Transport Roads & Maritime Services

Warrell Creek to Nambucca Heads Pacific Highway upgrade

North facing ramps at North Macksville preferred option report

September 2015

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Customer feedback
Roads and Maritime
Locked Bag 928,
North Sydney NSW 2059

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Glossary

AADJV	Arup Aurecon Design Joint Venture
AADT	Annual average daily traffic
AFJV	Acciona-Ferrovial Joint Venture
AHIMS	Aboriginal Heritage Information Management System
Approved layout	The approved layout represents the scope of works as originally approved, including realignment of Old Coast Road to pass above the upgraded highway but not including north facing ramps at North Macksville
ASS	Acid sulfate soils
dB; Decibel	A relative unit of measurement widely used in acoustics, electronics and communications. The dB is a Logarithmic unit used to describe a ratio between the measured level and a reference or threshold level of 0dB. The ratio may be Sound Power, Sound Pressure, voltage or Sound Intensity etc
EEC	Endangered Ecological Community
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process
LoS	Level of Service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers
Roads and Maritime	NSW Roads and Maritime Services
RoTAP	Rare or Threatened Australian Plants
WC2NH	Warrell Creek to Nambucca Heads

1. Introduction

1.1 Background

Roads and Maritime Services (Roads and Maritime) completed an environmental assessment of the Warrell Creek to Urunga Pacific Highway upgrade (the Project EA) in January 2010. The Project EA identified a range of environmental, social and planning issues associated with the construction and operation of the Pacific Highway Upgrade between Warrell Creek and Urunga and proposed measures to mitigate or manage those potential impacts. This project was designated critical infrastructure, under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and was formally approved on 19 July 2011.

Roads and Maritime Services has engaged Pacifico, an Acciona and Ferrovial Joint Venture, to design and build the 20 kilometre Warrell Creek to Nambucca Heads section of the Pacific Highway upgrade. The project involves upgrading the highway to a four lane divided road between the Allgomera deviation, south of Warrell Creek and Nambucca Heads, just south of the railway line.

In response to representations from Nambucca Shire Council and the Macksville Chamber of Commerce, north facing ramps are proposed at North Macksville. This is in addition to the approved interchanges at Warrell Creek and at Bald Hill Road south of Macksville. The proposed ramps would include a northbound on-ramp onto the highway, a southbound off-ramp from the highway and a median cross-over facility to enable emergency vehicles (including ambulances stationed at North Macksville) to travel both north and south on the highway.

Inclusion of the north facing ramps and median cross-over brings a number of advantages to the Warrell Creek to Nambucca Heads Pacific Highway upgrade:

- The ramps would improve connectivity between Macksville and areas to the north, and in particular connectivity between Macksville and Nambucca Heads
- While Macksville is not identified by Roads and Maritime as a Service Centre, addition of the north facing ramps and appropriate signage would, in conjunction with the Bald Head Road interchange to the south, allow both northbound and southbound vehicles using the upgraded highway to stop at Macksville with only a short diversion
- The ramps would allow greater utilisation of the infrastructure investment in the section of the Warrell Creek to Nambucca Heads upgrade between Macksville and the Nambucca Heads interchange, about 10 kilometres to the north. By adding the north facing ramps at Macksville, more vehicles will be able to take advantage of safer and faster travel on the upgraded highway to the north
- The ramps would improve access to and from Macksville for emergency services and reduce response times. The northbound entry ramp, in conjunction with the proposed emergency vehicle cross-carriageway access just north of Mattick Road, would provide improved access to a major incident on the upgraded highway south of the Nambucca River.

Since these ramps are not currently included in the approved Warrell Creek to Nambucca Heads project, planning approval will need to be obtained before being built.

Three options for the layout of the north facing ramps and their connections to the road network were investigated and developed as documented in this report. On 20 May 2015 an Options Assessment workshop was held by Roads and Maritime to compare and assess the

three options using a Value Management methodology, from this Option 2 was selected as the preferred option.

Community comment on the preferred option is invited.

An assessment of the potential environmental impacts of the preferred option and proposed measures to mitigate these impacts will be prepared. Community comment on the preferred option will be considered in the environmental assessment.

Potential impacts to be identified and assessed include:

- Compliance with design criteria and safety impacts
- Traffic impacts
- Noise and vibration impacts
- Air quality impacts
- Impacts on native plants and animals
- Impacts on Aboriginal and non-Aboriginal heritage
- Impacts on flooding, drainage and groundwater
- Property impacts.

The environmental assessment would then be submitted to the NSW Department of Planning and Environment for planning approval as part of a Modification Assessment Report under Section 75 W of the EP&A Act.

The modification would be displayed by the NSW Department of Planning and Environment for public comment. A Submissions report would then be prepared and the concept design and environmental assessment would be refined as required to address feedback.

Following the NSW Department of Planning and Environment approval of the modification, construction can proceed subject to meeting any approval conditions.

1.2 Purpose of this report

The proposed addition of two north facing ramps at North Macksville to the Warrell Creek to Nambucca Heads Pacific Highway Upgrade project, created the need to examine alternatives as to how the ramps could be incorporated to ensure that a range of project objectives are best realised.

In August 2014, Pacifico developed potential arrangements for review, from which Roads and Maritime selected three options for further investigation.

The purpose of this report is to present and describe the three short-listed ramp options, report on potential impacts, compare the options, and outline how the preferred option was selected.

In comparing the options in this report, assessment of the impacts of the three options are relative to the impact of the approved layout in the area that the north facing ramps are located (Chainage 52800 to 54250). The approved layout includes realignment and provision of a new overbridge for the Old Coast Road to pass above the upgraded highway but does not include north facing ramps. The designs of the approved layout and the three options layouts that were developed are shown in **Appendix A**.

Section 2 describes the design criteria used in developing the three options and the description of each of the three options.

Section 3 provides a comparative assessment of the three options according to the criteria identified in **Section 2.1** and **2.2**.

Section 4 is a summary of the key differences identified in the comparative assessment.

Section 5 outlines the options selection workshop and the selection of the preferred option.

Section 6 describes refinements to the preferred option following the options selection workshop.

Section 7 describes the next steps which are proposed in order to obtain the planning approval that is required before the ramps can be constructed.

2. Development of options

2.1 Objectives

As part of the Project EA specific project objectives were developed for the Warrell Creek to Nambucca Heads upgrade. These align and relate to the overall objectives of the Pacific Highway Upgrade Program. When developing the north facing ramps options these objectives were reviewed and those considered relevant used to guide the development. The project objectives are:

- Develop solutions for the ultimate grade separation of the Pacific Highway and local road intersections including consolidation of accesses by the use of service roads
- Provide rest areas within the investigation area
- Achieve safe driving conditions on the highway for travel speeds of 110 km/h in rural areas and 80 km/h in urban areas
- Have acceptable roadway capacity for traffic volumes 30 years after opening
- Develop a dual carriageway road that accommodates all vehicles up to and including B-Doubles
- Provide acceptable access to properties
- Maintain highway access during flood conditions
- Integrate input from local communities into the development of the Proposal
- Provide connections from the upgraded highway to the key centres of Macksville, Nambucca Heads and Urunga
- Develop delay management strategies to minimise disruption to local and through traffic and maintain access to affected properties and land during construction
- Provide transport infrastructure that is complementary with surrounding land use
- Ensure the project outcomes achieve value for money
- Develop solutions that facilitate the staged construction of the project.

2.2 Design and performance criteria

The three ramp options under consideration have been developed and refined based on the design criteria set out for the project. These key requirements are summarised in **Table 2-1** and **Table 2-2**.

Table 2-1 General design criteria

Design item	Design development requirements
Traffic performance	Interchanges and intersections must be designed to provide a minimum Level of Service "C", in accordance with "Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis", for design year 2036 for the 100th highest hourly volumes."
Design vehicle	▪ Existing Pacific Highway / Old Coast Road South intersection: 25 metre B Double ▪ Intersections with Old Coast Road South / Letitia Close: 19 metre semi-trailer ▪ Intersections with North Macksville Ramps: 25 metre B Double ▪ Property access intersections: 19 metre semi-trailer
Pavement	Pavement types are designed to be consistent with the Warrell Creek to Nambucca Heads upgrade. Low noise pavement surfacing is proposed for the ramps including the ramp merge and diverge areas on all options. For improved design life and reduced maintenance costs, concrete pavement is proposed for roundabouts.
Exit ramps	Exit ramp layouts must allow for all deceleration to occur in the deceleration lane, with no deceleration taking place in the adjacent through lane.
Lighting	Lighting is not required on the upgraded highway but flag lighting (one or two strategically placed lamps) is required at the ramp junctions with local roads. Lighting must be provided on all roundabouts on local roads. A further requirements is that the design of lighting must ensure that light spillage into residential and other sensitive areas is avoided.
Utilities	A preliminary review of utilities in the vicinity of the ramps and related roadworks did not identify any major utilities that would be affected by the options.
Medium Cross-over access, and bus facilities	A combined median cross-over, emergency U-turn facility and heavy vehicle stopping bay is located at Chainage 54,000 under the approved layout. This would have broadly coincided with the proposed ramp merge and diverge locations on all three options, and in order to provide for the north facing ramps the facility will be relocated to Chainage 54,750, just north of Mattick Road. A bus bay is required in each direction on Old Coast Road near the intersection with Letitia Close.

Table 2-2 Local road and ramp geometric design criteria

Old Coast Road (south)	**Minimum Requirement**
Design speed:	60 km/h
Minimum number of lanes and widths:	2 x 3.5m
Minimum shoulder width:	1.0m
Stopping Sight Distance - reaction time (R_T):	1.5 sec
Stopping Sight Distance:	64m
Old Coast Road (south) bridge above upgraded highway	**Minimum Requirement**
Design speed:	60 km/h
Minimum number of lanes and widths:	2 x 3.5m
Minimum shoulder width (footway not required):	1.0m
Minimum vertical clearance above upgraded highway:	5.3m
Stopping Sight Distance - reaction time (R_T):	1.5 sec
Stopping Sight Distance:	64m
Letitia Close	**Minimum Requirement**
Design speed:	50 km/h
Minimum lane widths:	2 x 3.0m
Minimum nearside (outside) shoulder width:	0.5m
Stopping Sight Distance - reaction time (R_T):	1.5 sec
Stopping Sight Distance:	48m
Design Criteria - Ramps	**Minimum Requirement**
Design speed:	80 km/h
Minimum lane widths:	3.5m
Minimum nearside (outside) shoulder width:	2.0m
Minimum offside shoulder width:	1.0m
Target speed for trucks at start of 110m entry ramp merge:	75 km/h
Stopping Sight Distance - reaction time (R_T):	1.5 sec

2.3 Option descriptions

Three options were developed and these are outlined below. More detail on each option can be found in Section 2.2 of the Roads and Maritime North Macksville – North Facing Ramps Options Assessment Report in **Appendix B**.

2.3.1 Option 1

Option 1 (purple design in **Appendix A**) is closely aligned to the approved layout (yellow design) which includes realignment of the Old Coast Road to pass over the upgraded highway. Option 1 is a comparatively simple addition to the approved layout by adding north facing ramps which connect as simple T-intersections to the realigned Old Coast Road. At the new intersections priority is given to through traffic on the Old Coast Road.

The existing channelised intersection where Old Coast Road connects to the existing Pacific Highway would be retained. With the lower volume of traffic on the existing highway the existing layout with right and left turn lanes off the highway would meet capacity requirements.

2.3.2 Option 2

Option 2 (black design in **Appendix A**) is a relatively minor variation on Option 1 which aims at overcoming some of the alignment difficulties in Option 1. It still includes realignment of the Old Coast Road to pass over the upgraded highway, and the north facing ramps still connect to the realigned Old Coast Road. The main difference is that the Letitia Close and exit ramp intersections are combined as a roundabout east of the upgraded highway, allowing the alignment of the bridge over the upgraded highway to be straightened. The other change is that west of the upgraded highway the priority has been reversed, with access onto the northbound entry ramp given priority over traffic from Old Coast Road central.

The existing channelised intersection where Old Coast Road connects to the existing Pacific Highway would be retained. As with Option 1, the lower volume of traffic on the existing highway means that the existing layout with right and left turn lanes off the highway would meet capacity requirements.

2.3.3 Option 3

Option 3 (orange design in **Appendix A**) is quite different from Options 1 and 2. Rather than realigning the Old Coast Road onto a new bridge over the upgraded highway, a new connection for the Old Coast Road is provided on the west side of the upgraded highway. This connection also provides access between the existing Pacific Highway and the existing Old Coast Road to the north. The proposed treatment of this intersection is a priority T-junction with channelised right turn and left turn lanes on the highway.

On the eastern side of the ungraded highway the off-ramp connects to the redundant section of the Old Coast Road and an intersection allows for connectivity to Letitia Close to be retained. The existing intersection where the redundant section of the Old Coast Road connects to the existing Pacific Highway on the east would be retained with two lanes northbound and separate right and left turn lanes off the existing highway. Letitia Close would connect as a T-junction with priority given to traffic from the exit ramp.

While this option requires the construction of a new connecting road to the existing highway on the west side of the upgraded highway, close to the existing intersection on the east side, it avoids the need to construct a bridge to carry Old Coast Road over the upgraded highway.

3. Assessment of options

3.1 Road user safety

A Pre-construction Strategic Design Road Safety Audit (RSA) was carried out on the three ramp options, with the objective of identifying potential road safety risks with each option.

The Road Safety Audit Report identified potential safety issues for each option and then estimated the likely frequency of crashes arising from the safety issue as well as the likely severity of those crashes. A rating was then allocated to each safety issue based on the frequency and severity matrix in **Table 3-1**.

Table 3-1 Matrix of level of risk for each safety issue

		Frequency of crashes			
		Frequent	**Probable**	**Occasional**	**Improbable**
Severity of crashes	**Catastrophic**	Intolerable	Intolerable	Intolerable	High
	Serious	Intolerable	Intolerable	High	Medium
	Minor	Intolerable	High	Medium	Low
	Limited	High	Medium	Low	Low

It is normal for any safety audit to identify safety issues and this does not mean that the safety issues cannot be addressed in subsequent design refinements or that the design is inherently unsafe. Rather, the purpose of the strategic audit is to identify if there are relative differences in the safety of options and to ensure that issues are identified and addressed to the extent possible in subsequent stages of design.

In order to compare the relative safety of the options, the number of safety issues corresponding to each level of risk has been summed for each option as shown in **Table 3-2** below.

Table 3-2 Number of high, medium and low risk safety issues for each option

Risk Level	Option 1	Option 2	Option 3
High	1	3	2
Medium	8	6	7
Low	1	0	2
Total safety issues raised	10	9	11

There were no intolerable risks identified for any of the options. There were six high risk, 21 medium risk and three low risk safety issues identified for the options. One medium risk safety issue that was raised for all options is the proposed location of the median crossover facility which is about 500 metres north of the ramp merge and diverge. While this facility improves access for emergency vehicles, its location may encourage illegal and unsafe usage by unauthorised road users. A safety review will be required during the detail design stage.

Other risks that were identified included:

- Bus bay facility: The proposed bus bay facility, south of Letitia Close, may encourage pedestrians to walk on the road due to the discontinuous foot paths on either side of the roadway. This high level risk is applicable to Option 1 and 2
- Limited sight distance: A number of high and/or medium level limited sight distance risks were identified for all three options. Drivers at intersections that have insufficient sight distance may select unsafe gaps to turn, as they cannot see approaching traffic, potentially resulting in crashes with through traffic. The high level limited sight distance safety risks identified for Option 2 and 3 (there are no high level limited sight distance safety risks identified for Option 1) include:
  - Option 2: Vehicles on the southbound off-ramp, giving way at the roundabout, may have limited sight distance to vehicles from the west over the Old Coast Road bridge
  - Option 2: Drivers of vehicles on the existing Old Coast Road (west of the upgraded highway) waiting to turn right onto the realigned Old Coast Road may have limited sight distance to approaching vehicles on the realigned Old Coast Road (Chainage 53400) due to safety barriers and/or the curvature of the road
  - Option 3: Drivers of vehicles stopped on Letitia Close, waiting to turn left onto the Old Coast Road, may have limited sight distance to approaching vehicles from the southbound off-ramp
  - Option 3: The proposed 30 metre retaining wall for the upgraded highway may obscure sight distance at the existing Pacific Highway and realigned Old Coast Road intersection
- Heavy vehicles using the northbound on-ramp may not accelerate sufficiently to merge onto the main carriageway. This medium level risk applies to all three options.

3.2 Traffic assessment

This section of the report contains the findings from the assessment of the ramp options and SIDRA intersection analysis (SIDRA is software used for intersection modelling), using outputs from the traffic assessment presented within the *"Pacific Highway Upgrade, Warrell Creek to Urunga, Traffic Modelling Final Report"* dated May 2012 by SMEC on behalf of Roads and Maritime. This ramp traffic assessment is based on the same Transcad assignment model that was used for the Project EA.

3.2.1 Interchange traffic volume estimates

The process for determining traffic volumes for the purposes of preliminary assessment of the ramp options included:

- Reviewing preliminary outputs from sensitivity tests using the Transcad assignment model
- A check comparing modelled traffic volume estimates at the Bald Hill Road interchange ramps both with and without the north facing ramps, and comparing these to reported estimates at the north facing ramps at Bald Hill Road interchange
- Review by comparing modelled traffic volume estimates with the matrix demands between origins / destinations in proximity to the interchange.

Sensitivity tests were performed using the Transcad assignment model and the model was found to be capable of replicating the estimated volumes around the north facing ramps at North Macksville.

Using the methodology described above, traffic volumes on the main links have been estimated as shown in **Table 3-3**. These volumes are the outputs from the Transcad model that was shown to perform closest to the origin destination matrix, and to best correlate with the Bald Hill Interchange volumes and the sensitivity checks applied.

Table 3-3 2036 AADT Transcad model volume outputs

Location	Section	Direction	AADT* Approved layout without ramps			AADT* With north facing ramps		
			LV	HV	Total	LV	HV	Total
North Facing Ramps	On-ramp	Northbound	N/A	N/A	N/A	424	5	429
	Off-ramp	Southbound	N/A	N/A	N/A	391	55	446
Macksville Bridge		Northbound	2,104	110	2,215	2,371	114	2,485
		Southbound	1,738	158	1,896	1,962	192	2,154
Bald Hill Interchange	Off-ramp	Northbound	652	1	653	652	1	653
	On-ramp	Northbound	4,191	1,218	5,408	3,905	1,214	5,119
	Off-ramp	Southbound	5,717	903	6,620	5,478	870	6,348
	On-ramp	Southbound	288	5	293	288	5	293
Existing Highway	West of North Macksville Ramps	Northbound				1,903	44	1,947
		Northbound				1,503	106	1,609
	East of North Macksville Ramps	Southbound				1,479	39	1,518
		Southbound				1,112	51	1,163
New Highway	South of Upper Warrell Creek Interchange	Northbound	5,059	1,040	6,099	5,059	1,040	6,099
		Southbound	4,447	1,155	5,602	4,443	1,155	5,597
	Upper Warrell Creek Interchange to Bald Hill Interchange	Northbound	4,044	592	4,636	4,044	592	4,636
		Southbound	3,001	623	3,624	2,997	623	3,619
	Bald Hill Interchange (between Off and On-ramps)	Northbound	3,392	591	3,983	3,392	591	3,983
		Southbound	2,713	618	3,331	2,709	618	3,326
	Bald Hill - North Macksville Ramps	Northbound	7,583	1,809	9,391	7,297	1,805	9,102
		Southbound	8,430	1,521	9,951	8,187	1,487	9,674
	North of North Macksville Ramps	Northbound	7,583	1,809	9,391	7,721	1,810	9,531
		Southbound	8,430	1,521	9,951	8,578	1,542	10,120

* AADT: Annual Average Daily Traffic

For traffic capacity calculations the 100th Highest Hourly Volumes have been derived from the modelling as shown in the following **Table 3-4** below.

Table 3-4 2036 AADT and 100th highest hourly volumes

Road	Section	Direction	100th Highest Hourly Volumes		
			LV	HV	Total
North Facing Ramps	On-Ramp	Northbound	40	0	40
	Off-Ramp	Southbound	37	5	42
New Highway	Bald Hill to Macksville	Northbound	686	170	856
		Southbound	770	140	909
	North of North Macksville Ramps	Northbound	726	170	896
		Southbound	806	145	951
Existing Highway	West of North Macksville Ramps	Northbound	179	4	183
		Southbound	141	10	151
	East of North Macksville Ramps	Northbound	139	4	143
		Southbound	105	5	109

3.2.2 Traffic performance results

A traffic analysis has been carried out for each option. While some discrepancies were found in adapting the model to incorporate the ramps, the forecast volumes on the ramps are relatively low and would be unlikely to change significantly using a different traffic model. The forecast volumes are considered adequate for assessment of the options.

For the purposes of the traffic modelling the same ramp volumes have been used for all three options. This is considered to be an appropriate assumption as the position and functionality of the three ramp options are similar and when reviewed it was concluded that the volumes of the ramps for the three options would be similar.

3.2.2.1 Intersection analysis

Intersection analyses have been undertaken using Sidra. Level of Service (LoS) is a qualitative measure that is used to assess the traffic efficiency of a road or intersection. LoS ranges from 'LoS A' which generally indicates free flowing traffic conditions to 'LoS F' which typically indicates fully congested traffic conditions. The LoS was assessed for each intersection in each option. The results indicated that there would be a Los A at all intersections for all options.

3.2.2.2 Traffic assessment summary

The traffic assessment has shown that all intersections in all three options would perform at a high level of service with capacity to cater for significant increases in future traffic volumes. Forecast traffic volumes on the ramps would be very similar in all three options and in terms of traffic capacity there is no real difference between the three options.

3.2.3 Travel distances

The traffic analysis shows that the vast majority of traffic that would use the north facing ramps has an origin or destination west towards Macksville on the existing Pacific Highway.

Option 3 therefore would have a minor functional advantage since it provides a more direct route for northbound traffic between Macksville and the entry ramp. Northbound vehicles making this movement with Option 3 would save approximately 300 metres in travel distance compared to Options 1 or 2, where northbound vehicles must firstly pass under the upgraded highway then cross back over the upgraded highway again to access the entry ramp.

For southbound traffic from the exit ramp, there is little difference between the options although Option 3 has a slight advantage over the other options as it is the only one which provides priority to exit ramp traffic heading for the existing Pacific Highway.

However, Option 3 results in longer travel distance for buses using Old Coast Road to service Letitia Close as the bus would need to travel down to the new intersection with the existing highway (on the western side of the upgraded highway), travel east along the existing highway, then turn left into the section of the Old Coast Road that connects to Letitia Close, and the bus stop.

3.3 Noise impacts

3.3.1 Introduction

A noise assessment has been undertaken for the potential noise impacts from the three ramp options. This assessment was undertaken to assist in the selection of a preferred option for the ramps. This section of the report presents the approach and findings of the assessment.

This noise assessment of the ramp options is based on the same approach and methodology adopted for the approved layout in the Project EA.

3.3.2 Methodology

The three ramp options were incorporated into the Detail Design acoustic model (the "approved layout". The ramp options modelled are consistent with the ramp option layouts shown in **Appendix A**. For comparison purposes the noise levels for the approved layout without the ramps are also provided, based on the same mainline alignment. To allow for a more focussed and simple comparison, noise levels are only shown for the night-time criteria, as the assessment found that this is the critical period for assessing compliance with the noise criteria for this project.

3.3.3 Traffic volumes

Traffic volumes for local roads and the proposed ramps have been sourced from the 2026 traffic volumes. For the purposes of the noise modelling the AADT traffic volumes for the year 2026 were split into estimated daytime 15 hour and night-time 9 hour volumes using the same day/night splits that were adopted in the approved layout Project EA. Traffic volumes used for the night-time criteria assessment are shown in **Table 3-5**.

Table 3-5 2026 Traffic volumes used for the acoustic assessment

Road	Direction	Light Vehicles 10pm – 7am	Heavy Vehicles 10pm – 7am
New Highway - Bald Hill to North Macksville Ramps	Northbound	559	563
	Southbound	628	464
Main carriageway - North of North Macksville Ramps	Northbound	592	565
	Southbound	657	481
North Facing Ramps	Northbound	33	2
	Southbound	30	17
Old Coast Road (excluding ramp traffic)	Northbound	27	16
	Southbound	27	16
Letitia Close	Northbound	3	2
	Southbound	3	2
Existing highway - West of North of North Macksville Ramps	Northbound	178	15
	Southbound	141	35
Existing highway - East of North of North Macksville Ramps	Northbound	138	13
	Southbound	104	17

3.3.4 Results

Predicted noise levels for the approved layout without the ramps as well as for the three options are shown in **Figure 3-1**. To allow a focussed comparison, noise levels are only shown for buildings exceeding the critical night-time criteria of 50 dBLAeq,9hr.

The maximum increase in noise compared to the approved layout (which did not include any ramps at this location) is 2 dB(A).

3.3.5 Conclusion

All of the options would result in a slight increase in noise levels at nearby residences compared to the approved layout, but the maximum variation between the approved layout and any of the options is a maximum of 2 dB(A). This is not considered a significant variation in noise levels, since changes in noise level of less than 3 dB(A) are not able to be detected by most people.

Figure 3-1 Acoustic comparison of options

3.4 Other environmental considerations

The other environmental issues associated with the proposed options are:

- Native vegetation clearing
- Impacts on threatened flora and fauna and habitat
- Impacts on hollow bearing trees
- Impacts on Aboriginal and non-Aboriginal heritage.

Considering that air quality impacts of the approved layout were assessed in the Project EA as minor or negligible, the ramps with their relatively low traffic flows would have negligible impact on air quality and there would be no significant differences between options.

Each of the options has been assessed against the current environmental constraints mapping for the project. Figures showing each of the options and the environmental sensitive areas and constraints are included in **Appendix C**.

The sensitive area and constraints mapping shown in **Appendix C** was previously ground-truthed inside the approved project boundary during the Project EA. Additional ground-truthing has been carried out as necessary where the options extend outside the approved project boundary. The additional ground-truthing included the area between the project boundary and a 50 metre buffer measured from the footprint of the ramp options.

The additional flora and fauna ground truthing undertaken by GeoLink on 14 April 2015, confirmed that the current vegetation generally conforms to vegetation communities mapped as part of the Project EA. No additional hollow-bearing trees were detected within the study area and fauna habitats within the study area are considered to be generally low quality. No additional threatened flora species or listed Rare or Threatened Australian Plants (RoTAP species) were detected within the 50 metre buffer area.

The changes to vegetation communities that were identified by the additional ground truthing included:

- Modified vegetation community boundaries associated with Swamp Oak Forest Endangered Ecological Community (EEC) and Saltmarsh EEC
- An additional area of Swamp Forest EEC located to the north-east of the intersection of Old Coast Road and the existing Pacific Highway
- An additional area of Swamp Forest EEC located to the east of the upgraded highway and north of Letitia Close on private property.

These areas are shown in **Figure** 3-2.

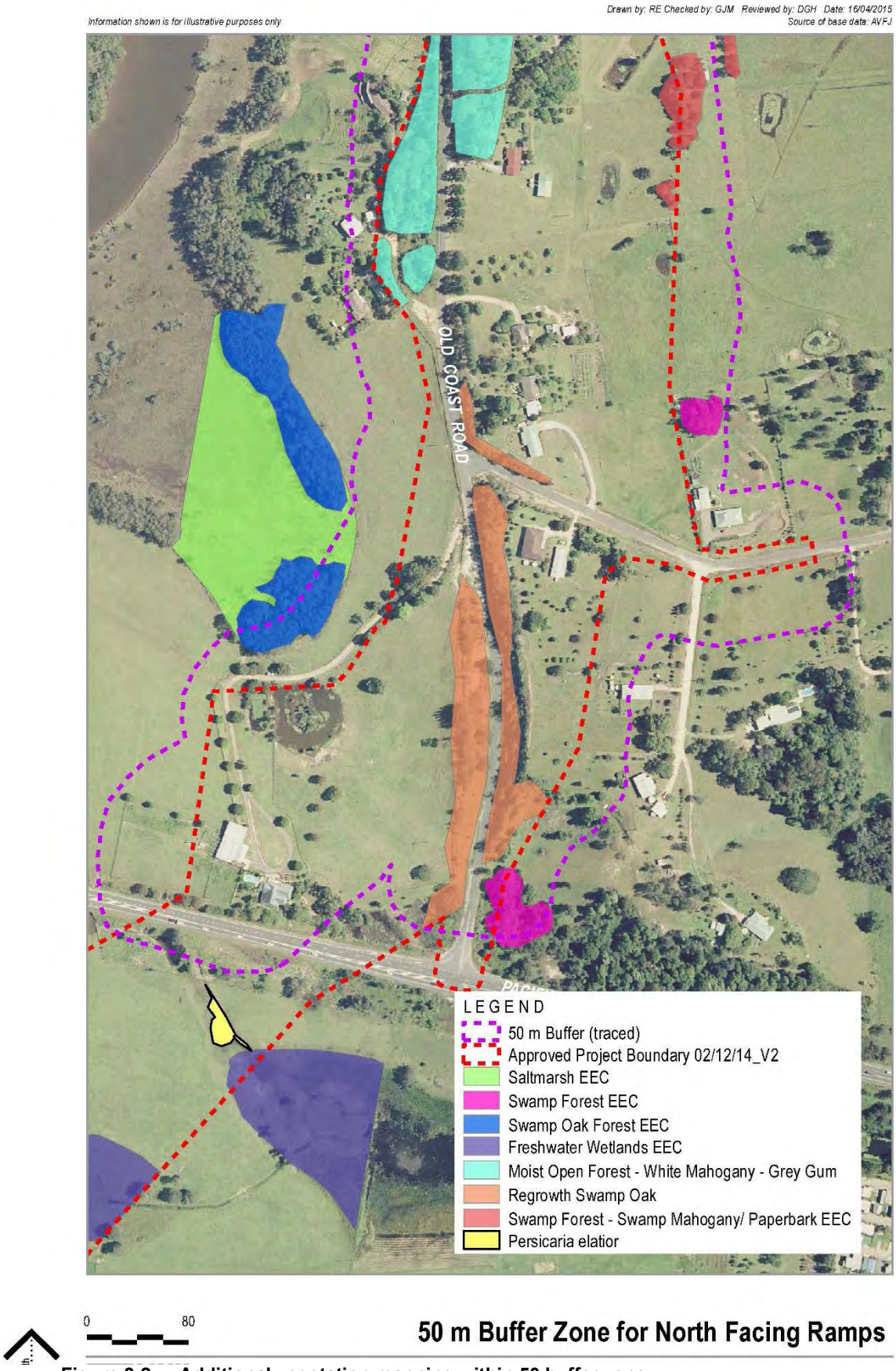


Figure 3-2 Additional vegetation mapping within 50 buffer zone

To assist with the assessment, the area of clearing of flora and fauna habitat required for each of the options has been calculated, assuming that clearing to accommodate all of the project infrastructure would extend 15 metres from the edge of the earthworks footprint. In **Table 3-6** clearing areas for each option have been compared against the EPBC Act approvals and the approved layout.

Table 3-6 Clearing area comparison with EPBC approval requirements for flora and fauna habitat

Habitat description	EPBC Act approval (ha) Note (1)	Approved layout with 15m buffer (ha) Note (2)	Option 1 with 15m buffer (ha) Note (2)	Option 2 with 15m buffer (ha) Note (2)	Option 3 with 15m buffer (ha) Note (2)
Slender Marsdenia/Clear Milkvine and Wooll's Tylophora/Cryptic Forest Twiner habitat	0.14	0.07	0.23	0.26	0.07
Koala habitat	0.90	1.24	1.67	2.06	0.86
Koala habitat (critical to survival)	0.81	1.18	1.54	1.95	0.75
Grey-headed Flying-fox habitat (foraging habitat critical to survival)	0.90	1.24	1.67	2.06	0.86
Spotted-tail Quoll habitat	0.90	1.24	1.67	2.06	0.86
Regent Honeyeater (*Anthochaera Phrygia*) and Swift Parrot (*Lathamus discolour*) wintering habitat, comprising dry sclerophyll forests containing Swamp Mahogany	0.00	0.00	0.06	0.06	0.07
Parsonsia dorrigoensis (Milky Silkpod) habitat	0.83	1.23	1.60	1.98	0.75

(1) Estimate of approved clearing under the EPBC approval based on Concept Design plus a 15m buffer

(2) Includes a 10% contingency allowance for design changes, water quality basins, drainage, utilities etc.

Similarly, the impacts on hollow bearing trees and *Marsdenia longiloba* (Slender Marsdenia) (listed as endangered under the Threatened Species Conservation Act 1995 and the EPBC Act) have been calculated, assuming that clearing to accommodate all of the project infrastructure would extend 15 metres from the edge of the earthworks footprint. The Slender Marsdenia plants are identified as being either indirectly impacted or retained in situ in the road reserve in the Threatened Flora Management Plan. **Table 3-7** below provides a comparison of the additional impacts.

Table 3-7 Other flora impacts

Vegetation type	EP&A Act Part 3A approval (ha) (1)	EPBC Act approval (ha) (2)	Approved layout with 15m buffer (ha)	Option 1 with 15m buffer (ha)	Option 2 with 15m buffer (ha)	Option 3 with 15m buffer (ha)
Number of Slender Marsdenia affected	1	1	2	3	3	2
Number of hollow bearing trees affected	6	9	12	23	26	13
TOTAL	7	10	14	26	29	15

(1) Estimate of approved clearing under the EP&A Act approval based on Concept Design plus a 10 metre buffer

(2) Estimate of approved clearing under the EPBC approval based on Concept Design plus a 15 metre buffer

An additional desktop cultural heritage due diligence assessment has also been carried out for the areas within the 50 metre buffer measured from the footprint of the ramp options. The assessment of the area affected by the north facing ramps identified that impacts to cultural heritage values are unlikely and that no further assessment is required.

The following sections provide an assessment of each option in terms of flora and fauna and heritage impacts.

3.4.1 Option 1

Compared to the EPBC Act approvals, Option 1 would require almost twice as much clearing of native fauna habitat. For example, Option 1 would require about 1.7 hectares of clearing of Koala habitat and Spotted-tail Quoll habitat, whilst the EPBC Act approval includes an estimated maximum of 0.9 hectares of habitat clearing for these species. Compared to the approved layout without the ramps, Option 1 would require about 35 per cent more native fauna habitat clearing.

Option 1 also requires clearing of two additional examples of the threatened flora species Slender Marsdenia and 14 additional hollow bearing trees compared to the EPBC Act approvals. Compared to the approved layout without the ramps, Option 1 would require clearing of one additional example of a threatened flora species and 11 additional hollow bearing trees.

Overall the impact of Option 1 on native vegetation clearing, on threatened flora and fauna and habitat and on hollow bearing trees would be more than the approved layout and Option 3, but less than Option 2.

There are no known Aboriginal heritage items or potential archaeological deposits impacted by this option.

Option 1 has no impact on non-Aboriginal heritage additional to that of the approved project.

3.4.2 Option 2

Compared to the EPBC Act approvals, Option 2 would require more than twice as much clearing of native fauna habitat. For example, Option 2 would require about 2.1 hectares of clearing of Koala habitat and Spotted-tail Quoll habitat, whilst the EPBC Act approval includes an estimated maximum of 0.9 hectares of habitat clearing for these species. Compared to the approved layout without the ramps, Option 2 would require about 65 per cent more native fauna habitat clearing.

Option 2 also requires clearing of two additional examples of the threatened flora species Slender Marsdenia and 17 additional hollow bearing trees compared to the EPBC Act approvals. Compared to the approved layout without the ramps, Option 2 would require clearing of one additional example of a threatened flora species and 14 additional hollow bearing trees.

Overall the impact of Option 2 on native vegetation clearing, on threatened flora and fauna and habitat and on hollow bearing trees would be more than the approved layout and Option 1 and 3.

There are no known Aboriginal heritage items or potential archaeological deposits impacted by this option.

Option 2 has no impact on non-Aboriginal heritage additional to that of the approved project.

3.4.3 Option 3

Compared to the EPBC Act approvals, Option 3 would require slightly less clearing of native fauna habitat. For example, Option 3 would require about 0.86 hectares of clearing of Koala

habitat and Spotted-tail Quoll habitat, whilst the EPBC Act approval includes an estimated maximum of 0.9 hectares of habitat clearing for these species. Compared to the approved layout without the ramps, Option 3 would require about 30 per cent less native fauna habitat clearing.

Option 3 also requires clearing of one additional example of the threatened flora species Slender Marsdenia and four additional hollow bearing trees compared to the EPBC Act approvals. Compared to the approved layout without the ramps, Option 3 would not require clearing of any additional examples of a threatened flora species but would affect one additional hollow bearing tree.

Overall the impact of Option 3 on native vegetation clearing, on threatened flora and fauna and habitat and on hollow bearing trees would be less than the approved layout and less than Options 1 and 2.

There are no known Aboriginal heritage items or potential archaeological deposits impacted by this option.

Option 3 has no impact on non-Aboriginal heritage additional to that of the approved project.

3.5 Water quality, erosion and sediment control

This section evaluates the impacts and requirements of the three options in terms of water quality and erosion and sediment control.

The key water quality consideration in this location is a SEPP 14 Wetland located approximately 100 metres to the west of the upgraded highway. While project requirements do not specifically require water quality control measures for local roads, including on and off-ramps, due to the proximity of the wetland it is proposed that all pavement runoff from the upgraded highway or local roads be treated before discharging into this SEPP 14 Wetland.

The drainage design of the upgraded highway includes a permanent water quality basin, named B 52.93, located on the western side of the upgraded highway at Chainage 53000 to treat, and provide spill containment, before road water runoff is released into the SEPP 14 Wetland. The approved layout also includes a clean water detention basin next to B 52.93 which is required to maintain the flood immunity of the property access track downstream and manage flows to the downstream wetland. In developing the options, consideration was given to their impact on the permanent and the temporary basins, as well as on the clean water detention basin.

Temporary erosion and sediment control for this project has been developed based on the Landcom publication Managing Urban Stormwater – Soils and Construction Volume 1 – 4th Edition (2004), commonly known as the Blue Book. Temporary basins have been specified for areas where average annual soil loss is greater than 150m^3/year. A set of progressive erosion and sediment control plans will be prepared on site to ensure that sediment runoff is managed to suit construction activity.

There is a temporary basin (B53.20) located on the western side of the upgraded highway at Chainage 53200 to capture and treat sediment runoff before it is discharged into the wetland. This basin would be affected by Option 3.

There are two temporary basins (B53.50 and B53.55) located on the eastern side of the upgraded highway near Chainage 53500 to capture and treat sediment runoff before it is discharged to the east. Each of the three options would impact on these temporary basins and sediment runoff may need to be controlled by moving these sediment basins outside the project boundary. Land outside the project boundary adjacent to these basins is owned by Roads and Maritime.

3.5.1 Option 1

Option 1 would not impact the permanent basin B52.93 or the adjacent clean water detention basin. Therefore the permanent water quality design of the upgraded highway would not need to be altered. Access to this basin would need to be provided in coordination with a new property access for an affected landholder.

3.5.2 Option 2

Option 2 would not impact the permanent basin B52.93 or the adjacent clean water detention basin. Therefore the permanent water quality design of the upgraded highway would not need to be altered. Access to the basin would need to be provided in coordination with a new property access for an affected landholder.

3.5.3 Option 3

Option 3 would directly affect the permanent basin B52.93 and the adjacent clean water detention basin. The proposed connection to Old Coast Road and the northbound on-ramp is located in line with the proposed basin location and therefore the drainage and water quality design would need to be changed.

An alternative water quality design in this location is constrained by the limited width to the project boundary and relatively steep natural topography in sections. Three potential water quality arrangements have been considered including:

1. Moving the basin to the east of the main alignment, upstream of the proposed culvert C53.02. It would be difficult to contain the basin earthworks here and it would be undesirable for it to discharge upstream of the culvert.

2. Diverting the flows away from the SEPP 14 Wetland to the sag at Chainage 53500 and therefore not requiring water quality treatment. This would involve a relatively significant diversion of catchment and change the upgraded highway drainage design.

3. Shifting the basin slightly further to the west of the proposed northbound on-ramp.

The third arrangement is proposed as this avoids the difficulties of the first two arrangements, however some additional land acquisition outside the project boundary would be required.

The clean water detention basin has been retained with Option 3 but needs to be shifted slightly to the west to be clear of the new access road to the entry ramp and Old Coast Road. Since alternative access to the adjacent property is available from the permanent basin access track, there is less need to reduce peak discharges to maintain the flood immunity of the existing track, but the clean water detention basin has been retained for environmental reasons in order to manage flows into the SEPP 14 Wetland. Further discussion on the resulting discharges into the SEPP 14 Wetland is provided in **Section 3.6** below.

Option 3 would also affect the location of the temporary basin B53.20 which captures and treats sediment prior to discharge in the SEPP 14 Wetland. If this basin were moved downstream of the site it would need to be placed on to private property, or alternatively if the area is managed suitably during construction, a temporary basin may not be required. The additional land acquisition is included in **Section 3.8**.

3.6 Flooding and hydrology

This Section evaluates the impacts and requirements of the three options in terms of hydrology and flooding.

Some backwater effects from the Nambucca River cause water to pond to the west of the upgraded highway during major regional events. There are two key flooding and hydrology considerations in comparing the ramp options:

- The flood immunity available with each option for access to the ramps and to Old Coast Road central
- Potential discharge to the SEPP 14 Wetland downstream of culvert C53.02 which could be sensitive to changes in flow rates. This culvert is linked to the permanent basin B52.93 and the associated clean water detention basin that is part of the approved layout without the ramps.

In terms of the first consideration, of flood immunity for access to the ramps and Old Coast Road, all options would provide the immunity required by the project and allow access in a 20 year flood event. All options would still be accessible in a 50 year event. The ramps and Old Coast Road central in Option 3 would remain accessible during a 100 year flood event while a small section of the existing Old Coast Road just north of the intersection with the existing highway would start to go under water in a 100 year flood event. In Options 1 and 2 this would start to restrict access to the ramps, Letitia Close and Old Coast Road central in anything above a 100 year event. For Option 3, only access to Letitia Close would be affected by a 100 year flood event.

In terms of the second consideration of discharge to the SEPP 14 Wetland the following **Table 3-8** summarises the flow rates and velocities discharging to the SEPP 14 Wetland, for the existing situation, the approved layout, and Options 1, 2 and 3.

Table 3-8 Discharge into SEPP 14 Wetland at culvert C 53.02 and permanent basin B 52.93

Case	5 year event		100 year event	
	Velocity (m/s)	Flow rate (m^3/s)	Velocity (m/s)	Flow (m^3/s)
Existing	2.03	0.092	2.31	0.154 (pipe) 0.201 (over road)
Approved layout, Options 1, 2 and 3	1.49	0.142	2.05	0.227*

* *This flow would occur both over the access road and through the pipe. The exact split would be likely to be similar to the split in the existing situation*

For the approved layout the permanent basin B52.93 is supplemented by a clean water detention basin which reduces peak flows into the wetland and allows the existing flood immunity of the access track between the basin and the SEPP 14 Wetland to be maintained. With these measures in place, **Table 3-8** shows that the approved layout would generally have lower discharge velocities and lower peak discharges than the existing situation.

Option 1 and Option 2 will not affect the upgraded highway and location of culvert C53.02, or the permanent basin B52.93 and clean water retention basin. Therefore these two options would also have generally lower discharge velocities and lower peak discharges to the SEPP 14 Wetland than the existing situation.

Similarly, Option 3 would have generally lower discharge velocities and lower peak discharges to the SEPP 14 Wetland than the existing situation since, as discussed in **Section 3.5**, it is proposed for Option 3 that both the permanent sedimentation basin B52.93 and the clean water detention basin would be relocated to the west.

All three options require a new culvert to drain the trapped area between the southbound exit ramp and the upgraded highway at Chainage 53450. Additionally Option 3 would require a new culvert to drain the area between the upgraded highway and northbound on-ramp. Bridge drainage requirements for Options 1 and 2 would not be required for Option 3.

A number of other adjustments to culverts and outlets would be required for each option. These changes are compared in **Table 3-9**.

Table 3-9 Culvert changes for Options 1, 2 and 3

Culvert	Option 1	Option 2	Option 3
C53.02	No change	No change	Extended about 25m downstream
C53.53	Extended about 10m	Extended about 10m	Relocated and extended about 30m
C53.74	Extend upstream. An additional inlet pit between the upgraded highway and northbound ramp may be needed.	Extended about 20m upstream	No change
C53.97	Extended by about 6m upstream	Extended about 10m upstream	No change
C53.31SR	No change	Relocated and reduced in length	Not required
C53.25SR	No change	Relocated but remain the same diameter and length	Not required

3.7 Earthworks quantities

Earthworks quantities have been calculated for the approved layout as well as for the three options, as shown in **Table 3-10** below. The quantities include earthworks for local roads and the ramps, but exclude the earthworks quantity for the upgraded highway as this quantity is the same in all cases.

Table 3-10 Earthworks quantities

Earthworks Volumes (m^3)	Approved layout (no ramps)	Option 1	Option 2	Option 3
Cut	43,501	61,564	61,410	90,411
Total Fill (excluding pavements and excluding SMZ)	29,735	85,907	63,102	39,824
Balance - shortage		24,343	1,692	
Balance - excess	13,766			50,587
Balance in relation to approved layout - shortage	0	38,109	15,458	
Balance in relation to approved layout - excess	0			36,821

Based on the above table, and allowing for the fact that the approved layout already factors in the anticipated excess of 13,800 cubic metres, the impact of each option on overall earthworks is as follows:

- Construction of Option 1 would require borrowing about 38,000 cubic metres
- Construction of Option 2 would require borrowing about 15,500 cubic metres
- Construction of Option 3 would require disposal of about 37,000 cubic metres.

A review of the option design layouts (**Appendix A**) have identified for Options 1 and 2 that widening of the cutting on the east side of the upgraded highway between Chainage 54100 and 54250 would provide the additional material required without affecting sensitive vegetation and while staying within the project boundary. For Option 3 suitable disposal areas that could accommodate the excess material without affecting sensitive vegetation and while staying within the project boundary have been identified.

3.8 Property impacts

This section describes the impact that each option would have on private land acquisition and access requirements of nearby properties. Additional impacts on land which has already been acquired by Roads and Maritime are not considered in this assessment.

For the purposes of comparison, property accesses have been designed with a 19m semi-trailer used as the design vehicle for each option. As the design progresses, the vehicle access requirements would be reviewed with the property owners.

To determine the property acquisition areas the following methodology was applied:

- Where the formation extends into private property, a six metres formation offset was applied to determine the acquisition required for the upgraded highway and local roads, and a three metre offset was adopted for local access and drainage works.
- Where the formation does not extend into private property, the lesser of a six metres formation offset or the offset to the property boundary was adopted to determine the amount (if any) of acquisition required.

Additional consideration has been provided where catch drains have been designed and extend beyond the six metres formation offset; this occurs for the approved layout and Option 1. The lesser of a one metres offset from the edge of the drain or the offset to the property boundary has been adopted to define the acquisition area in these instances.

Where temporary basins may be required outside the project boundary to manage sediment runoff, these have not been included in this assessment as they are not considered permanent works. Erosion and sediment control methodology will be at the discretion of the Contractor and the possibility of temporarily placing a sediment basin on an adjacent property would need to be agreed with the land owner.

Option 3 would require additional acquisition from one privately owned property, as shown in **Table 3-11** below. Options 1 and 2 would not require additional acquisition.

Table 3-11 Property adjustments

Lot and DP number	Required acquisition area (m^2) for:			
	Approved layout	Option 1	Option 2	Option 3
LOT 21 DP1186376	No additional impact	No additional impact	No additional impact	3243

3.9 Lighting

Lighting design and construction must comply with the requirements of relevant Authorities, including local councils, and consultation with these relevant Authorities and local councils is undertaken to ensure acceptance of the lighting design. Based on the SWTC requirements additional lighting is proposed as follows:

- Option 1:
  - Flag lighting at the off-ramp intersection with the realigned Old Coast Road
  - Flag lighting at the on-ramp intersection with the realigned Old Coast Road
  - Flag lighting at the Old Coast Road intersection with the existing Pacific Highway.
- Option 2:
  - Lighting at the roundabout connecting Letitia Close, the off-ramp, and the realigned Old Coast Road
  - Flag lighting at the on-ramp intersection with the realigned Old Coast Road
  - Flag lighting at the Old Coast Road intersection with the existing Pacific Highway.
- Option 3:
  - Flag lighting at the off-ramp intersection with Letitia Close
  - Flag lighting at the off-ramp intersection with the existing Pacific Highway
  - Flag lighting at the on-ramp intersection with Old Coast Road
  - Flag lighting at the on-ramp intersection with the existing Pacific Highway.

Flag lighting (one or two strategically placed lamps) is required at new intersections in Options 1, 2 and 3. Option 3 would require more lighting than Option 1 for the additional connection of the off ramp with the existing Pacific Highway. Option 2 would require the most lighting as in addition to flag lighting for two intersections, increased lighting is required for the roundabout.

3.10 Risk assessment

A Risk Workshop was held on 7 April 2015 to identify and rate risks associated with each of the ramp options. The outcome of the workshop was a risk management register which describes each risk and the controls and mitigation measures that might be required to address the risk. An initial risk rating was then determined for each identified risk based on the following risk matrix in **Table 3-12**.

Table 3-12 Risk matrix

		Estimated probability of risk occurring		
		LOW Less than 20%	**MEDIUM** 20-50%	**HIGH** 50-100%
Likely consequence if the risk eventuates	**HIGH** $1M plus; 3 months delay	MODERATE	MAJOR	MAJOR
	MEDIUM $300,000 - $1M	MINOR	MODERATE	MAJOR
	LOW Below $300,000	MINOR	MINOR	MODERATE

At the workshop a total of 55 risks were identified and rated. Most of the risks were common to all options but the workshop did identify a number of risks that were specific to individual options as summarised in **Table 3-13**.

Table 3-13 Number of option specific risks

	Option 1	Option 2	Option 3
MAJOR RISK	1	-	1
MODERATE RISK	4	4	6
MINOR RISK	1	4	5

The major risk item identified for Option 1 was that the Old Coast Road overbridge over the upgraded highway has quite complex geometry and requires widening and design refinements to meet the sight distance criteria.

The major risk item identified for Option 3 was there would be significant delay to construction resulting from property acquisition.

Moderate risks that were identified for the options included:

- Option 1 and Option 2:
  - Depth to required bearing material (for column and western abutment pad footings of the bridge) is deeper, resulting in increased width of excavation and longer column and/or deeper pad footing
  - Road alignment changes resulting in need to increase skew and/or increase span lengths and/or increase bridge width especially the eastern span
  - Stakeholder concerns with lighting at intersections due to increased light spill. Higher and closer intersections to residents will likely have a greater impact on residents
  - Risk of falls from height due to bridge construction
- Option 3:
  - Two intersections on the existing Pacific Highway are located close to each other which result in increased risk of accidents. Signage will be close to each other and could potentially result in confusion, especially for tourists, regarding which intersection to use

- Injury or death caused by pedestrian/vehicle illegally crossing the main carriageway to avoid walking/driving via the existing Pacific Highway
- Longer route for bus companies
- Underestimation of unsuitable soil material
- Proximity to SEPP 14 Wetland. The sedimentation and retention basins require relocation and are constrained by private property
- Design does not adequately address traffic staging requirements.

Overall, more risks were identified with Option 3 because compared to the other options it would involve more change compared to the approved layout.

4. Option assessment summary

The following **Table 4-1** summarises the findings of the assessment of Options 1, 2 and 3 that is described in **Section 3**. The table has been prepared to identify more clearly the main differences between the options, based on the information provided or referred to in this report.

Table 4-1 Option assessment summary table

	Option 1	Option 2	Option 3
Road user safety	1 high risk safety issue. 8 medium risk safety issues. 1 low risk safety issue.	3 high risk safety issues. 6 medium risk safety issues. 0 low risk safety issues.	2 high risk safety issues. 7 medium risk safety issues. 2 low risk safety issues.
Traffic assessment	Provision of the ramps improves travel time to/from Macksville and the north. However compared to Option 3, Option 1 would have slightly longer travel distance for traffic using the northbound entry ramp.	Provision of the ramps improves travel time to/from Macksville and the north. However compared to Option 3, Option 2 would have slightly longer travel distance for traffic using the northbound entry ramp.	Provision of the ramps improves travel time to/from Macksville and the north. Option 3 would have the shortest travel distance for traffic using the entry ramp but a longer travel distance for school buses using Old Coast Road to service Letitia Close.
Noise consideration	Increases of 1dB(A) in night-time noise levels at 2 dwellings compared to the approved layout and a reduction of 1dB(A) at 1 dwelling.	Increases of 1 dB(A) in night-time noise levels at 4 dwellings compared to the approved layout.	Increases of 1 dB(A) in night-time noise levels at five dwellings and 2dB(A) at one dwelling, compared to the approved layout.
Environmental consideration	Compared to the EPBC Act approvals, Option 1 requires less additional clearing of native fauna habitat than Option 2. For example, Option 1 requires 1.7 ha of clearing of Koala habitat. Option 1 requires clearing of 2 additional examples of a threatened flora species and 11 additional hollow bearing trees compared to the EPBC Act approvals.	Compared to the EPBC Act approvals, Option 2 requires the most additional clearing of native fauna habitat. For example, Option 2 requires 2.1 ha of clearing of Koala habitat. Option 2 requires clearing of 2 additional examples of a threatened flora species and 17 additional hollow bearing trees compared to the EPBC Act approvals.	Compared to the EPBC Act approvals, Option 3 requires slightly less clearing of native fauna habitat. For example, Option 3 requires 0.83 ha of clearing of Koala habitat. Option 3 requires clearing of 1 additional examples of a threatened flora species and 4 additional hollow bearing trees compared to the EPBC Act approvals.
Water quality and erosion and sediment control	The permanent water quality design of the upgraded highway would not need to be altered.	The permanent water quality design of the upgraded highway would not need to be altered.	Permanent basin B52.93 would need to be relocated onto private property. The clean water detention basin would need to be shifted slightly to the west. Temporary basin B53.20 would need to be relocated on to private property, or alternatively if the area is managed

	Option 1	Option 2	Option 3
			suitably, a temporary basin may not be required.
Flooding and hydrology consideration	Option 1 would require additional bridge drainage.	Option 2 would require additional bridge drainage.	Option 3 would require a new culvert to drain the area between the upgraded highway and northbound on-ramp.
Earthwork quantities	Construction of Option 1 would require borrowing an additional 38,000 m^3.	Construction of Option 2 would require borrowing an additional 15,500 m^3.	Construction of Option 3 would require disposal of an additional 37,000 m^3.
Property impacts	No additional private land acquisition compared to the approved layout.	No additional private land acquisition compared to the approved layout.	Requires acquisition of an additional 3243 m^2 from one property compared to the approved layout.
Lighting impacts	Option 1 would require flag lighting at new intersections. This is the option with the least lighting requirements.	Option 2 would require the most lighting. In addition to flag lighting for two intersections, lighting is required for the roundabout.	Option 3 would require more lighting than Option 1 due to the additional connection of the off-ramp with the existing Pacific Highway.
Risk assessment	1 high risk issue. 4 medium risk issues. 1 low risk issue.	0 high risk issues. 4 medium risk issues. 4 low risk issues.	1 high risk issues. 6 medium risk issues. 5 low risk issues.

5. Selection of the preferred option

5.1 Options assessment workshop

A detailed Options Development Report was prepared by Pacifico in consultation with Roads and Maritime. The three options presented then underwent an assessment by Roads and Maritime to test their performance against a range of agreed project objectives.

To determine the preferred option an Options Assessment Workshop, using a Value Management methodology, was convened on 20 May 2015 at the Pacific Highway Office at Grafton. The attendees are listed in the Roads and Maritime Options Assessment Report in **Appendix B**.

The agreed purpose of the workshop was to:

- Obtain an understanding of the project and the planning to date
- Identify, discuss and agree to criteria to be used to assess the options
- Review and then assess the options against the agreed criteria
- Draw conclusions, select a preferred option and agree to key actions arising.

5.2 Options assessment criteria

The purpose of the assessment was to differentiate between the options rather than undertake an absolute assessment of all project criteria for each option – so only those criteria that highlighted differences were considered in this assessment.

An assessment criteria to comparatively assess these differences was developed. The assessment criteria was divided into four key perspectives including: constructability and timing, functionality, community impacts and environmental impacts. Each criterion had a number of key descriptive aspects to help assess points of difference between the ramp options.

The agreed criteria are noted below in **Table 5-1** and following a group discussion the weighting for each criteria was agreed as indicated.

Table 5-1 Assessment criteria and weighting

Criteria	Descriptive Aspects	Weighting
Constructability & Timing	Program impacts and risks Staged construction of ramps Traffic / accessibility disruptions Bridge roadworks impacts (changes of scope / approved layout design)	35%
Functionality (Traffic Efficiency & user safety)	Attractiveness to users Impacts on travel times / road operations School bus Road user safety Road / bridge maintainers' safety	30%
Community Impacts	Additional land acquisition Local enterprises, shops and services Agribusinesses River / marine activities Emergency events Noise Light impacts on residences Headlight intrusion Visuals Severance	25%
Environmental Impacts	Water quality & flooding Flora & fauna Heritage	10%
Capital & Operating Costs*		

* Please note that this workshop only used the qualitative (non-price) criteria as preliminary estimated costs for the three options were similar and cost information was indicative only at the date of the workshop.

5.3 Summary of weighted criteria assessment

Scoring for each of the options (as show in **Table 5-2**) was undertaken relative to the approved layout. The scoring scale selected – from -5 to +5 was to acknowledge that some factors, for certain options had negative impacts rather than positive impacts compared to the approved layout.

These scores were also used as prompts to identify and propose any mitigation measures or improvements in the option – so that any assessment would be based on optimised options.

Table 5-2 Options assessment

Criteria	Descriptive Aspects	Weighting	Option 1		Option 2		Option 3	
Constructability & Timing	Program impacts & risks	35%	-1	This option will cause a minor delay to the overall project but can be managed by staging the construction.	-1	This option will cause a minor delay to the overall project but can be managed by staging the construction.	-5	Planning and approval risks with need to acquire more land for this option. Less complex construction program without a bridge for this option – especially for earthworks but needs some soft soil treatments and settling that would offset potential gains to the program.
	Staged construction of ramps		2	Construction of ramps can be staged as a bridge will be constructed over the highway.	2	Construction of ramps can be staged as a bridge will be constructed over the highway.	0	No opportunity to stage construction as a bridge will not be constructed.
	Traffic / accessibility disruptions		0	Minimal disruption to local traffic is expected with this option.	-1	Slightly more disruptive due to the construction of a roundabout at Letitia Close as this takes longer than a standard T intersection.	0	Minimal disruption to local traffic is expected with this option.
	Bridge and/or roadworks impacts (changes of scope / approved layout)		-3	This option needs 38,000 cubic metres of additional material to construct the embankments as compared to the approved layout.	-2	This option requires 15,000 cubic metres additional material to construct the embankments as compared to the approved layout.	-3	This option has a surplus of 36,800 material that would need to be disposed of as compared to the approved layout.
	Total Score		**-2**	**Weighted Score: -70**	**-2**	**Weighted Score: -70**	**-8**	**Weighted Score: -280**
	General Assessment Comments		The contract for the design and construction of this section of the highway has already been let – so the design and installation of the new ramps will involve negotiating a contract variation. There will be an impact on the construction program – to allow for design to be completed but also for planning approval from Department of Planning and the Environment. The timing of the ramps is ideally set to coincide with the opening of the motorway – not as a later addition – so they need to integrate with the bridge and roadworks. Options 1 and 2 are similar with the same weighted score. Options 1 and 2 performed substantially better than Option 3. Construction of Option 2 would be slightly more disruptive than Options 1 and 3 due to longer time required for construction of roundabout. Option 2 provides the best earthworks balance of the three options.					
Functionality (Traffic Efficiency & user safety)	Attractiveness to users	30%	4	Attractiveness to road users, same for all options.	4		4	
	Impacts on travel times / road operations		3	Impacts on travel times, same for all options.	3		3	
	School bus		1	Enhanced school bus facility provided with this option.	1	Enhanced school bus facility provided with this option.	-1	Only effect on school bus is option 3 – a longer route to collect Letitia close school children.
	Road user safety		-3	Layout of Option 1 has issues including adverse crossfall and poor coordination of curves on the off ramp that cannot be designed out. Three back to back curves at near minimum radii, tangent length between curves less than desirable minimum. Possible issues with the visibility of linemarking at the intersection of the off ramp and Old Coast Road.	-1	Roundabouts tend to have low-speed incidents, but more of them compared to other intersections. Better geometric layout than Option 1 with only one curve at minimum radius.	-4	Additional intersection with the old Pacific Highway is an increased safety risk.
	Road / bridge maintainers safety		-1	Normal risks associated with bridge maintenance.	-1	Normal risks associated with bridge maintenance.	1	No bridge to inspect and therefore safer.

Criteria	Descriptive Aspects	Weighting	Option 1		Option 2		Option 3	
	Total Score		**4**	**Weighted Score: +120**	**6**	**Weighted Score: +180**	**3**	**Weighted Score: +90**
	General Assessment Comments		Option 2 performed best for road safety and delivers a better road solution for functionality and more important long-term characteristics for road operations. Option 2 better caters for traffic growth as compared to option 1 – especially with a roundabout. Overall Option 1 performed better than Option 3 against functionality criteria.					
Community Impacts	Additional land acquisition	25%	0	No land acquisition needed	0	No land acquisition needed	-3	Additional land acquisition is required to allow for the proposed intersections with the Pacific highway and the Old Coast road.
	Local enterprises, shops and services		4	All options are good at attracting traffic to commercial interests in Macksville	4		4	
	Agribusinesses		0	No option affects agribusiness	0		0	
	River / marine activities		0	No option affects river or marine activities	0		0	
	Emergency events		3	All options improve accessibility for emergency events and incidents	3		3	
	Noise		-1	Will be some extra traffic noise due to increased traffic	-2	Slightly worse effects of noise from this option due to increased traffic and roundabout.	-1	Will be some extra traffic noise due to increased traffic.
	Light impacts on residences		-1	Only additional flag lighting required	-2	Lighting for the roundabout – because it is close to homes and it will have lights in an area where there is currently no lighting.	-2	Similar rating to option 2 re lighting impacts - Option 3 will have lighting around the intersections and the new bus bay, which is also closer to residences.
	Headlight intrusion		-1	Some headlight impact from the ramps and bend on Old Coast Road	-1	Some headlight impact from the ramps and roundabout.	0	Similar headlight impact to the approved project.
	Visuals		-1	Bridge has a negative impact on the appearance of the road	-1	Bridge has a negative impact on the appearance of the road	1	Improved appearance due to removal of the bridge
	Severance		0	There is no additional severance with this option.	0	There is no additional severance with this option.	-3	This option cuts Letitia Close from Old Coast Road.
	Total Score		**3**	**Weighted Score: +75**	**1**	**Weighted Score: +25**	**-1**	**Weighted Score: -25**
	General Assessment Comments		Noise modelling indicates no discernible change in noise impacts to receivers for all 3 options. There would need a doubling of traffic to create a 2 dB change in noise impact, which is the level that becomes discernible to the receivers. There will be some variation of noise during the different times of the day and increases when heavy vehicles use the ramps and intersections. A roundabout, as proposed in Option 2 is generally more noisy compared to a T-intersection and Options 1 & 2 may have traffic queuing – which generate braking and gear change noise. Option 2 with a roundabout better caters for traffic growth than options 1 or 3. Overall Option 1 performs best for community impacts followed by Option 2 and Option 3.					
Environmental Impacts	Water quality & flooding	10%	-1	More pavement area than the current approved project	-1	More pavement area than the current approved project	-2	This option has the most pavement area which increases runoff from pavement
	Flora & fauna		-2	Moderate clearing required	-3	Most clearing required	-1	Less clearing required
	Heritage		0	No impact on heritage	0	No impact on heritage	-1	Increased risk of finding a heritage item due to increased acquisition
	Total Score		**-3**	**Weighted Score: -30**	**-4**	**Weighted Score: -40**	**-4**	**Weighted Score: -40**

Criteria	Descriptive Aspects	Weighting	Option 1	Option 2	Option 3
	General Assessment Comments		No difference in flooding effects or management between the options. Water quality – all involve some extra pavement and required detention capacity. Option 3 marginally worse than the others due to additional pavement areas involved. Flora / fauna – all three impact larger areas and habitats – each results in a slightly different mix in what is being impacted. Need to go back to Commonwealth to outline the changes in the mix that the project will impact for the preferred option.		
Overall conclusions			The NSW Government has made the commitment to provide the ramps. Option 3 is not a viable strategy compared to the others – it scores significantly worse in all aspects of constructability and timing. Community expectations are important to address in the solution and its implementation strategy, including necessary consultation.		
TOTAL WEIGHTED SCORES			**+95**	**+95**	**-225**
Capital & Operating Costs[1]			Not considered in this assessment as task to develop costs and define any effects on operating costs not yet complete – a risk-based assessment of costs also needed here.		

[1] Please note that this workshop only used the qualitative (non-price) criteria as preliminary estimated costs for the three options were similar and cost information was indicative only at the date of the workshop. Cost estimates still needing some inclusions and exclusions to be defined. Cost estimates to be updated to include any agreed improvements and latest risk-based pricing.

5.4 Preferred option

The weighted assessment concluded that Option 1 and Option 2 both scored 95 and Option 3 scored a negative 225. Each option was scored relative to the approved layout and generally for each Criteria the results are:

- Constructability & Timing: Option 1 and 2 scored highest
- Functionality (Traffic Efficiency & user safety): Option 2 scored highest
- Community Impacts: Option 1 scored highest
- Environmental Impacts: Option 1 scored highest

As Option 1 and 2 scored equally in the assessment, the workshop then looked at each criteria and descriptive aspects in more detail to determine the preferred option. Option 2 was chosen as the preferred option as:

- It was assessed as better than Option 3 for the Constructability and Timing Criteria and equal to Option 1
- It was assessed as the best option for the Functionality Criteria (traffic efficiency and road user safety). In particular is was the preferred option as:
  - It scored highest in road user safety
  - It best caters for traffic growth and long term functionality
- It was assessed as having less Community Impacts than Option 3 but more noise and light impacts (due to the roundabout) than Option 1
- It was assessed as having less Environmental Impacts that Option 3 however it has slightly greater environmental impacts than Option 1 due to additional clearing of native vegetation.

In summary Option 2 was chosen as the preferred option as it is the safest option and improves functionality and road alignment, and is the best option for the long term performance of the north facing ramps.

6. Refinements of the preferred option

During the option assessment workshop a number of improvement opportunities were identified for the preferred option by workshop participants. Option 2 was compared to Option 1 and the criteria where Option 2 scored less were identified, these were:

- Traffic / accessibility disruptions
- Noise impacts
- Light impacts and intrusion
- Vegetation clearing

These criteria were examined and discussed in more detail and a number of specific opportunities and design refinements, that could be investigated and adopted in the design and construction phases, were identified for the preferred option. These opportunities and mitigation measures include:

- Extra earth mounds and screenings – would help to address headlight intrusion; eg use surplus soil to create a mound between the roundabout and residences
- Review the design alignment, including the skew angle of the bridge to reduce vegetation clearing
- Put plantings on top of the mounds to increase natural screening.

As part of the concept design development process these opportunities were investigated and a refined preferred option (see **Appendix D**) was designed. Preliminary property accesses were also considered and included in the refinement of the design. The refinements that were made included:

- Earth mounds between the roundabout and properties near Letitia Close to reduce noise and headlight intrusion were examined. However, due to limited area within the highway corridor, the height of the mound would not be sufficient to reduce impacts
- The bridge location was moved about 10 metres to the north and the skew angle increased from 15 degrees to 21 degrees. This allowed for the Old Coast Road, on the western side of bridge, to be realigned and reduce the vegetation clearing required for the Moist Open Forest vegetation community. This also moved the road further away from three residences on the western side of Old Coast Road reducing their noise impacts (compared to the Option 2 design). The change in skew angle in the bridge caused the location of the roundabout to move about 12 metres to the south east to maintain sight distance and achieve design criteria
- Moving the roundabout lowered and realigned the south section of Old Coast Road on the eastern side of the bridge. This increased the depth of the cutting between chainage 53000 and 53150, providing some needed additional material, however this does increase vegetation removal of the Regrowth Swamp Oak vegetation community in this area. There would be no change in noise impacts for nearby properties
- Plantings for the approved design were reviewed and these could be incorporated into the landscaping and urban design reports and further refined during detailed design.

7. What happens next

Since the north facing ramps at North Macksville are not currently included in the approved Warrell Creek to Nambucca Heads project, planning approval needs to be obtained before the ramps can be built.

The proposed process for obtaining the required approvals is as follows:

- A public display of the Preferred Options Report will be held, and public comments on the preferred option will be sought
- Public comments received on the refined preferred option will be considered and where appropriate further refinements would be made
- A concept design and environmental assessment will be prepared for the refined preferred option incorporating any relevant design refinements arising from public consultation. The environmental assessment will document potential environmental impacts of the ramps and the measures adopted to mitigate these impacts
- The refined concept design and environmental assessment would be submitted to the NSW Department of Planning and Environment for planning approval as part of a Modification Assessment Report under Section 75 W of the EP&A Act
- The modification would be displayed by the NSW Department of Planning and Environment for public comment. A Submissions Report would then be complied and the refined concept design and environmental assessment may be further refined if required to address feedback
- Following the NSW Department of Planning and Environment approval of the modification, construction can proceed subject to meeting any approval conditions.

References

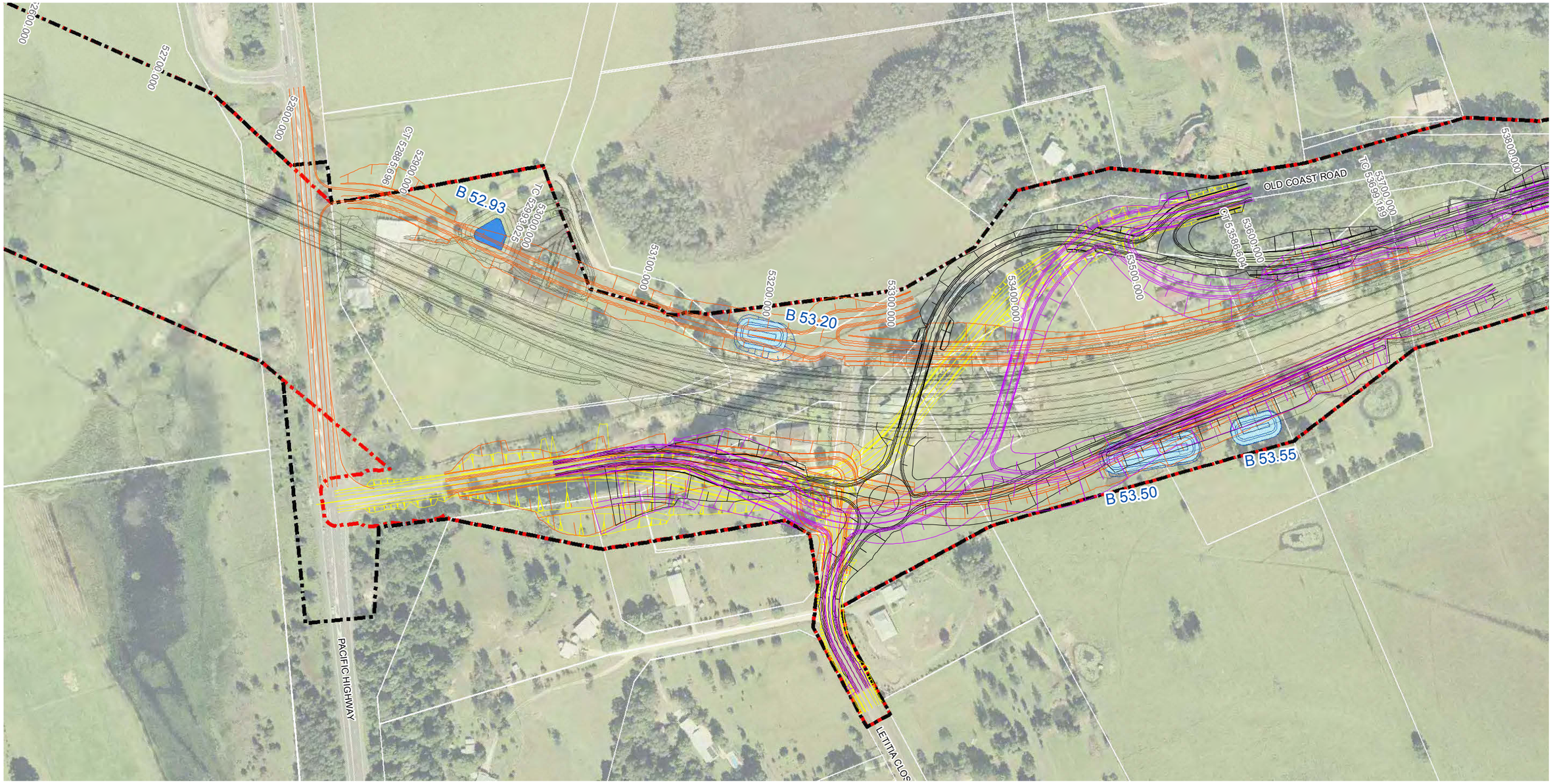
Austroads *Guide to Traffic Management Part 3: Traffic Studies and Analysis*

RMS 2012 *Pacific Highway Upgrade, Warrell Creek to Urunga, Traffic Modelling Final Report* May 2012, Roads and Maritime Services.

RMS 2010 *Warrell Creek to Urunga Pacific Highway upgrade Environmental Impact Assessment*, January 2010, Roads and Maritime Services.

Appendix A

North facing ramp design options



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Design options - Old Coast Rd South

- Concept design
- Option 1 ramps
- Option 2 ramps
- Option 3 ramps
- Proposed project boundary (16/06/2015)
- Approved Project boundary # (edited at Northern end)

Stormwater management

- Drainage basin (Permanent)
- Drainage basin (Temporary)

 # denotes: Project boundary based on WC2NH_Approved_Project_Boundary_20141202_V2.shp received 02/12/2014, and adjusted to suit survey accurate cadastre (edited at Northern end)

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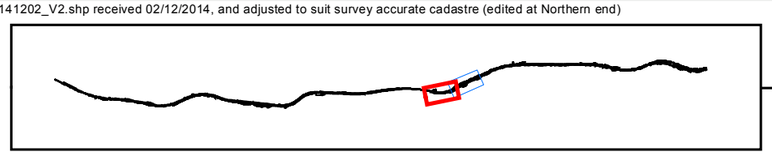
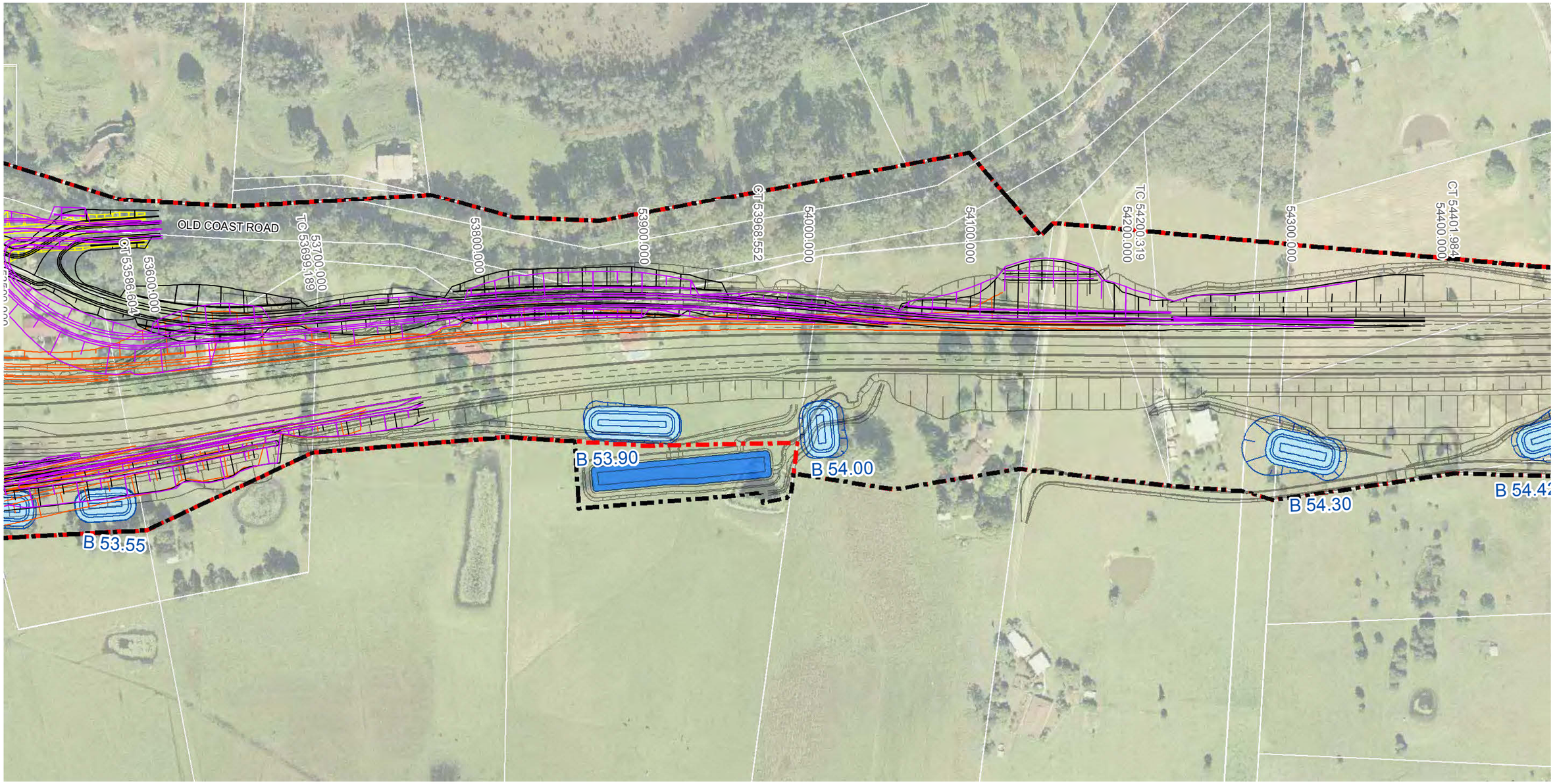


Note:

Projection: GDA 1994 MGA Zone 56
Source: RMS, AADJV, Geolink, Benwell

PACIFIC HIGHWAY UPGRADE **WC2NH**
North Facing Ramps at North Macksville – Preferred Option Report

FIGURE: Design Options
(Map 1 of 2)



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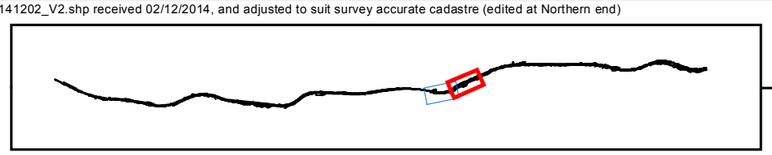

Note:

Projection: GDA 1994 MGA Zone 56

Source: RMS, AADJV, Geolink, Benwell

PACIFIC HIGHWAY UPGRADE **WC2NH**

North Facing Ramps at North Macksville – Preferred Option Report

FIGURE: Design Options (Map 2 of 2)

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PACIFIC HIGHWAY UPGRADE – WARRELL CREEK TO NAMBUCCA HEADS

North Facing Ramps at North Macksville - Options Assessment Report

MAY 2015

Prepared by:-

The Australian Centre for Value Management

55 Albion Street

Surry Hills NSW 2010 Australia

Tel (61 2) 9211 6488

Fax (61 2) 9211 6499

acvm@acvm.com.au

Contents

1. Workshop report

1.1 Background

The addition of two north facing ramps at North Macksville to the Warrell Creek to Nambucca Heads Pacific Highway Upgrade project, created the need to examine alternatives as to how the ramps could be incorporated to ensure that a range of project objectives are best realised.

An Options Report was therefore prepared by the design and construction consortia (Pacifico - an Acciona and Ferrovial joint venture) in consultation with Roads and Maritime Services.

The options presented in that report needed to undergo an assessment by Roads and Maritime to test their performance against a range of agreed project objectives.

An Options Assessment workshop using a Value Management methodology was convened on Wednesday 20 May 2015 at the Pacific Highway Office at Grafton. The attendees at the meeting were:

Chris Clark – Senior Project Manager

Bob Higgins – General Manager, Pacific Highway (part)

Jim Campbell – Principal Manager, Major Projects

Rachel Sadler – Communications Officer

Luke Fluechter – Resident Engineer

David Ledlin – Pacific Highway, Environment Manager

Chris Wicks – Environment Officer

Chris Vickery – Lead Road Designer

Matthew Francisco – Assistant Resident Engineer

Mark Neasbey – Facilitator ACVM

Only limited relevant extracts from the Options Report, which were pertinent to the options assessment, are included in this report.

1.2 Workshop objectives and activities

The agreed purpose of the workshop was to:

- Obtain a understanding of the project and the planning to date
- Table and agree criteria to be used to assess the options
- Review and then assess the options against the agreed criteria
- Draw conclusions, select a preferred option and agree key actions arising.

1.3 Summary of the workshop outcomes

It was concluded that:

- Option 2 is the preferred option. The identified mitigation measures should be considered further in the design and construction solution and implemented where reasonable.
- Option 2 is the most appropriate basis for consulting the community to explain the option and how it addresses the government's and community's expectations and seek relevant feedback comments.
- Option 2 would involve some variations to environmental effects that may need to be presented to the Federal and State Governments for relevant planning endorsements.

2. Project information and options descriptions

The information presented in this section is a summary of the information shared by the workshop participants about the options.

2.1 Purpose of the project

Roads and Maritime engaged Pacifico (an Acciona and Ferrovial joint venture) to design and build the 20 kilometre Warrell Creek to Nambucca Heads Pacific Highway upgrade. The project involves upgrading the highway to a four lane divided road between the Allgomera deviation, south of Warrell Creek and Nambucca Heads, just south of the railway line.

In response to representations from Nambucca Shire Council and the Macksville Chamber of Commerce, north facing ramps are proposed at North Macksville. This is in addition to the approved interchanges at Warrell Creek and at Bald Hill Road south of Macksville. The proposed ramps would include a northbound on-ramp onto the highway, a southbound off-ramp from the highway and a median crossover facility to enable emergency vehicles (including ambulances stationed at North Macksville) to travel both north and south on the highway.

Inclusion of the north facing ramps and median crossover brings a number of advantages to the Warrell Creek to Nambucca Heads Pacific Highway upgrade, including:

- The ramps would improve connectivity between Macksville and areas to the north, and in particular connectivity between Macksville and Nambucca Heads
- While Macksville is not identified by Roads and Maritime as a Service Centre, addition of the north-facing ramps and appropriate signage would, in conjunction with the Bald Hill Road interchange to the south, allow both northbound and southbound vehicles using the upgraded highway to stop at Macksville with only a short diversion
- The ramps would allow greater utilisation of the infrastructure investment in the section of the Warrell Creek to Nambucca Heads upgrade between Macksville and the Nambucca Heads interchange, about 10 km to the north. By adding the north facing ramps at Macksville, more vehicles will be able to take advantage of safer and faster travel on the upgraded highway to the north
- The ramps would improve access to and from Macksville for emergency services and reduce response times. The northbound entry ramp, in conjunction with the proposed emergency vehicle cross-carriageway access just north of Mattick Road, would provide improved access to a major incident on the upgraded highway south of the Nambucca River

Since these ramps are not currently included in the approved Warrell Creek to Nambucca Heads project, planning approval will need to be obtained before the ramps are built.

Three options for the layout of the north facing ramps and their connections to the road network have been developed following an initial assessment with Roads and Maritime.

Following selection of the preferred option, an assessment of the potential environmental impacts of the preferred location of the ramps and proposed measures to mitigate these impacts will be prepared. The environmental assessment will then be displayed for public comment before planning approval for the proposal is sought.

2.2 Ramp design considerations

Key considerations in the design of the ramps include:

- Traffic performance – a minimum Level of Service “C” for 2036 for the 100th highest hourly volumes
- Geometric design:
  - entry ramps - target truck speed at the end of the ramp of 75 km/h
  - exit ramp - all deceleration to occur in the deceleration lane
- Design Vehicle - allowance for 25m B-Double – to travel between the existing Pacific Highway and the new ramps and though movements at intermediate intersections

- Pavements – Consistent with other Pacific Highway upgrade projects including the use of concrete for roundabouts
- Ultimate layout to accommodate future additional lane in each direction.

2.3 Options descriptions

Three north facing ramp options were developed and the description of each option is outlined below.

2.3.1 Option 1

Option 1 is closely aligned to the approved layout of works for the Project, which includes realignment of the Old Coast Road to pass above the upgraded highway. Option 1 is a comparatively simple addition to the approved layout by adding north facing ramps, which connect as simple T-intersections to the realigned Old Coast Road. At the new intersections priority is given to through traffic on the Old Coast Road.

The existing channelised intersection where Old Coast Road connects to the existing Pacific Highway would be retained. With the lower volume of traffic on the existing highway the existing layout with two lanes northbound and separate right and left turn lanes off the highway would meet capacity requirements.

Diversion of Old Coast Road (MCD0)

The diversion of the Old Coast Road (MCD0) starts about 150 metres north of the existing Pacific Highway on the east side of the main carriageways and extends for about 660 metres before reconnecting to the existing Old Coast Road on the west side of the main carriageways. The horizontal geometry of the diversion does not fully conform to the Project Scope of Works and Technical Criteria (SWTC) requirements:

- Curve radii on the Old Coast Road diversion, from the start of the diversion near the existing highway, are +125m, -105m, +105m and then -340m, with 3% superelevation provided on all curves. The radius of 105 metres is the minimum permitted with 3% superelevation for the design speed of 60 km/h
- The length of tangent between the +125m and -105m radii curves (Ch150 – 180) is 29.3m, which is less than the 60 metres desirable minimum (length required is equal to V) and less than the normal minimum of 0.6V or 36 metres
- The eight metre length of tangent between the +105m and -340m radii curves (Ch584 – 592) is substantially less than the 60 metre desirable minimum
- The length of the horizontal curve from Ch 54 to 152 (98 metres) is marginally below the desirable minimum horizontal curve length of 100 metres.

Geometry issues are further considered where necessary in the road safety audit of the options.

Old Coast Road Bridge over main carriageways

The realigned roadway passes above the main carriageways on a skewed bridge, which is 62 metres long and has one lane plus a minimum one metre wide shoulder in each direction. The bridge itself is unchanged and retains the same horizontal alignment as in the approved design, with the proposed form of the bridge being a two span bridge with twin 1600 deep precast U-girders supported at the abutments and by twin piers in the median.

The tight horizontal geometry as noted above does create some difficulties with the bridge.

The horizontal curve on the east side of the main carriageway extends onto the bridge, and the result is that curve widening and sight line widening is required. The minimum bridge width would be nine metres comprising 2 x 3.5 metre lanes and 2 x 1.0 metre shoulders.

The bridge width as designed varies from 10.2 to 10.7 metres to meet the curve widening requirements and to provide sight lines past the nearside bridge barrier for northbound traffic approaching from the eastern side. It is also noted that the 3% superelevation for the horizontal curve which extends onto the east end of the bridge has been continued across the full length of the bridge to avoid the added complexity of a superelevation transition on the bridge.

Letitia Close T-intersection

The T-intersection with Letitia Close remains unchanged as a simple priority junction. It is located on the outside of a minimum radius horizontal curve. As per SWTC requirements, bus bays/stops are provided in each direction on the realigned Old Coast Road just south of Letitia Close. The design vehicle for turns at the intersection is a 19m semi-trailer.

Southbound exit ramp (MCD1)

The southbound exit ramp (MCD1) comprises a 110 metre long parallel diverge with a further distance of about 300 metres from the linemarking nose to the T-junction where the exit ramp connects to the realigned Old Coast Road.

Option 1 retains the visual mound on the east side as required by the SWTC. With the ramp in place the mound extends from chainage 160 to 320, with the ramp itself effectively extending the mound where it is on fill as it climbs to Old Coast Road.

Most of the ramp beyond the physical nose is climbing at 4.8%, which will assist in deceleration. The ramp fully meets the SWTC guidelines in terms of rate of deceleration but there are some safety issues approaching Old Coast Road:

- Due to the need to match the longitudinal grade on the realigned Old Coast Road there is adverse cross-fall on the 115 metre radius curve that connects the exit ramp. With adverse cross-fall the design speed is about 40 km/h. The adverse cross-fall is undesirable in a braking area and on reverse curves with no tangent between. The safety audit identified the risk as low, however further design development will determine whether it is possible to reduce the risk by introducing superelevation of the first part of the curve
- Due to the need to match the superelevation on the realigned Old Coast Road there is a crest curve just before the intersection. This crest curve hides the intersection layout and pavement markings from the approaching driver. Adopting a shorter crest curve would improve visibility
- The ramp intersection is located on a minimum radius horizontal curve on the realigned Old Coast Road.

The intersection itself with the realigned Old Coast Road is a simple T-junction and traffic from the ramp would be able to turn left or right into Old Coast Road. Due to the comparatively low volumes, no acceleration lanes are proposed. The design vehicle for turns at the intersection is a 25m B-Double.

Northbound entry ramp (MCD2)

The northbound entry ramp (MCD2) has a total length of 876 metres from the intersection with the realigned Old Coast Road to the end of the 110 metre merge taper. Most of the length from the intersection to the physical nose is on a 0.8% down grade, which assists with acceleration.

Typically the cross section of the ramps consists of a 3.5 metre lane with a two metre left hand side shoulder and a one metre right hand side shoulder.

At the northern end of the ramp Option 1 retains the visual mound on the west side as required by the SWTC. The position of the mound is adjusted slightly between Chainage (Ch) 760 and 876 to accommodate the ramp. North of Ch 876 the mound matches the mound in the approved project.

The length of the entry ramp in Option 1 is in accordance with advice from Roads and Maritime, which was to achieve a truck speed of 75 km/h at the start of the 110 metre merge length. The actual speed would be about 74 km/h, with about 100 metre extra length required to achieve 75 km/h. To fully meet the SWTC guidelines which require a truck speed of 85 km/h to be reached at the start of the 110 metre merge length would not be practicable as it would require over one kilometre of additional lane.

The proposed treatment of the intersection with the realigned Old Coast Road at the start of the ramp is a T-junction with a channelised right turn for northbound traffic on Old Coast Road to turn onto the ramp. Due to the comparatively low traffic volumes, a shortened right turn lane is proposed.

It is noted that for the design hourly turning volume of about 40 vehicles per hour, a channelised right-turn would not be required.

The channelised right turn would be safer, especially considering that the intersection is located on a minimum radius curve (R105 metres), and the treatment of this intersection should be reviewed if Option 1 is selected as the preferred option.

The design vehicle for turns at the intersection is a 25m B-Double.

2.3.2 Option 2

Option 2 is a relatively minor variation on Option 1, which aims at overcoming some of the alignment difficulties inherent in Option 1. It still includes realignment of the Old Coast Road to pass above the upgraded highway, and the north facing ramps still connect to the realigned Old Coast Road. The main difference is that the Letitia Close and exit ramp intersections are combined as a roundabout on the east side, allowing the alignment of the bridge over the main carriageways to be straightened.

The other change is that on the west side the priority has been reversed, with access onto the northbound entry ramp given priority over traffic from Old Coast Road central.

The existing channelised intersection where Old Coast Road connects to the existing Pacific Highway would be retained. As with Option 1, the lower volume of traffic on the existing highway means that the existing layout with two lanes northbound and separate right and left turn lanes off the highway would meet capacity requirements.

Diversion of Old Coast Road (MCD0 and MCD2)

The diversion of the Old Coast Road (MCD0 and MCD2) still starts about 150 metres north of the existing Pacific Highway on the east side of the main carriageways and extends for about 660 metres before reconnecting to the existing Old Coast Road central on the west side of the main carriageways. The existing Old Coast Road central connects as a T-junction to Old Coast Road south and its continuation as the entry ramp. The total length of the diversion of Old Coast Road is almost identical to Option 1 but the geometry is somewhat improved:

- Apart from negotiating the intersections, the curve radii are increased, with one 200 metre radius curve on the east side but a minimum 105 metre radius curve remains on the west side
- The roundabout will control speeds and allows a straight connection for the bridge across the main carriageways and through a 105 metre radius right hand before entering the on-ramp northbound.

Old Coast Road Bridge over main carriageways

The realigned roadway passes above the main carriageways on a bridge at a slightly reduced skew compared to Option 1 and located about 70 metres to the south. The bridge form would remain the same as in the approved layout and Option 1, with the proposed form of the bridge still a two span bridge with twin 1600mm deep precast U-girders supported at the abutments and by twin piers in the median.

The length of the bridge would be similar to that in the approved layout and in Option 1. The skew angle (15 degrees) is slightly less than the 21 degree skew of the approved layout and Option 1, but the bridge clearance is increased because the main carriageways are in deeper cut at the revised bridge location. The main advantage of the roundabout is that the bridge can be straight and should not require curve widening or widening for sight lines. Preliminary reviews suggest that the bridge is far enough from the roundabout that the bridge parapets should not affect sight triangles for the roundabout.

Pending detailed design it has been assumed that the Option 2 bridge would be 62 metres long, the same as in the approved layout and Option 1, however the deck area is less because the width would be a constant nine metres comprising 2 x 3.5 metre lanes and 2 x 1.0 metre shoulders.

Letitia Close and roundabout

The T-intersection with Letitia Close in the approved project and in Option 1 is replaced in Option 2 by a connection to the new roundabout. A minor realignment of Letitia Close would be required to connect it to the new roundabout, which provides safe and convenient access to Letitia Close from all directions. The proposed roundabout has an 11 metre radius central island and a 20 metre radius inscribed circle, and is designed for B-Double access to and from the ramps.

Bus bays/stops are provided in each direction on the realigned Old Coast Road just south of the roundabout.

Southbound exit ramp (MCD1)

The Option 2 southbound exit ramp (MCD1) comprises a 110 metre long parallel diverge with a further distance of about 350 metres from the linemarking nose to the roundabout where the exit ramp connects to the Old Coast Road roundabout.

Option 2 retains the visual mound on the east side as required by the SWTC. With the ramp in place the mound extends from Ch 170 to 390, with the ramp itself effectively extending the mound where it is on fill as it climbs to the Old Coast Road roundabout.

Most of the ramp beyond the physical nose is climbing at 4.0%, which will assist in deceleration. The ramp fully meets the SWTC guidelines in terms of rate of deceleration and the roundabout approach has improved visibility and safety compared to Option 1.

Northbound entry ramp (MCD3)

The northbound entry ramp (MCD3) has a total length of 870 metres from the intersection with the realigned Old Coast Road to the end of the 110 metre merge taper. Most of the length from the intersection to the physical nose is on a 0.9% down grade which will assist with acceleration.

Typically the cross section of the ramps consists of a 3.5 metre lane with a two metre left hand side shoulder and a one metre right hand side shoulder.

At the northern end of the ramp Option 2 retains the visual mound on the west side as required by the SWTC. The position of the mound is adjusted slightly between Ch 1040 and 1200 to accommodate the ramp. North of Ch 1200 the mound matches the mound in the approved project.

The length of the entry ramp in Option 2 is in accordance with advice from Roads and Maritime, which was to achieve a truck speed of 75 km/h at the start of the 110 metre merge length. The actual speed achieved using Figure 9.11 of Appendix 9 of the SWTC would be about 75 km/h for the majority of trucks, which would approach from the Old Pacific Highway and have priority as they enter the ramp. On the west side of the upgrade, the central portion of the existing Old Coast Road connects as a T-junction to realigned Old Coast Road south and its continuation as the entry ramp.

The proposed treatment of this intersection is a priority controlled T-junction with priority given to northbound entry ramp traffic over southbound traffic from Old Coast Road central.

Due to the comparatively low turning traffic volumes, no channelised left turn lane is shown. The design hourly turning volume of about 29 vehicles per hour and low through volume (42 vehicles per hour) do not warrant a channelised left turn.

However, a channelised left turn would be safer, especially considering that the intersection is located at the start of the onramp where vehicles may be travelling at higher speeds and/or accelerating, this can be developed further during detailed design.

The design vehicle for turns at the intersection with Old Coast Road is a 19m semi-trailer.

2.3.3 Option 3

Option 3 is quite different from Options 1 and 2. Rather than realigning the Old Coast Road onto a new bridge above the carriageway, a new connection for the Old Coast Road is provided on the west side of the main carriageways. This connection provides a two-way link between the existing Pacific Highway and the existing Old Coast Road to the north.

Connectivity to Letitia Close is retained by maintaining the redundant section of the Old Coast Road to the east of the main carriageways.

With these connections to the existing Pacific Highway available on both sides of the main carriageways, the north facing ramps can be added on each side north of the Letitia Close and Old Coast Road central connections.

While this option requires the construction of a new connecting road on the west side of the existing highway, it avoids the need to construct a bridge to carry Old Coast Road above the main carriageways.

The existing channelised intersection where the redundant section of the Old Coast Road connects to the existing Pacific Highway would be retained. As with the other options the lower volume of traffic on the existing highway means that the existing layout with two lanes northbound and separate right and left turn lanes off the highway would meet capacity requirements.

Letitia Close and exit ramp connection

The realignment of the redundant section of the Old Coast Road is similar to Option 1 but is located closer to the main carriageway. The cross section adopted for the realignment consists of a 2 x 3.5 metre lanes with a one metre shoulder on each side. The extent of works is approximately 300 metres to intersect with Letitia Close and the exit ramp. Letitia Close still connects as a T-junction with priority given to traffic from the exit ramp.

All northbound vehicles from the existing Pacific Highway would be required to turn right into Letitia Close, and the right turn is channelised to direct vehicles accordingly and minimise the risk of vehicles inadvertently entering the exit ramp. No Entry signage would be required at the exit ramp connection. The design vehicle for turns at the intersection is a 19m semitrailer.

One potential issue with the arrangement shown is that Safe Intersection Sight Distance looking towards the exit ramp is restricted by the safety barrier on the inside of the exit ramp curve, and further assessment would be required if this option is selected.

To meet the SWTC requirements a bus stop facility is proposed in this location to service Letitia Close. Unlike Options 1 and 2 however, this option does not provide a continuation across the proposed Pacific Highway so the bus bays/stops have been combined into a bus turnaround facility at the new intersection. This facility could also be used by other vehicles when necessary as a U-turn facility. The channelised right turn arrangement shown would make it easier for buses to use the bus loop that has been provided to allow buses to return to the existing Pacific Highway. If Option 3 is selected then further discussions would need to be held with the bus operator(s) to confirm the proposed layout.

The design shows a short left turn lane into Letitia Close for southbound vehicles on the exit ramp but due to the low volume of left turning traffic (one vehicle per hour) the separate lane would not be warranted.

It is recommended that the need for this left turn lane should be further reviewed if Option 3 is selected as the preferred option.

Southbound exit ramp (MCD1)

The Option 3 southbound exit ramp (MCD1) comprises a 110 metre long parallel diverge with a further distance of about 370 metres from the linemarking nose to the T-junction with Letitia Close.

Option 3 retains the visual mound on the east side as required by the SWTC. With the ramp in place the mound extends from Ch 540 to 710, with the ramp itself effectively extending the mound where it is on fill as it climbs to the Letitia Close intersection.

The latter part of the ramp is climbing at 4.0%, which will assist in deceleration. The ramp fully meets the SWTC guidelines in terms of rate of deceleration and visibility to the ramp terminal junction.

Realignment of Old Coast Road (MCN0)

The realignment of the Old Coast Road (MCN0) starts just west of where the main carriageways pass above the existing Pacific Highway on the Nambucca River bridge structures. The realignment is about 400 metres long and requires cuts and fills of up to about seven metres.

The cross section adopted for the realignment consists of a 2 x 3.5 metre lanes with a one metre shoulder on each side.

Sections of the Old Coast Road realignment are within 25 metres of the edge line of the main carriageway and are therefore likely to require planting or screens to minimise headlight glare.

At the southern end a new intersection would be provided off the existing Pacific Highway just to the west of the main carriageways and about 80 metres east of the Nursery Road intersection, which is on the other side of the highway. The proposed treatment of the intersection of the realigned Old Coast Road with the existing Pacific Highway is a priority T-Junction with channelised right turn and left turn lanes on the highway. The left turn lane into the realigned Old Coast Road is warranted, by the volume of left turning traffic.

While the volume of right turn traffic from the highway into the realigned Old Coast Road is very low, a short right turn lane has been proposed for safety and consistency with intersection treatments on the existing Pacific Highway in the vicinity. It is recommended that the layout of this intersection should be further reviewed if Option 3 is selected as the preferred option.

Due to the proximity of the new carriageways and bridge abutments, it is likely that a retaining wall up to about 40 metres long (MCN0 chainage 30 to 70 approx.) and 4 metres high will be required to keep fill from the main carriageways at the Nambucca River bridge abutment from extending onto the realigned Old Coast Road. Without this wall it is likely that the realigned Old Coast Road would have to be shifted further west and additional property acquisition would be required.

At the northern end a new intersection would be provided to connect the realigned Old Coast Road south with Old Coast Road central and the start of the one-way entry ramp. The proposed treatment of the intersection is for the through movement onto the entry ramp to have priority while Old Coast Road central is realigned slightly to connect as a T-junction. A short left turn lane into Old Coast Road central is shown even though it is not warranted by the volume (29 vehicles per hour) of left turning traffic.

The short left turn lane has been shown for safety reasons considering that through vehicles will be accelerating in anticipation of the start of the entry ramp. It is recommended that the layout of this intersection and the need for this left turn lane should be further reviewed if Option 3 is selected as the preferred option. The design vehicle for turns at the intersection is a 19m semi-trailer.

No provision has been made for bus bays/stops on the realigned Old Coast Road on the west side of the main carriageways as this is not a requirement of the SWTC. Provision for buses has been made at Letitia Close on the east side of the main carriageways.

Northbound entry ramp (MCD3)

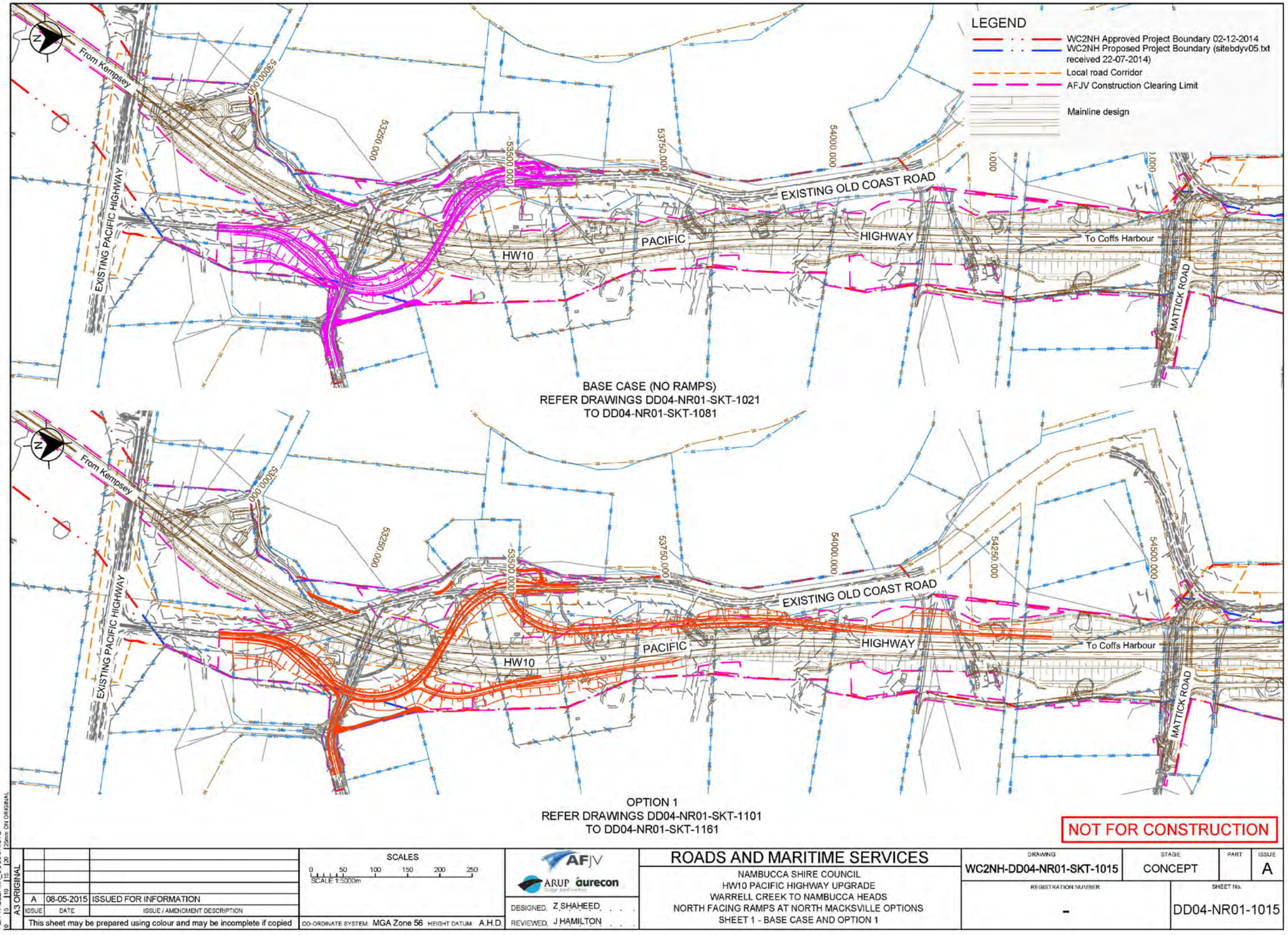
The northbound entry ramp (MCD3) has a total length of 940 metres from the intersection with the realigned Old Coast Road central to the end of the 110 metre merge taper. From the start of the ramp the grade climbs for 100 metres at about +2% to a crest, then falls at -3.5% for 200 metres to a low point, then climbs again at about +1% for the remainder.

The length of the entry ramp in Option 3 is broadly in accordance with advice from Roads and Maritime, which was to achieve a truck speed of 75 km/h at the start of the 110 metre merge length. The actual speed achieved using Figure 9.11 of Appendix 9 of the SWTC would be about 73 km/h for the majority of trucks which would approach from the Old Pacific Highway and have priority as they enter the ramp. For a truck turning the left from Old Coast Road, the truck speed achieved would be about 69 km/h. To fully meet the SWTC guidelines of 85 km/h for trucks from the Old Pacific Highway would not be practicable as it would require over 1km of additional lane.

Another difficulty with the entry ramp is that the merge area is poorly positioned at the end of a left hand curve on the main carriageway. This makes it more difficult for an entering driver on the ramp to see approaching vehicles on the highway, and to judge the length of approaching multi-combination vehicles. This difficulty has been addressed by extending the length of the merge area from the minimum 120 metres (four seconds of travel time). The actual length provided with the Option 3 layout is about 450 metres, equivalent to about 15 seconds of travel time. Given that the horizontal curve ends just before the merge starts this extended parallel lane provides drivers of entering vehicles more time to view vehicles in the adjacent lane, select a gap and merge safely, and is considered a safe arrangement.

The northern end of the Option 3 ramp ends just before the visual mound on the west side that is required by the SWTC. The mound would not be affected.

2.4 Ramp options designs



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AFJV
ARUP aurecon

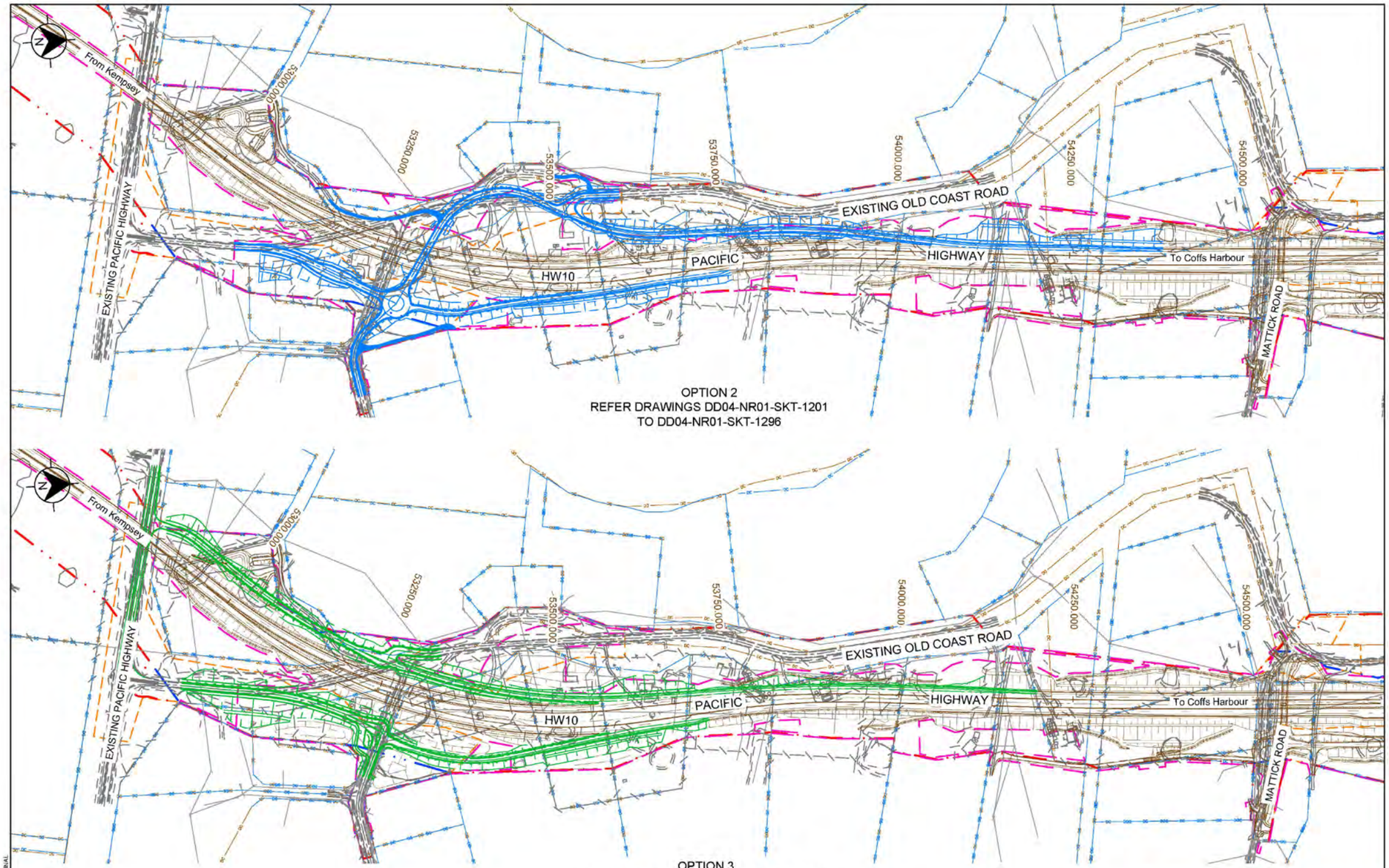
DESIGNED: Z.SHAHEED
REVIEWED: J HAMILTON

ROADS AND MARITIME SERVICES

NAMBUCCA SHIRE COUNCIL
HW10 PACIFIC HIGHWAY UPGRADE
WARRELL CREEK TO NAMBUCCA HEADS
NORTH FACING RAMPS AT NORTH MACKSVILLE OPTIONS
SHEET 1 - BASE CASE AND OPTION 1

DRAWING	STAGE	PART	ISSUE
WC2NH-DD04-NR01-SKT-1015	CONCEPT		A

REGISTRATION NUMBER	SHEET No.
-	DD04-NR01-1015



OPTION 2
REFER DRAWINGS DD04-NR01-SKT-1201
TO DD04-NR01-SKT-1296

OPTION 3
REFER DRAWINGS DD04-NR01-SKT-1301
TO DD04-NR01-SKT-1382

NOT FOR CONSTRUCTION

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ISSUE	DATE	ISSUE / AMENDMENT DESCRIPTION
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CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

AFJV
ARUP aurecon
DESIGNED: Z.SHAHEED
REVIEWED: J.HAMILTON

ROADS AND MARITIME SERVICES

NAMBUCCA SHIRE COUNCIL
HW10 PACIFIC HIGHWAY UPGRADE
WARRELL CREEK TO NAMBUCCA HEADS
NORTH FACING RAMPS AT NORTH MACKSVILLE OPTIONS
SHEET 2 - OPTIONS 2 AND 3

DRAWING	STAGE	PART	ISSUE
WC2NH-DD04-NR01-SKT-1016	CONCEPT		A

REGISTRATION NUMBER: -

SHEET No.: DD04-NR01-1016

3. Options assessment criteria

The purpose of the assessment was to differentiate between the options rather than undertake an absolute assessment of all project criteria for each option – so only those criteria that highlighted differences were considered in this particular assessment.

The agreed criteria are noted below in **Table 3-1** and following group discussion a weighting was agreed as indicated.

Table 3-1 Assessment criteria and weighting

Criteria	Descriptive Aspects	Weighting
Constructability & Timing	Program impacts and risks	35%
	Staged construction of ramps	
	Traffic / accessibility disruptions	
	Bridge roadworks impacts (changes of scope / approved layout design)	
Functionality (Traffic Efficiency & user safety)	Attractiveness to users	30%
	Impacts on travel times / road operations	
	School bus	
	Road user safety	
	Road / bridge maintainers' safety	
Community Impacts	Additional land acquisition	25%
	Local enterprises, shops and services	
	Agribusinesses	
	River / marine activities	
	Emergency events	
	Noise	
	Light impacts on residences	
	Headlight intrusion	
	Visuals	
	Severance	
Environmental Impacts	Water quality & flooding	10%
	Flora & fauna	
	Heritage	
Capital & Operating Costs*		

Scoring for each of the options is relative to the approved layout which is the highway upgrade without the north facing ramps at North Macksville.

The scoring scale selected – from -5 to +5 was to acknowledge that some factors, for certain options had negative impacts rather than positive impacts compared to the approved layout.

These were used as prompts to identify and propose any mitigation measures or improvements in the option – so that any assessment would be based on optimised options.

4. Options assessment

Criteria	Descriptive Aspects	Weighting	Option 1		Option 2		Option 3	
Constructability & Timing	Program impacts & risks	35%	-1	This option will cause a minor delay to the overall project but can be managed by staging the construction.	-1	This option will cause a minor delay to the overall project but can be managed by staging the construction.	-5	Planning and approval risks with need to acquire more land for this option. Less complex construction program without a bridge for this option – especially for earthworks but needs some soft soil treatments and settling that would offset potential gains to the program.
	Staged construction of ramps		2	Construction of ramps can be staged as a bridge will be constructed over the highway.	2	Construction of ramps can be staged as a bridge will be constructed over the highway.	0	No opportunity to stage construction as a bridge will not be constructed.
	Traffic / accessibility disruptions		0	Minimal disruption to local traffic is expected with this option.	-1	Slightly more disruptive due to the construction of a roundabout at Letitia Close as this takes longer than a standard T intersection.	0	Minimal disruption to local traffic is expected with this option.
	Bridge and/or roadworks impacts (changes of scope / approved layout)		-3	This option needs 38,000 cubic metres of additional material to construct the embankments as compared to the approved layout.	-2	This option requires 15,000 cubic metres additional material to construct the embankments as compared to the approved layout.	-3	This option has a surplus of 36,800 material that would need to be disposed of as compared to the approved layout.
	Total Score		**-2**	**Weighted Score: -70**	**-2**	**Weighted Score: -70**	**-8**	**Weighted Score: -280**
	General Assessment Comments		The contract for the design and construction of this section of the highway has already been let – so the design and installation of the new ramps will involve negotiating a contract variation. There will be an impact on the construction program – to allow for design to be completed but also for planning approval from Department of Planning and the Environment. The timing of the ramps is ideally set to coincide with the opening of the motorway – not as a later addition – so they need to integrate with the bridge and roadworks. Options 1 and 2 are similar with the same weighted score. Options 1 and 2 performed substantially better than Option 3. Construction of Option 2 would be slightly more disruptive than Options 1 and 3 due to longer time required for construction of roundabout. Option 2 provides the best earthworks balance of the three options.					
Functionality (Traffic Efficiency & user safety)	Attractiveness to users	30%	4	Attractiveness to road users, same for all options.	4		4	
	Impacts on travel times / road operations		3	Impacts on travel times, same for all options.	3		3	
	School bus		1	Enhanced school bus facility provided with this option.	1	Enhanced school bus facility provided with this option.	-1	Only effect on school bus is option 3 – a longer route to collect Letitia close school children.
	Road user safety		-3	Layout of Option 1 has issues including adverse crossfall and poor coordination of curves on the off ramp that cannot be designed out. Three back to back curves at near minimum radii, tangent length between curves less than desirable minimum. Possible issues with the visibility of linemarking at the intersection of the off ramp and Old Coast Road.	-1	Roundabouts tend to have low-speed incidents, but more of them compared to other intersections. Better geometric layout than Option 1 with only one curve at minimum radius.	-4	Additional intersection with the old Pacific Highway is an increased safety risk.
	Road / bridge maintainers safety		-1	Normal risks associated with bridge maintenance.	-1	Normal risks associated with bridge maintenance.	1	No bridge to inspect and therefore safer.
	Total Score		**4**	**Weighted Score: +120**	**6**	**Weighted Score: +180**	**3**	**Weighted Score: +90**

Criteria	Descriptive Aspects	Weighting	Option 1		Option 2		Option 3	
	General Assessment Comments		Option 2 performed best for road safety and delivers a better road solution for functionality and more important long-term characteristics for road operations. Option 2 better caters for traffic growth as compared to option 1 – especially with a roundabout. Overall Option 1 performed better than Option 3 against functionality criteria.					
Community Impacts	Additional land acquisition	25%	0	No land acquisition needed	0	No land acquisition needed	-3	Additional land acquisition is required to allow for the proposed intersections with the Pacific highway and the Old Coast road.
	Local enterprises, shops and services		4	All options are good at attracting traffic to commercial interests in Macksville	4		4	
	Agribusinesses		0	No option affects agribusiness	0		0	
	River / marine activities		0	No option affects river or marine activities	0		0	
	Emergency events		3	All options improve accessibility for emergency events and incidents	3		3	
	Noise		-1	Will be some extra traffic noise due to increased traffic	-2	Slightly worse effects of noise from this option due to increased traffic and roundabout.	-1	Will be some extra traffic noise due to increased traffic.
	Light impacts on residences		-1	Only additional flag lighting required	-2	Lighting for the roundabout – because it is close to homes and it will have lights in an area where there is currently no lighting.	-2	Similar rating to option 2 re lighting impacts - Option 3 will have lighting around the intersections and the new bus bay, which is also closer to residences.
	Headlight intrusion		-1	Some headlight impact from the ramps and bend on Old Coast Road	-1	Some headlight impact from the ramps and roundabout.	0	Similar headlight impact to the approved project.
	Visuals		-1	Bridge has a negative impact on the appearance of the road	-1	Bridge has a negative impact on the appearance of the road	1	Improved appearance due to removal of the bridge
	Severance		0	There is no additional severance with this option.	0	There is no additional severance with this option.	-3	This option cuts Letitia Close from Old Coast Road.
	Total Score		**3**	**Weighted Score: +75**	**1**	**Weighted Score: +25**	**-1**	**Weighted Score: -25**
	General Assessment Comments		Noise modelling indicates no discernible change in noise impacts to receivers for all 3 options. There would need a doubling of traffic to create a 2 dB change in noise impact, which is the level that becomes discernible to the receivers. There will be some variation of noise during the different times of the day and increases when heavy vehicles use the ramps and intersections. A roundabout, as proposed in Option 2 is generally more noisy compared to a T-intersection and Options 1 & 2 may have traffic queuing – which generate braking and gear change noise. Option 2 with a roundabout better caters for traffic growth than options 1 or 3. Overall Option 1 performs best for community impacts followed by Option 2 and Option 3.					
Environmental Impacts	Water quality & flooding	10%	-1	More pavement area than the current approved project	-1	More pavement area than the current approved project	-2	This option has the most pavement area which increases runoff from pavement
	Flora & fauna		-2	Moderate clearing required	-3	Most clearing required	-1	Less clearing required
	Heritage		0	No impact on heritage	0	No impact on heritage	-1	Increased risk of finding a heritage item due to increased acquisition
	Total Score		**-3**	**Weighted Score: -30**	**-4**	**Weighted Score: -40**	**-4**	**Weighted Score: -40**
	General Assessment Comments		No difference in flooding effects or management between the options. Water quality – all involve some extra pavement and required detention capacity. Option 3 marginally worse than the others due to additional pavement areas involved. Flora / fauna – all three impact larger areas and habitats – each results in a slightly different mix in what is being impacted. Need to go back to Commonwealth to outline the changes in the mix that the project will impact for the preferred option.					

Criteria	Descriptive Aspects	Weighting	Option 1	Option 2	Option 3
Overall conclusions			The NSW Government has made the commitment to provide the ramps. Option 3 is not a viable strategy compared to the others – it scores significantly worse in all aspects of constructability and timing. Community expectations are important to address in the solution and its implementation strategy, including necessary consultation.		
TOTAL WEIGHTED SCORES			**+95**	**+95**	**-225**
Capital & Operating Costs1			Not considered in this assessment as task to develop costs and define any effects on operating costs not yet complete – a risk-based assessment of costs also needed here.		

[1] Please note that this workshop only used the qualitative (non-price) criteria as preliminary estimated costs for the three options were similar and cost information was indicative only at the date of the workshop. Cost estimates still needing some inclusions and exclusions to be defined. Cost estimates to be updated to include any agreed improvements and latest risk-based pricing.

5. Assessment conclusions

5.1 Preferred option

As Option 1 and 2 scored equally in the assessment, the workshop then looked at each criteria and descriptive aspect of these two options in more detail to determine the preferred option. Option 2 was chosen as the preferred option as:

- It was assessed as better than Option 3 for the Constructability and Timing Criteria and equal to Option 1
- It was assessed as the best option for the Functionality Criteria (traffic efficiency and road user safety). In particular is was the preferred option as:
  - It scored highest in road user safety
  - It best caters for traffic growth and long term functionality
- It was assessed as having less Community Impacts than Option 3 but more noise and light impacts (due to the roundabout) than Option 1
- It was assessed as having less Environmental Impacts that Option 3 however it has slightly greater environmental impacts than Option 1 due to additional clearing of native vegetation.

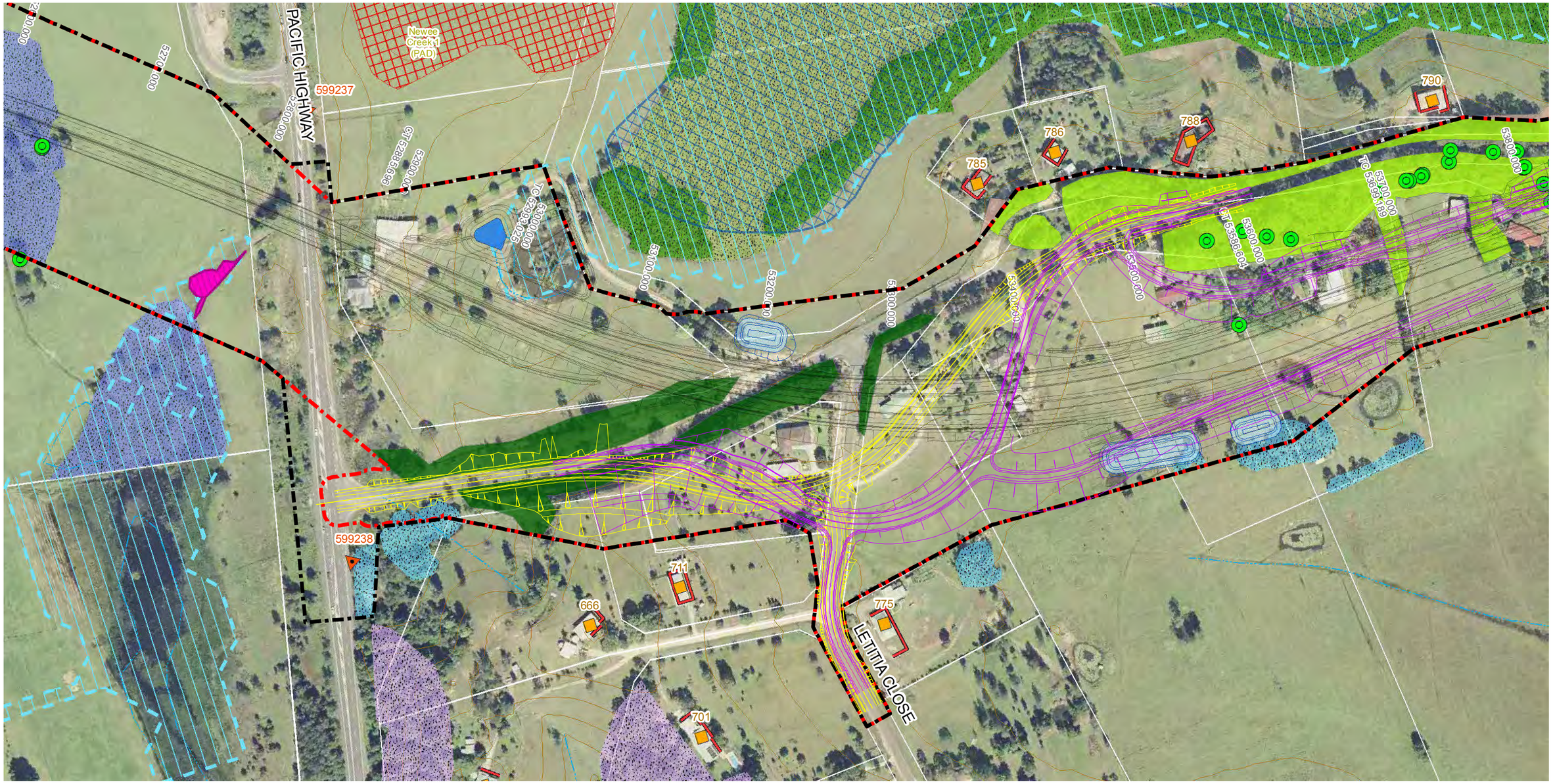
In summary Option 2 was chosen as the preferred option as it is the safest option and improves functionality and road alignment, and is the best option for the long term performance of the ramps.

During the workshop a number of improvement opportunities were identified, these could be adopted in the design and construction phases to reduce impacts. These improvement opportunities include:

- Earth mounds and screenings – would help to address headlight intrusion; e.g. use surplus soil to create a mound between the roundabout and residences. Also in the area between highway and the ramp, if possible
- Review options to minimise vegetation impacts
- Review road design to increase the skew of the bridge
- Plantings on top of the mounds to increase natural screening.

Appendix C

Sensitive area plans



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Concept design
Option 1 ramps
Proposed project boundary (16/06/2015)
Approved Project boundary # (edited at Northern end)
5m contours
20yr ARI flood
Natural drainage
SEPP14 wetland

Stormwater management
Drainage basin (Permanent)
Drainage basin (Temporary)

Heritage
Archaeological PAD/Site

Acoustic
Facade treatments to noise receivers
Sensitive noise receiver

Vegetation Community (EEC)
Freshwater Wetlands (EEC)
Swamp Forest - Swamp Mahogany/ Paperbark EEC
Swamp Oak Forest (EEC)
Saltmarsh EEC

Vegetation Community
Moist Open Forest - White Mahogany - Grey Gum
Regrowth Swamp Oak

Hollow-bearing tree/Habitat tree
Microbat roost site/habitat
Persicaria elatior

 # denotes: Project boundary based on WC2NH_Approved_Project_Boundary_20141202_V2.shp received 02/12/2014, and adjusted to suit survey accurate cadastre (edited at Northern end)

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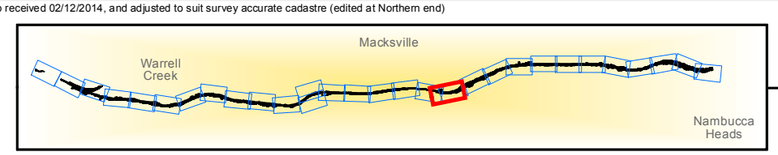
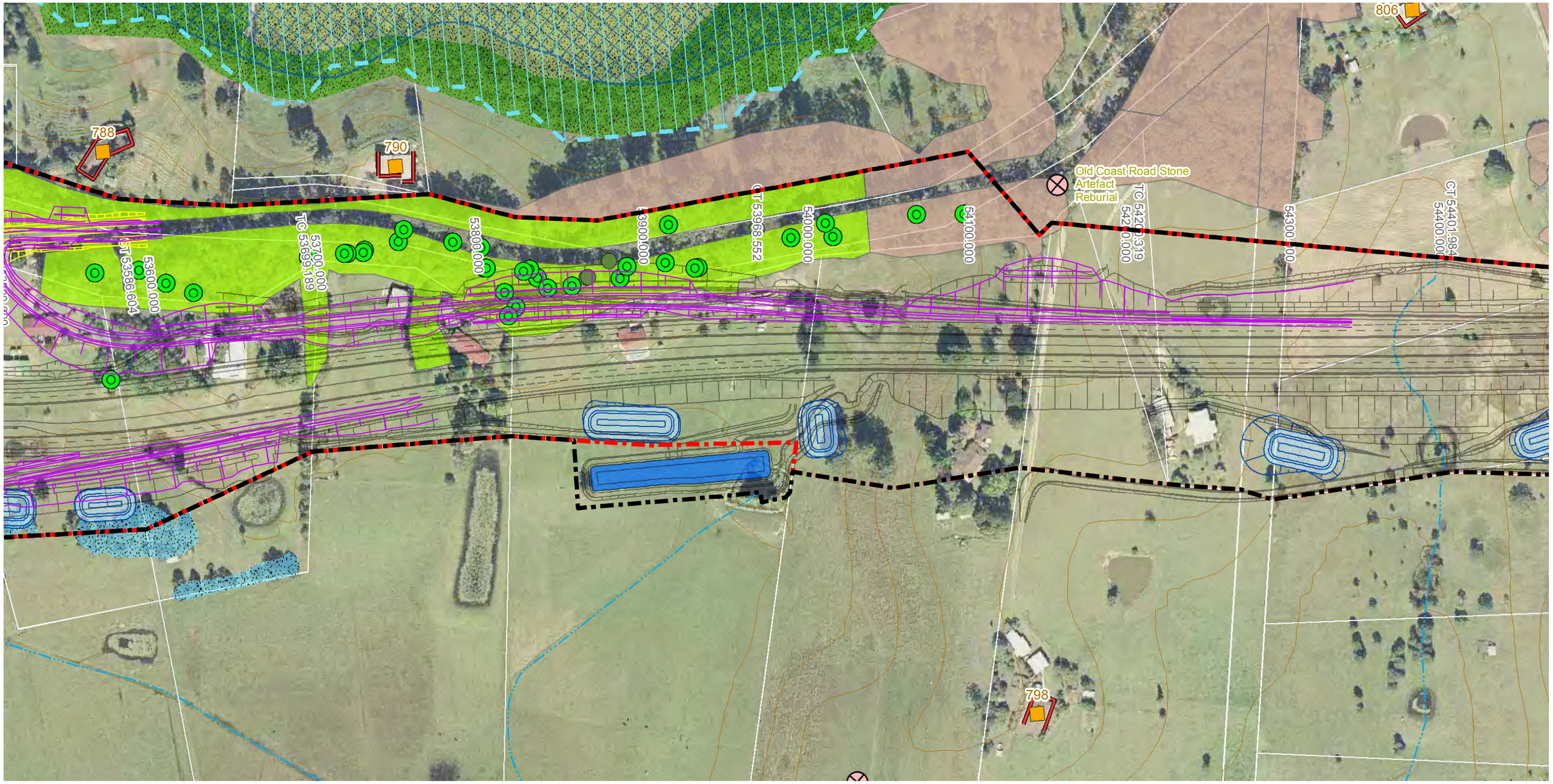


Projection: GDA 1994 MGA Zone 56
Source: AFJV, RMS, AADJV, Geolink, Benwell

PACIFIC HIGHWAY UPGRADE **WC2NH**
North Facing Ramps at North Macksville – Preferred Option Report

FIGURE: Option 1
Sensitive Area Plans (Map 1 of 2)



Concept design
Option 1 ramps
Proposed project boundary (16/06/2015)
Approved Project boundary # (edited at Northern end)
5m contours
20yr ARI flood
Natural drainage
SEPP14 wetland

Stormwater management
Drainage basin (Permanent)
Drainage basin (Temporary)

Heritage
Archaeological PAD/Site
WC2NH_Identified_points_edit

Acoustic
Facade treatments to noise receivers
Sensitive noise receiver

Vegetation Community (EEC)
Swamp Forest - Swamp Mahogany/ Paperbark EEC

Vegetation Community
Moist Open Forest - White Mahogany - Grey Gum
Open Forest - Blackbutt
Marsdenia longiloba
Hollow-bearing tree/Habitat tree

 # denotes: Project boundary based on WC2NH_Approved_Project_Boundary_20141202_V2.shp received 02/12/2014, and adjusted to suit survey accurate cadastre (edited at Northern end)

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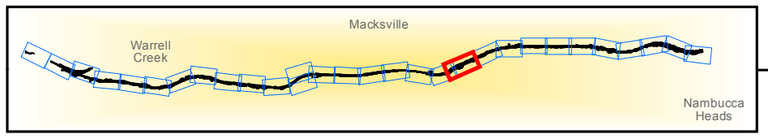

Projection: GDA 1994 MGA Zone 56
Source: AFJV, RMS, AADJV, Geolink, Benwell

PACIFIC HIGHWAY UPGRADE **WC2NH**
North Facing Ramps at North Macksville – Preferred Option Report

FIGURE: Option 1
Sensitive Area Plans (Map 2 of 2)

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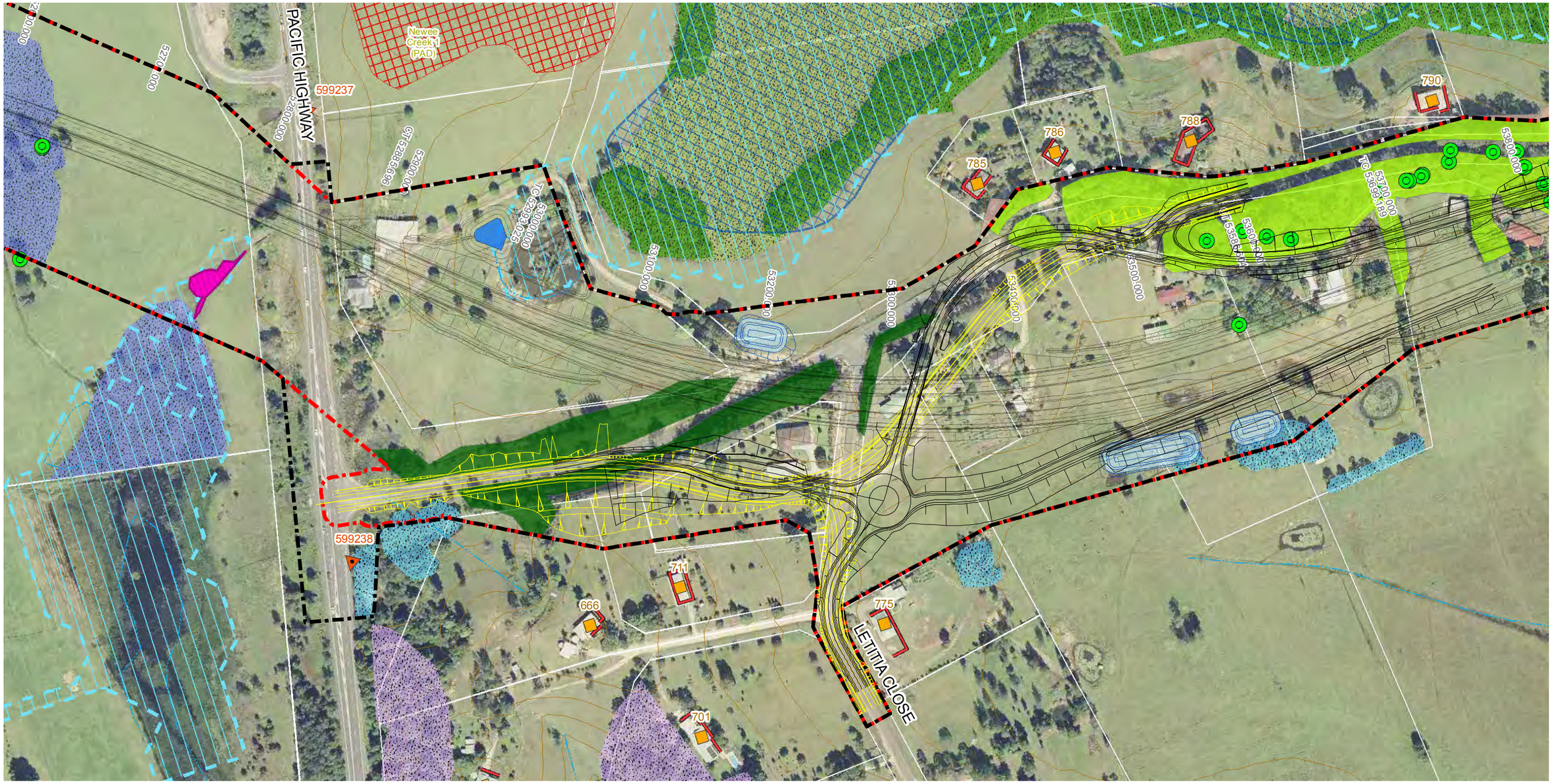

Concept design
Option 2 ramps
Proposed project boundary (16/06/2015)
Approved Project boundary # (edited at Northern end)
5m contours
20yr ARI flood
Natural drainage
SEPP14 wetland

Stormwater management
Drainage basin (Permanent)
Drainage basin (Temporary)

Heritage
Archaeological PAD/Site

Acoustic
Facade treatments to noise receivers
Sensitive noise receiver

Vegetation Community (EEC)
Freshwater Wetlands (EEC)
Swamp Forest - Swamp Mahogany/ Paperbark EEC
Swamp Oak Forest (EEC)
Saltmarsh EEC

Vegetation Community
Moist Open Forest - White Mahogany - Grey Gum
Regrowth Swamp Oak

Hollow-bearing tree/Habitat tree
Microbat roost site/habitat
Persicaria elatior

 # denotes: Project boundary based on WC2NH_Approved_Project_Boundary_20141202_V2.shp received 02/12/2014, and adjusted to suit survey accurate cadastre (edited at Northern end)

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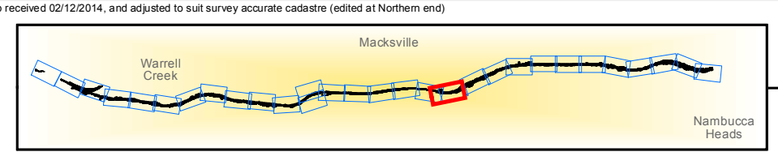

Projection: GDA 1994 MGA Zone 56
Source: AFJV, RMS, AADJV, Geolink, Benwell

PACIFIC HIGHWAY UPGRADE **WC2NH**
North Facing Ramps at North Macksville – Preferred Option Report

FIGURE: Option 2
Sensitive Area Plans (Map 1 of 2)

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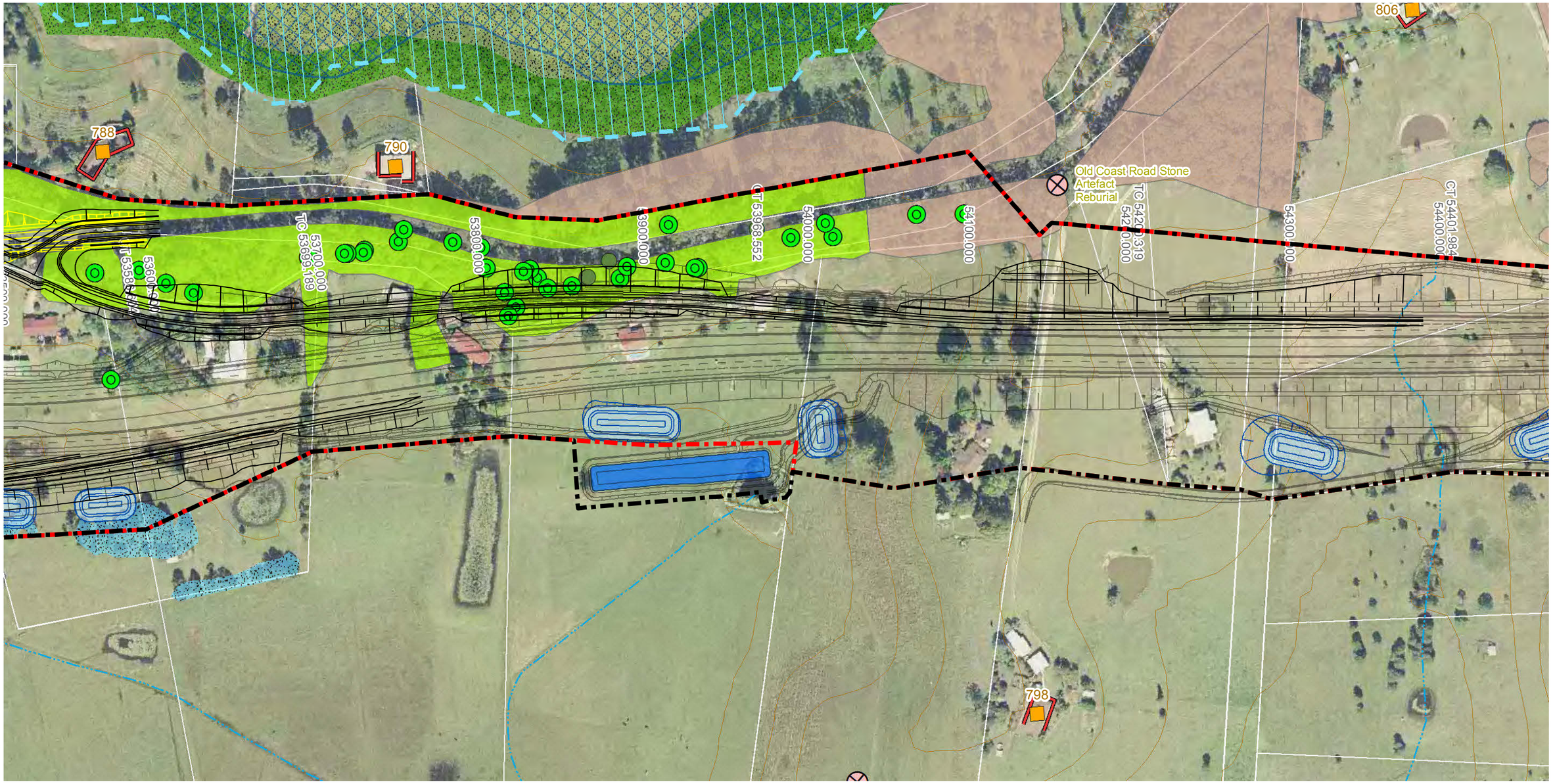


Concept design
Option 2 ramps
Proposed project boundary (16/06/2015)
Approved Project boundary # (edited at Northern end)
5m contours
20yr ARI flood
Natural drainage
SEPP14 wetland

Stormwater management
Drainage basin (Permanent)
Drainage basin (Temporary)

Heritage
Archaeological PAD/Site
WC2NH_Identified_points_edit

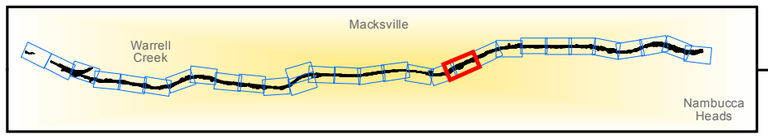
Acoustic
Facade treatments to noise receivers
Sensitive noise receiver

Vegetation Community (EEC)
Swamp Forest - Swamp Mahogany/ Paperbark EEC

Vegetation Community
Moist Open Forest - White Mahogany - Grey Gum
Open Forest - Blackbutt
Marsdenia longiloba
Hollow-bearing tree/Habitat tree

 # denotes: Project boundary based on WC2NH_Approved_Project_Boundary_20141202_V2.shp received 02/12/2014, and adjusted to suit survey accurate cadastre (edited at Northern end)

1:2,500
0 50 100m



Projection: GDA 1994 MGA Zone 56
Source: AFJV, RMS, AADJV, Geolink, Benwell

PACIFIC HIGHWAY UPGRADE **WC2NH**
North Facing Ramps at North Macksville – Preferred Option Report

FIGURE: Option 2
Sensitive Area Plans (Map 2 of 2)

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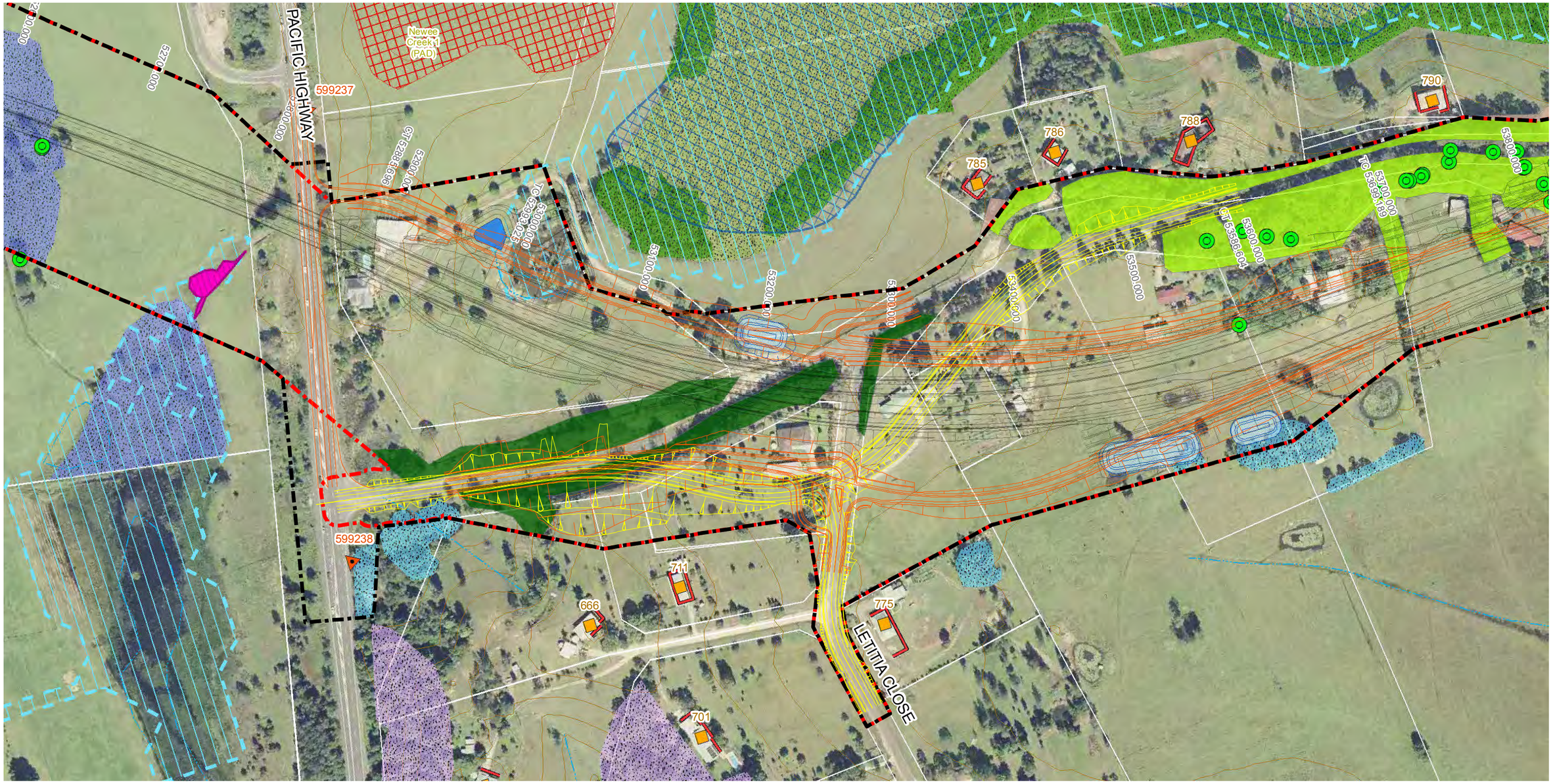


Concept design
Option 3 ramps
Proposed project boundary (16/06/2015)
Approved Project boundary # (edited at Northern end)
5m contours
20yr ARI flood
Natural drainage
SEPP14 wetland

Stormwater management
Drainage basin (Permanent)
Drainage basin (Temporary)

Heritage
Archaeological PAD/Site

Acoustic
Facade treatments to noise receivers
Sensitive noise receiver

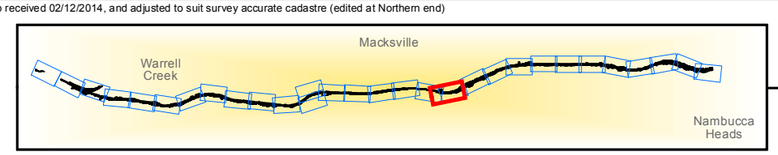
Vegetation Community (EEC)
Freshwater Wetlands (EEC)
Swamp Forest - Swamp Mahogany/ Paperbark EEC
Swamp Oak Forest (EEC)
Saltmarsh EEC

Vegetation Community
Moist Open Forest - White Mahogany - Grey Gum
Regrowth Swamp Oak

Hollow-bearing tree/Habitat tree
Microbat roost site/habitat
Persicaria elatior

 # denotes: Project boundary based on WC2NH_Approved_Project_Boundary_20141202_V2.shp received 02/12/2014, and adjusted to suit survey accurate cadastre (edited at Northern end)

1:3,000
0 50 100 m



PACIFIC HIGHWAY UPGRADE **WC2NH**
North Facing Ramps at North Macksville – Preferred Option Report

Projection: GDA 1994 MGA Zone 56
Source: AFJV, RMS, AADJV, Geolink, Benwell

FIGURE: Option 3
Sensitive Area Plans (Map 1 of 2)

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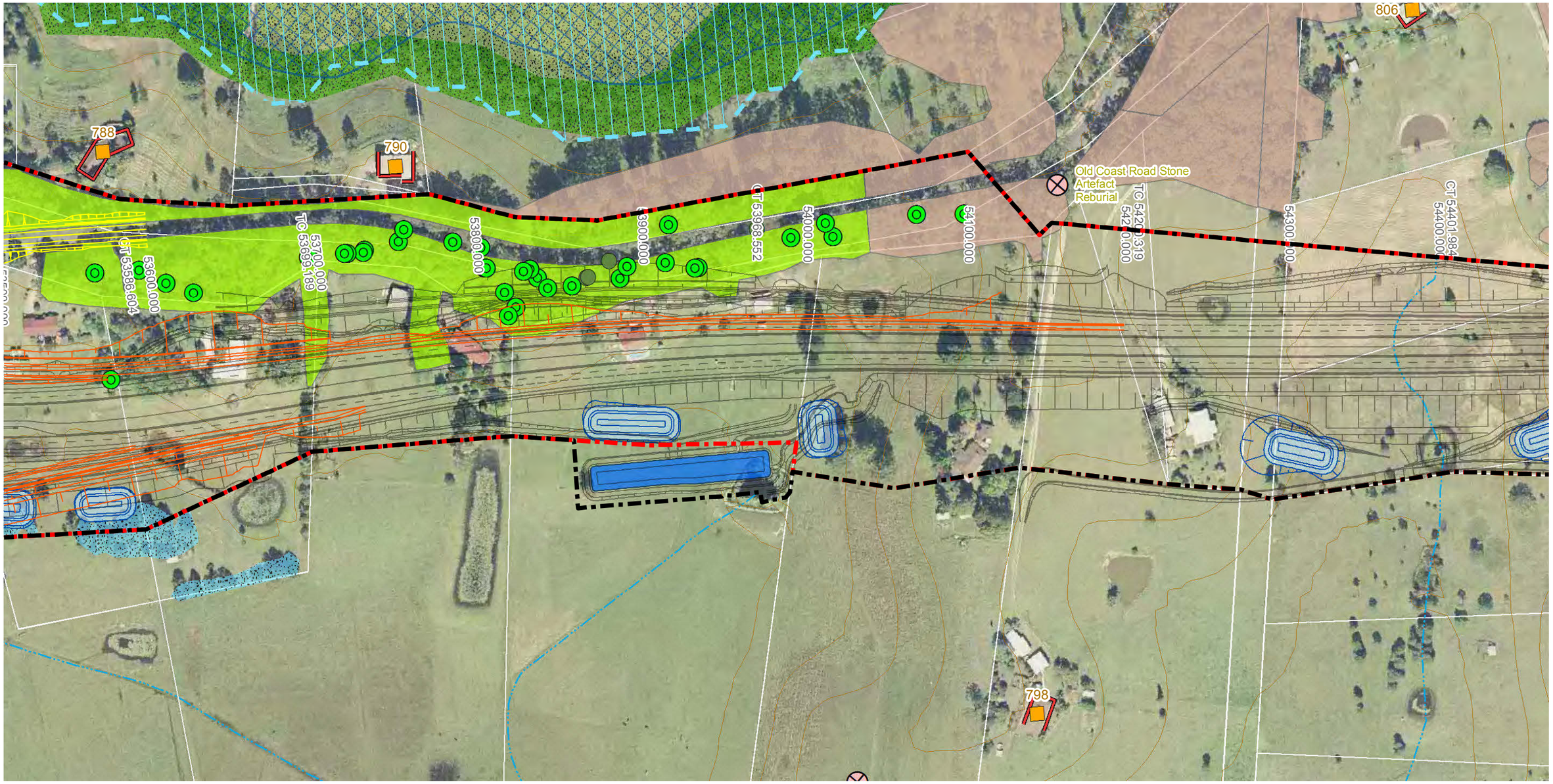

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- Concept design
- Option 3 ramps
- Proposed project boundary (16/06/2015)
- Approved Project boundary # (edited at Northern end)
- 5m contours
- 20yr ARI flood
- Natural drainage
- SEPP14 wetland

Stormwater management
- Drainage basin (Permanent)
- Drainage basin (Temporary)

Heritage
- Archaeological PAD/Site
- WC2NH_Identified_points_edit

Acoustic
- Facade treatments to noise receivers
- Sensitive noise receiver

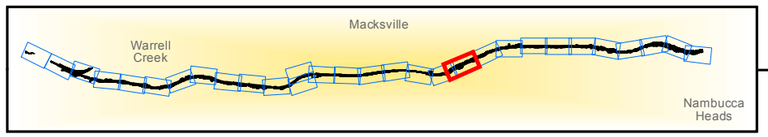
Vegetation Community (EEC)
- Swamp Forest - Swamp Mahogany/ Paperbark EEC

Vegetation Community
- Moist Open Forest - White Mahogany - Grey Gum
- Open Forest - Blackbutt
- Marsdenia longiloba
- Hollow-bearing tree/Habitat tree

 # denotes: Project boundary based on WC2NH_Approved_Project_Boundary_20141202_V2.shp received 02/12/2014, and adjusted to suit survey accurate cadastre (edited at Northern end)

1:2,500

0 50 100m



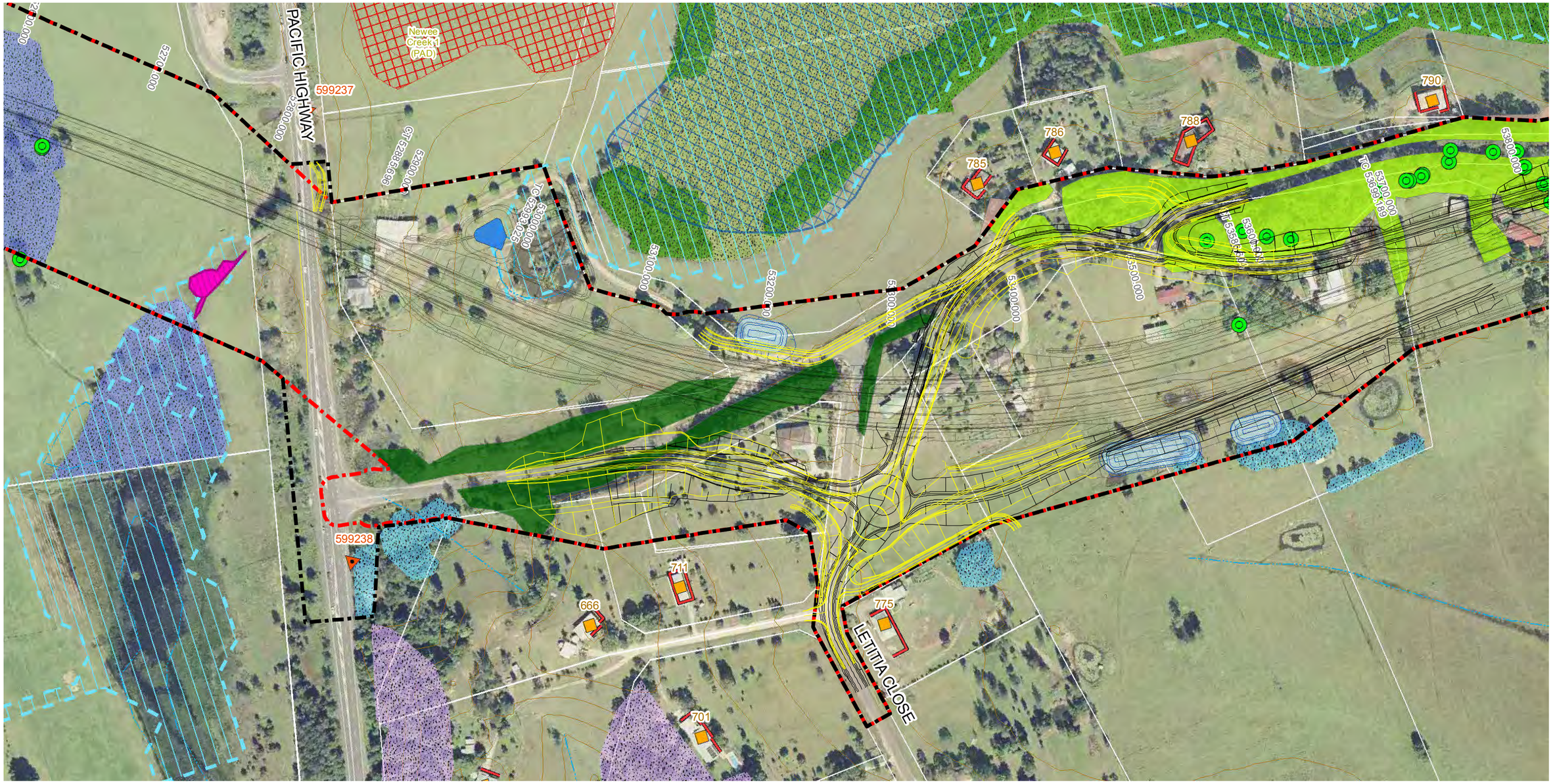
PACIFIC HIGHWAY UPGRADE **WC2NH**
North Facing Ramps at North Macksville – Preferred Option Report

Projection: GDA 1994 MGA Zone 56
Source: AFJV, RMS, AADJV, Geolink, Benwell

FIGURE: Option 3
Sensitive Area Plans (Map 2 of 2)

Appendix D

Refined preferred option design



Option 2 (refined design)
Option 2 ramps (from Options Development Phase)
Proposed project boundary (16/06/2015)
Approved Project boundary # (edited at Northern end)
5m contours
20yr ARI flood
Natural drainage
SEPP14 wetland

Stormwater management
Drainage basin (Permanent)
Drainage basin (Temporary)

Heritage
Archaeological PAD/Site

Acoustic
Facade treatments to noise receivers
Sensitive noise receiver

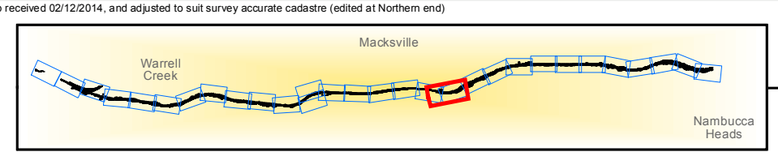
Vegetation Community (EEC)
Freshwater Wetlands (EEC)
Swamp Forest - Swamp Mahogany/ Paperbark EEC
Swamp Oak Forest (EEC)
Saltmarsh EEC

Vegetation Community
Moist Open Forest - White Mahogany - Grey Gum
Regrowth Swamp Oak
Hollow-bearing tree/Habitat tree

Microbat roost site/habitat
Persicaria elatior

 # denotes: Project boundary based on WC2NH_Approved_Project_Boundary_20141202_V2.shp received 02/12/2014, and adjusted to suit survey accurate cadastre (edited at Northern end)

1:3,000
0 50 100 m



PACIFIC HIGHWAY UPGRADE **WC2NH**
North Facing Ramps at North Macksville – Preferred Option Report

Projection: GDA 1994 MGA Zone 56
Source: AFJV, RMS, AADJV, Geolink, Benwell

FIGURE: Option 2 and Option 2 (refined design) Sensitive Area Plans

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