertainties and the ranges specified for them, a Monte Carlo simulation could involve thousands or tens of thousands of recalculations before it is complete. Monte Carlo simulation produces distributions of possible outcome values.”

(Reference: http://www.palisade.com/risk/monte_carlo_simulation.asp)

The results of the Monte Carlo assessment are summarised below.

<table>
<thead>
<tr>
<th>Option</th>
<th>Ranking</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+X</td>
<td></td>
<td>0%</td>
<td>0%</td>
<td>46%</td>
<td>54%</td>
</tr>
<tr>
<td>A+Z</td>
<td></td>
<td>6%</td>
<td>94%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>B+Z</td>
<td></td>
<td>94%</td>
<td>6%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>B+Y</td>
<td></td>
<td>0%</td>
<td>0%</td>
<td>54%</td>
<td>46%</td>
</tr>
</tbody>
</table>

This outcome means that 94% of the time the Pink option was ranked highest, and 6% of the time the Blue option was ranked highest. This gives confidence that the highest ranked option based on the criteria developed, is the Pink option.
Ranking the Options: including cost

In order to identify the best performing option, the results needed to be tested and normalised for cost.

The cost for each option has been estimated, based on the strategic concept designs. These estimates are as follows:

<table>
<thead>
<tr>
<th>OPTION</th>
<th>RED</th>
<th>BLUE</th>
<th>PINK</th>
<th>GREY</th>
</tr>
</thead>
<tbody>
<tr>
<td>STRATEGIC COST</td>
<td>$575m</td>
<td>$515m</td>
<td>$500m</td>
<td>$490M</td>
</tr>
</tbody>
</table>

To gain a meaningful comparison, the total weighted score (from above) was then divided by corresponding strategic cost estimate. This gives a value ratio, which ultimately identified the best performing option.

The result is shown in the table below.

<table>
<thead>
<tr>
<th>Option</th>
<th>MCA Result</th>
<th>EST in 2011$M</th>
<th>Final Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED</td>
<td>2.66</td>
<td>575</td>
<td>4.63</td>
</tr>
<tr>
<td>BLUE</td>
<td>3.33</td>
<td>515</td>
<td>6.46</td>
</tr>
<tr>
<td>PINK</td>
<td>3.53</td>
<td>500</td>
<td>7.01</td>
</tr>
<tr>
<td>GREY</td>
<td>2.68</td>
<td>490</td>
<td>5.47</td>
</tr>
</tbody>
</table>

The Pink option has been identified as the best performing option from this assessment.
Sensitivity Analysis

Based on the evidence presented, and discussion with relevant internal technical experts, it was the consensus of participants that the Pink option (existing Pacific Highway/Manns Road alignment) was the best performing option.

The two major elements that were instrumental in the final result were the ability to obtain tangible traffic benefits early through affordable and fundable staging and environmental factors.

A question was raised about the sensitivity of the staging costs (we understood this to be if the funding dollars of any stage or stages was removed as a possible constraint). As shown, the weighting for this criterion was 19% which was equal second highest with business impact. (Environment was highest at 23%).

However as a sensitivity test, the weightings have been re-run with changing the Greater benefits from staging (Staging) weighting ranging from 19% down to 0% and then comparing the result with and without the project cost included.

Without project cost considered; for 0% staging weighting (i.e. totally ignoring staging improvements as an issue), the blue option has a slightly higher score than the pink option. The tipping point is when the Staging weighting is 7.5% then the scores for Blue and Pink options are the same.

When project cost is considered; for 0% Staging weighting the Blue and Pink options are equal, and with any % over 0% for Staging weighting, the pink option (B+Z) increasingly ranks higher than the blue option (A+Z).

Conclusion

From the technical workshop and considering all available data, the Pink option was identified as the best performing option.
SKM were contracted to undertake Paramics modelling for each of the four viable route options.

The 2011 peak hour simulation results demonstrated that the current road network in the study area can accommodate the traffic flows in the AM peak and the introduction of the upgrade options increased the overall delays and queues in the network. This increase is a result of the increased number of signalised intersections on major corridors in the study area. However, in the PM peak the upgrade options operated more efficiently than the PM peak base model. This is because greater congestion is currently experienced in the PM peak in the study area and therefore the introduction of the signalised intersections decreases the average delays and queues in the network.
## VHT

<table>
<thead>
<tr>
<th>Model</th>
<th>2031 AM Peak</th>
<th>2031 PM Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VKT</td>
<td>VHT</td>
</tr>
<tr>
<td>Base Network</td>
<td>66,401</td>
<td>1,771</td>
</tr>
<tr>
<td>B+Y (Dark Grey)</td>
<td>68,024</td>
<td>1,437</td>
</tr>
<tr>
<td>A+Z (Light Blue)</td>
<td>67,248</td>
<td>1,436</td>
</tr>
<tr>
<td>B+Z (Pink)</td>
<td>67,725</td>
<td>1,429</td>
</tr>
<tr>
<td>A+X (Red)</td>
<td>68,429</td>
<td>1,396</td>
</tr>
</tbody>
</table>

From the above results, the road network within the study is expected to operate more efficiently than the 2031 base models. Based on the VKT and VHT results, the A+X (Red) option performs marginally better in the 2031 AM and PM peak periods.
### Table 24 – 2031 PM Peak Travel Times

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Base</th>
<th>B+Y</th>
<th>A+Z</th>
<th>B+Z</th>
<th>A+X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manns Road South</td>
<td>Pacific Highway North</td>
<td>NA</td>
<td>10:11</td>
<td>10:21</td>
<td>10:21</td>
<td>08:49</td>
</tr>
<tr>
<td>Pacific Highway North</td>
<td>Manns Road South</td>
<td>NA</td>
<td>11:22</td>
<td>09:27</td>
<td>10:59</td>
<td>08:19</td>
</tr>
</tbody>
</table>
AZ (Light Blue Option)

Precinct 5 – Ourimbah Street

<table>
<thead>
<tr>
<th>Precincts</th>
<th>Properties</th>
<th>Existing</th>
<th>Option</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>to Ourimbah Street</td>
<td>3504</td>
<td>3505</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>from 1969</td>
<td>1969</td>
<td>1969</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>to Brooks Avenue</td>
<td>3504</td>
<td>3505</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>from 2800</td>
<td>2800</td>
<td>2800</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>to Narara Creek Road</td>
<td>2800</td>
<td>2800</td>
<td>0</td>
</tr>
</tbody>
</table>
Averaged Travel Increase/Decrease per Household

- AX (Red): 680
- AZ (L Blue): -176
- BY (Grey): 2105
- BZ (Pink): 601
Pacific Hwy upgrade Stage 4
Narara to Lisarow
Environmental Considerations
Topics

- Physical Landscape
  - catchment / soil / waterways / habitat connectivity
- Threatened Flora
- Threatened Fauna
- Regionally Significant Species
- Mature trees
- Potential Land/Water Contamination
Physical Landscape

• The study area is a mosaic of urban, light industrial and commercial development with areas of disturbed and remnant vegetation.

• The landscape within the study area comprises gently undulating alluvial plans to slightly steeper foothills and slopes intersected with wetlands and streams.

• The broader landscape picture shows a general pattern of developed valleys and floodplains surrounded by vegetated hills. A significant amount of these vegetated areas are protected as conservation areas and state forest.

• This is an ecologically diverse landscape comprising a wide variety of landscape features, including hills, ridges, valleys, alluvial floodplains, creeks, streams, and freshwater wetlands which in turn support a variety of vegetation types along with a diversity of plants and animals.
Surrounding Landscape
Waterways and Wetlands

SEPP 14

Narara Creek and tributaries

Source: Cardno, Lawson, Teloar 2008, Brisbane Water Estuary Processes Study

Brisbane Water Catchment boundary

SEPP 14 wetlands

Source: Cardno, Lawson, Teloar 2008, Brisbane Water Estuary Processes Study
Narara Creek

Narara Creek was determined by ecologist undertaking PEA as a Class 1 Waterway

Waterway Class description

Class 1
Major fish habitat. Major permanently or intermittently flowing waterway, habitat of a threatened fish species.

Class 2
Moderate fish habitat. Named permanent or intermittent stream, creek or waterway with clearly defined bed and banks with semi - permanent to permanent waters in pools or in connected wetland areas. Marine or freshwater aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area.

Class 3
Minimal fish habitat. Named or unnamed waterway with intermittent flow and potential refuge, breeding or feeding areas for some aquatic fauna. Semi - permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or recognised aquatic habitats.

The presence of significant riparian and in-stream vegetation and habitats within the Project Area, particularly Narara Creek and its tributaries is likely to support a range of aquatic flora and fauna including fish, freshwater turtles and invertebrates.
Soil Landscape

Source: Murphy C.L. 1992 Soil Landscapes of the Gosford-Lake Macquarie
Soils Landscape

• Erina Soil Landscape (er)
  – Constraints - High soil erosion hazard, seasonal waterlogging, strongly acid soils, localised mass movement (slumping)
  – Topography - gentle to moderate slopes <25%, foothills, ridges, broad crests and narrow valleys

• Yarramalong Soil Landscape (ya)
  – Constraints – flooding, seasonal waterlogging, stream bank erosion
  – Topography – level to gently undulating, slope <3%, broad dissected alluvial plains, highly active landscape such as meanders, terraces, oxbows and back swamps.
Vegetation (PEA)

Figure 2 Vegetation Communities (Source: Gosford City Council)
Endangered Ecological Communities as described in original PEA
Recent Study by PB

• **Southern section** – bounded by Deane Street in North and Reeves Street in the south, Manns Road in the east and approximately 100 m north of Hanlan Street.

• **Northern section** – area adjacent to rail corridor. Bounded by Koninderie Parade to the north.
Updated Vegetation Survey of Preferred Option
Southern Section

Threatened Communities:
- Alluvial Blue Gum Forest
- Swamp Mahogany Paperbark Forest
- Alluvial Paperbark Sedge Forest
  (green / orange / dark yellow)

Listed under TSC Act as Endangered:
- River-Flat Forest on Coastal Floodplains (20.44 ha)
- Swamp Sclerophyll Forest on Coastal Floodplains (3.96 ha)

Non-threatened communities
- Coastal Narrabeen Moist Forest (purple)
- Exotic (pale yellow)
Updated Vegetation Survey of Preferred Option
Northern Section
Threatened Flora Species
as described under the original PEA
Melaleuca biconvexa
as described under original PEA
Revised *Melaleuca biconvexa*
Southern Section

Identified in all native vegetation communities identified in the study area (PB 2012).

Threatened plant species, *Melaleuca biconvexa*

Listed as Vulnerable under both TSC Act and EPBC Act
Revised *Melaleuca biconvexa*
Option alignments Red and Blue
Threatened Fauna
Initial Assessment of Likelihood Total Study Area (PEA)

• 45 State and Commonwealth listed species as recorded as having potential to inhabit or use the broader area.

• 31 of these species are considered moderately or highly likely to occur within the study area during some part of their life cycle.
Threatened Species Highly Likely to Use the Area

• Threatened species considered to have a high likelihood of being present:
  
  – Green and Golden Bell Frog – Freshwater wetlands
  – Giant Burrowing Frog – woodland with sandy soils
  – Square-tailed Kite – coastal ranges, timbered habitat
  – Gang Gang Cockatoo – open eucalypt forest
  – Powerful Owl – remnant eucalypt forest
  – Masked Owl – dry eucalypt forest, hunts on roadsides
  – Sooty Owl – rainforests and moist eucalypt forests
  – Grey-headed flying fox – rainforest, tall eucalypt forest, wetlands
Migratory Species

- Migratory species are Matters of National Environmental Significance under EPBC Act
- Five migratory species are considered likely to use the site:
  - Rainbow bee eater
  - Black-faces monarch
  - Satin Flycatcher
  - Cattle Egret
  - Rufous Fantail (high likelihood)
<table>
<thead>
<tr>
<th>Species</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green and Golden Bell Frog</td>
<td>Moderate</td>
</tr>
<tr>
<td>Regent Honeater</td>
<td>Moderate</td>
</tr>
<tr>
<td>Fork-tailed Swift</td>
<td>Moderate</td>
</tr>
<tr>
<td>Cattle Egret</td>
<td>Recorded</td>
</tr>
<tr>
<td>Eastern Great Egret</td>
<td>Moderate</td>
</tr>
<tr>
<td>Gang-gang Cockatoo</td>
<td>Moderate</td>
</tr>
<tr>
<td>Varied Sitella</td>
<td>Moderate</td>
</tr>
<tr>
<td>Latham's Snipe</td>
<td>Moderate</td>
</tr>
<tr>
<td>Little Lorikeet</td>
<td>Moderate</td>
</tr>
<tr>
<td>White Throated Needletail</td>
<td>Moderate</td>
</tr>
<tr>
<td>Black Bittern</td>
<td>Moderate</td>
</tr>
<tr>
<td>Swift Parrot</td>
<td>Moderate</td>
</tr>
<tr>
<td>Square-tailed Kite</td>
<td>Moderate</td>
</tr>
<tr>
<td>Black-faced Monarch</td>
<td>Moderate</td>
</tr>
<tr>
<td>Satin Flycatcher</td>
<td>Moderate</td>
</tr>
<tr>
<td>Powerful Owl</td>
<td>High</td>
</tr>
<tr>
<td>Glossy Ibis</td>
<td>Moderate</td>
</tr>
<tr>
<td>Wompoo Fruit-Dove</td>
<td>Moderate</td>
</tr>
<tr>
<td>Superb Fruit-Dove</td>
<td>Moderate</td>
</tr>
<tr>
<td>Rufous Fantail</td>
<td>Moderate</td>
</tr>
<tr>
<td>Masked Owl</td>
<td>Moderate</td>
</tr>
<tr>
<td>Sooty Owl</td>
<td>High</td>
</tr>
<tr>
<td>Eastern Pygmy Possum</td>
<td>Moderate</td>
</tr>
<tr>
<td>Spotted-Tailed Quoll</td>
<td>Moderate</td>
</tr>
<tr>
<td>Eastern False Pipistrelle</td>
<td>Moderate</td>
</tr>
<tr>
<td>Golden-tipped Bat</td>
<td>Moderate</td>
</tr>
<tr>
<td>Little Bent-wing Bat</td>
<td>Moderate</td>
</tr>
<tr>
<td>Eastern Bent-wing Bat</td>
<td>Moderate</td>
</tr>
<tr>
<td>Southern Myotis</td>
<td>Moderate</td>
</tr>
<tr>
<td>Koala</td>
<td>Moderate</td>
</tr>
<tr>
<td>Grey-headed Flying Fox</td>
<td>High</td>
</tr>
<tr>
<td>Yellow-bellied Sheathail Bat</td>
<td>Moderate</td>
</tr>
<tr>
<td>Greater Broad-nosed Bat</td>
<td>Moderate</td>
</tr>
<tr>
<td>Pale-headed Snake</td>
<td>Moderate</td>
</tr>
<tr>
<td>Stephen's Bearded Snake</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Habitat Assessment Summary
PB Study

• Wet sclerophyll forests provided foraging habitat for nectivorous fauna including the threatened species:
  – Swift Parrot
  – Regent Honeyeater
  – Little Lorikeet
  – Grey-headed flying fox

and hollows for hollow-dependent species.

• Fleshy fruit shrubs and trees (both native and exotic) provided winter foraging for a variety of birds, possums and Grey-headed flying fox.
Habitat Assessment (cont)

- Tributaries in moderate condition.
- Aquatic vegetation likely to provide habitat for native animal species such as turtles, frogs and reptiles.
- Creeks provide foraging, roosting and breeding habitat for a number of Threatened Species such as microchipteran bats.
- Stream is likely to be occupied by common disturbance tolerant fish and frogs.
Connectivity (PB Study)

• Close proximity to larger remnants in surrounding landscape – Stickland State Forest and Rumbalara Reserve.

• Even degraded areas can maintain local connectivity

• Allow movement for species that would not move across an open landscape

• Allow dispersal of plant seeds and pollen between remnants.
Contamination

- Possible contamination from imported fill
- Three boreholes tested for Stage 3 recorded concentration levels that exceed NEPM thresholds.
- One testpit tested for Stage 4 PEA exceeded for hydrocarbons (TP406) beside Pacific Hwy.
- Further testing recommended.
Conclusion

• Further detailed ecological investigations necessary to confirm EEC and to determine presence of threatened species

• Referral to Commonwealth may be necessary for either option due to impact on *Melaleuca biconvexa*

• Further testing to determine contamination presence necessary
HILL PDA were contracted to undertake a Business Impact Assessment for the study area.

They undertook a number of activities to determine the impacts, including:

- Shopper surveys
- Business surveys
- Number plate surveys
- Assessment of potential trade loss
Is this the main shopping centre where you do your food and grocery shopping?

<table>
<thead>
<tr>
<th></th>
<th>Lisarow Plaza</th>
<th>Niagara Park</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>64%</td>
<td>85%</td>
</tr>
<tr>
<td>No</td>
<td>36%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Source: Hill PDA (2012)
Shopper Survey

Why did you decide to shop here today: Lisarow Plaza

Figure 1 - Why did you decide to shop here today: Lisarow Plaza

Source: Hill PDA (2012)
Why did you decide to shop here today: Niagara Shopping Centre

Figure 1 - Why did you decide to shop here today: Niagara Shopping Centre

Source: Hill PDA (2012)
How did you arrive here today?

**Lisarow Plaza**
- Car: 84%
- Walk: 13%
- Other: 3%

**Niagara Shopping Centre**
- Car: 61%
- Walk: 34%
- Other: 5%

Source: Hill PDA (2012)
Number Plate Survey
## Impacts of Individual Businesses

### Impact Scale
- **+1** Positive business impact;
- **0** No business impact;
- **-1** Some negative business impact;
- **-3** Moderate negative business impact; and
- **-5** Very strong negative business impact.

### Table

<table>
<thead>
<tr>
<th>Business</th>
<th>Eastern Route Option</th>
<th>Western Route Option</th>
<th>Estimated No. of Jobs for all businesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net No. of Businesses Impacted</td>
<td>16</td>
<td>-51</td>
<td>1,668</td>
</tr>
</tbody>
</table>
How did we communicate this?

- 9000 community updates throughout the study area
- Webpage
- Media advertising
- Staffed displays
- Static displays
- Community information sessions
- Residents meetings
- Business meetings
What did the community say?

- Received 364 ‘Have your say forms’
- Received 670 formal and informal submissions
- Received three petitions:
  1. Reeves Street Residents
     - against the red and dark grey options
  2. Business petition
     - supporting a dark grey option
  3. Residential petition
     - opposed to turning Narara Valley Drive & Railway Crescent into main road
- Community feedback on route options was close.
- In order of preference
  - Red option 34%
  - Pink option 24%
  - Light Blue option 23%
  - Dark Grey option 19%
Just over half of respondents (53%) favoured utilising the floodplain (red and dark grey options)
Community feedback identified the 5 key areas of concern as:

1. Safety
2. Environmental impacts
3. Social amenity
4. Intersection treatments/local access
5. Pedestrian facilities
Community feedback identified the 5 key areas of community concern as:

1. Property acquisitions
2. Pedestrian facilities
3. Flooding
4. Noise
5. Intersection treatments
- Feedback on issues evenly spread between corridors;
  - Property impacts
  - Pedestrian facilities/safety – access to schools and railway stations
  - Flooding – benefits in utilising floodplain/upgrading Pacific Highway
  - Intersection treatments
Key Differences Pacific Highway/Narara Valley Corridors

Narara Valley Corridor;
- Increase in noise through Narara Valley Corridor
- Social amenity impacts of bridge structures – visual amenity, social isolation
- Access improvements during flood events
- Access during construction

Pacific Highway
- Cost effectiveness of upgrading existing infrastructure
- Impacts on business exposure
Narara to Lisarow Pacific Highway Upgrade
Flood Impact Assessment of Route Options

Narara Creek

Cut Rock Creek

Niagara Park Branch
4 Proposed Route “Options”

(1) A → X
(2) A → Z
(3) B → Y
(4) B → Z
Existing Conditions – 1% AEP Flood

1% AEP

- Floodwaters at various discharges:
  - 111 m³/s
  - 107 m³/s
  - 151 m³/s
  - 352 m³/s

Map showing flood risk areas with discharges at 111 m³/s, 107 m³/s, 151 m³/s, and 352 m³/s.
Flood Impacts A+X
Flood Impacts A+Y
Flood Impacts B+Y
Flood Impacts B+

[Map showing flood impact areas with color-coded risk levels]
IMPACTED PROPERTIES

- 53 houses flooded above FL in existing 1% AEP event
- Results based on WMA’s optimised cross drainage structures
- Flood impacted = experience increase over floor peak flood level/newly flooded over floor
- In any alignment little flood impact on houses not to be resumed.
- Some areal extent differences, more impact for Y,Z alignments (less driving head)
- Flood impact on property generally not a big problem.
Impacted Properties

Table 1: Summary of Study Results – 1% AEP Event

<table>
<thead>
<tr>
<th>Alignment Options</th>
<th>Impacted Properties</th>
<th># Flood Impacted</th>
<th># Construction Impacted (*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A + X</td>
<td>6</td>
<td>96 (33)</td>
<td></td>
</tr>
<tr>
<td>A + Z</td>
<td>6</td>
<td>113 (34)</td>
<td></td>
</tr>
<tr>
<td>B + Y</td>
<td>2</td>
<td>102 (0)</td>
<td></td>
</tr>
<tr>
<td>B + Z</td>
<td>1</td>
<td>126 (1)</td>
<td></td>
</tr>
</tbody>
</table>

* Previously flood affected in baseline scenario

Table 11: Flood Impacted Land Based on Optimised Alignment Options – 1% AEP Event

<table>
<thead>
<tr>
<th>Road Alignments</th>
<th>Council (km²)</th>
<th>Private (km²)</th>
<th>Total Impacted Area Aflx &gt;10mm (km²)</th>
<th>% Council</th>
<th>% Private</th>
<th>% Road/Kerb/Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td>A# + X*</td>
<td>0.12</td>
<td>0.24</td>
<td>0.38</td>
<td>32</td>
<td>61</td>
<td>7</td>
</tr>
<tr>
<td>A# + Z*</td>
<td>0.18</td>
<td>0.26</td>
<td>0.49</td>
<td>38</td>
<td>53</td>
<td>10</td>
</tr>
<tr>
<td>B + Y*</td>
<td>0.16</td>
<td>0.26</td>
<td>0.49</td>
<td>32</td>
<td>54</td>
<td>14</td>
</tr>
<tr>
<td>B + Z*</td>
<td>0.17</td>
<td>0.26</td>
<td>0.50</td>
<td>34</td>
<td>52</td>
<td>13</td>
</tr>
</tbody>
</table>
### Table 8: Floor Level Assessment Results for Alignment “A” Options – 1% AEP Event

<table>
<thead>
<tr>
<th>Alignment Options</th>
<th>Inundated Houses Not Impacted By Construction&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Properties (inc. Houses/Yards etc) Impacted By Construction</th>
<th>Mean Afflux for Impacted Houses (m)</th>
<th>Estimated Area of Afflux &gt; 10mm (km&lt;sup&gt;2&lt;/sup&gt;)</th>
<th>Average Afflux over Area (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Houses Newly Flooded</td>
<td>Houses Flood Worsens</td>
<td>Houses Flood Improves/No Change</td>
<td>Total</td>
<td>Properties Inundated in Existing Scenario</td>
</tr>
<tr>
<td>A# + X&lt;sup&gt;*&lt;/sup&gt;</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>18</td>
<td>33</td>
</tr>
<tr>
<td>A&lt;sup&gt;*&lt;/sup&gt; + X&lt;sup&gt;#&lt;/sup&gt;</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>18</td>
<td>33</td>
</tr>
<tr>
<td>A&lt;sup&gt;<em>&lt;/sup&gt; + X&lt;sup&gt;</em>&lt;/sup&gt;</td>
<td>3</td>
<td>4</td>
<td>11</td>
<td>18</td>
<td>33</td>
</tr>
<tr>
<td>A&lt;sup&gt;+&lt;/sup&gt; + X&lt;sup&gt;+&lt;/sup&gt;</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>18</td>
<td>33</td>
</tr>
<tr>
<td>A# + Z&lt;sup&gt;#&lt;/sup&gt;</td>
<td>3</td>
<td>4</td>
<td>10</td>
<td>17</td>
<td>34</td>
</tr>
<tr>
<td>A&lt;sup&gt;+&lt;/sup&gt; + Z&lt;sup&gt;+&lt;/sup&gt;</td>
<td>2</td>
<td>4</td>
<td>10</td>
<td>16</td>
<td>34</td>
</tr>
<tr>
<td>A&lt;sup&gt;+&lt;/sup&gt; + Z&lt;sup&gt;+&lt;/sup&gt;</td>
<td>3</td>
<td>4</td>
<td>10</td>
<td>17</td>
<td>34</td>
</tr>
</tbody>
</table>

<sup>1</sup> Only houses with surveyed/estimated FLs are assessed

<sup>2</sup> This total excludes properties that are only partially impacted by road construction

### Table 9: Floor Level Assessment Results for Alignment “B” Options – 1% AEP Event

<table>
<thead>
<tr>
<th>Alignment Options</th>
<th>Inundated Houses Not Impacted By Construction&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Properties (inc. Houses/Yards etc) Impacted By Construction</th>
<th>Mean Afflux for Impacted Houses (m)</th>
<th>Estimated Area of Afflux &gt; 10mm (km&lt;sup&gt;2&lt;/sup&gt;)</th>
<th>Average Afflux over Area (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Houses Newly Flooded</td>
<td>Houses Flood Worsens</td>
<td>Houses Flood Improves/No Change</td>
<td>Total</td>
<td>Properties Inundated in Existing Scenario</td>
</tr>
<tr>
<td>B + Y&lt;sup&gt;#&lt;/sup&gt;</td>
<td>1</td>
<td>1</td>
<td>52</td>
<td>54</td>
<td>0</td>
</tr>
<tr>
<td>B + Y&lt;sup&gt;*&lt;/sup&gt;</td>
<td>1</td>
<td>1</td>
<td>52</td>
<td>54</td>
<td>0</td>
</tr>
<tr>
<td>B + Z&lt;sup&gt;#&lt;/sup&gt;</td>
<td>1</td>
<td>1</td>
<td>51</td>
<td>53</td>
<td>1</td>
</tr>
<tr>
<td>B + Z&lt;sup&gt;*&lt;/sup&gt;</td>
<td>0</td>
<td>1</td>
<td>51</td>
<td>52</td>
<td>1</td>
</tr>
</tbody>
</table>

<sup>1</sup> Numbers inferred from Alignment “A” results

<sup>2</sup> This total excludes properties that are only partially impacted by road construction

---

NSW Government
Transport Roads & Maritime Services
WMA Water
Key Findings

• Number of flood liable houses does not significantly change compared to that affected by construction land take

• Alignment “Y” or “X” generally results in larger area with afflux >10mm and higher construction land take (less driving head and less slope)

• Flood impacts <10mm not possible but spatial extent can be minimised by optimising cross structure designs
Initial geotechnical investigations have been undertaken.

Numerous test pits and boreholes have been investigated as part of this investigation.

For the purpose of route option development, the study area can be divided into two primary geological terrain units, namely *hillslopes* and *floodplains*.
Narara Valley Corridor – floodplains
Deep soil profile (typically 10-20m) overlying weak bedrock

Pacific Highway Corridor - hillslopes
Shallow soil profile (typically <2m) overlying bedrock
Two Heritage assessment have been undertaken:
  • Indigenous (Aboriginal)
  • Non-Indigenous (European)
Key objectives of this assessment were:

- AHIMS database search
- Consult with relevant Local Aboriginal Land Councils and other identified representatives
- Carry out targeted field surveys
- Identify and map the location and extent of indigenous items
Aboriginal Historic Information Management System (AHIMS)

No previously recorded Aboriginal archaeological or heritage sites were present within or immediately adjacent to the study area.
Consultation with Local Aboriginal Representatives

The following people were invited to take part in this assessment:

- Archaeologist (Cosmos Coroneos)
- RMS Aboriginal Liaison Officer (Stephen Knight)
- Darkinjung Local Aboriginal Land Council (declined)
- Dave Prose (Aboriginal Elder, former Darkinjung LALC)
- Tracey-lee Howie (Guringai Aboriginal Representative)
A site inspection of the study area was undertaken in November 2009. As the route options were not prepared at the time of the survey, a large study area was defined.

The survey identified seven (7) Potential Archaeological Deposit (PAD) sites and one scarred tree.
A scarred tree was recorded adjacent to the Pacific Highway, Niagara Park (actual location withheld).

Significant amount of regrowth is present around the scar indicating that the scar is old enough for the tree to have regenerated itself.
Searches were conducted of Statutory and non-Statutory heritage registers. This included the National Heritage Register, Commonwealth Heritage Register and the Register of the National Estates through the Australia Heritage Database, NSW Heritage Register and Inventory; and items listed in the Gosford Planning Scheme Ordinance.
# Heritage Register Results

<table>
<thead>
<tr>
<th>NAME</th>
<th>LOCATION</th>
<th>SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Gates (House)</td>
<td>18 Hanlan Street</td>
<td>Local Significance</td>
</tr>
<tr>
<td>Narara Public Hall</td>
<td>19 Goonak Street</td>
<td>Local Significance</td>
</tr>
<tr>
<td>Holcombes (House)</td>
<td>Cnr Manns Road &amp; Bellbowrie Ave</td>
<td>Local Significance</td>
</tr>
<tr>
<td>Former Primary School Building</td>
<td>651 Pacific Highway</td>
<td>Local Significance</td>
</tr>
<tr>
<td>Narara Anglican Church</td>
<td>Cnr Pacific Highway &amp; Berrys Head Road</td>
<td>Local Significance</td>
</tr>
<tr>
<td>Prior Brothers Shop</td>
<td>20 Railway Crescent</td>
<td>Local Significance</td>
</tr>
<tr>
<td>Lisarow Anglican Cemetery</td>
<td>Pacific Highway</td>
<td>Local Significance</td>
</tr>
<tr>
<td>Narara Footbridge</td>
<td>Narara Railway Station</td>
<td>Local Significance</td>
</tr>
<tr>
<td>Niagara Footbridge</td>
<td>Niagara Railway Station</td>
<td>Local Significance</td>
</tr>
<tr>
<td>Lisarow Footbridge</td>
<td>Lisarow Railway Station</td>
<td>Local Significance</td>
</tr>
</tbody>
</table>
HERITAGE ITEMS (Local Significance)

1. White Gables (House)
2. Narara Public Hall
3. Holcombes (House)
4. Former Primary School Building
5. Narara Anglican Church
6. Prior Brothers Shop
7. Lisarow Anglican Cemetery
8. Narara Footbridge
9. Niagara Footbridge
10. Lisarow Footbridge
A program of archaeological test excavation was undertaken to investigate the possible presence of graves within the Pacific Highway road reserve adjacent to the Lisarow Anglican Cemetery, Lisarow, NSW.

This testing program indicated that no graves were present and that the anomalies identified in a previous report (April 2011) may have resulted from a number of sub-surface features such as major service lines and localised (recent) fill deposits.

The test program also failed to identify any other features that could be interpreted as having associations with the use of the road reserve for burial purposes.
This article should not be considered as a research paper but rather as a technical note which may prove beneficial to those assessing road traffic noise in order to satisfy RTA requirements.

An assessment procedure has been developed, which probably supports the intuition, which uses a simple numbers approach to break the overall selection process into a number of smaller packages that allow comparison and can be handled with greater ease.
## Noise Analysis

<table>
<thead>
<tr>
<th>Distance from Proposed Alignment</th>
<th>0-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from Existing alignment</td>
<td>&gt;300</td>
</tr>
<tr>
<td>Weighting</td>
<td>6.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chainage</th>
</tr>
</thead>
</table>

| Awaba to Ourimbah               | 5     | 4      |
| Kathleen/Washington to Awaba    | 4     |
| Bently to Kathleen/Washington   |       |
| Fountains to Bentley            |       |
## Noise Analysis

<table>
<thead>
<tr>
<th>Option</th>
<th>0-50</th>
<th>50-100</th>
<th>100-200</th>
<th>200-300</th>
<th>300-500</th>
<th>500-1000</th>
<th>1000-2000</th>
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<tbody>
<tr>
<td>Distance from Existing alignment</td>
<td>&gt;300</td>
<td>200-300</td>
<td>100-200</td>
<td>50-100</td>
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<td>&gt;300</td>
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<tr>
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<td>6.4</td>
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<td>3.7</td>
<td>3</td>
<td>2.2</td>
<td>4</td>
<td>3</td>
<td>2.3</td>
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<td>Channage</td>
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<tr>
<td>Awaba to Ourimbah</td>
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<td>4</td>
<td>9</td>
<td>10</td>
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<td>6</td>
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<tr>
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<td>4</td>
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<tr>
<td>Bentley to Kathleen/Washington</td>
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<td>3</td>
<td>106</td>
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<td>15</td>
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<tr>
<td>Fountains to Bentley</td>
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<td>93</td>
<td>32</td>
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<tr>
<td>Reeves/Adam to Fountains</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>12</td>
<td>3</td>
<td>1</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Narara Ck to Reeves/Adam</td>
<td>6</td>
<td>6</td>
<td>16</td>
<td>4</td>
<td>15</td>
<td>20</td>
<td>6</td>
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<tr>
<td>Properties</td>
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<td>11</td>
<td>6</td>
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<td>Properties x Weighting</td>
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<td>427.6</td>
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<td>1090.5</td>
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</tbody>
</table>

**Property Total:** 1519  
**Weighted Grand Total:** 2414.6
### Noise Analysis

**RED (A+X) Option – Narara Valley Corridor**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Total</td>
<td>1519</td>
</tr>
<tr>
<td>Weighted Grand Total</td>
<td>2414.6</td>
</tr>
</tbody>
</table>

**PINK (B+Z) Option – Existing Pacific Highway**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Property Total</td>
<td>1769</td>
</tr>
<tr>
<td>Weighted Grand Total</td>
<td>2493.55</td>
</tr>
</tbody>
</table>
Construction Staging

- Niagara Park Railway Station
- Narara Valley Drive
- Main Northern Railway Line
- Narara Railway Station
- Manns Road
- Pacific Highway
- Lisarow Railway Station
Option Total Cost - $2011
Staging Cost

N2L - PROJECT STAGING
• RM Planning have undertaken a preliminary Social Impact Assessment on behalf of RMS

• Involves identifying and assessing changes to or impacts on communities, business and industry that are likely to occur as a result of a proposed development
Scope of the PSIA

- Mainly concerned with scoping potential impacts related to the selected route options
- Takes into account local context, known issues for the local community, and potential impacts, both positive and negative
- Does not recommend mitigation measures at this stage
Results and Conclusion

- Amenity
- Access and Connectivity
- Cohesion and Severance
- Business and Industry
- Community and Recreation Facilities
- Property Impacts
Severance and Cohesion

- In general, each option would foster community cohesion through improved access and connectivity, particularly between eastern and western parts of the study area.
- Red and Light Blue create potential for community severance through displacement of residents on Koninderie Parade and also in Narara Crescent.
- Red would also isolate dwellings on Hanlan Street, particularly at northern end.
- Red has greatest potential to change semi-rural character of the area.
- Dark Grey is least likely to change the way the community currently uses and accesses facilities.