Annex D

Road User Benefit Cost Analysis

Road User Benefit Cost Analysis

D.1 BACKGROUND

A Road User Cost Benefit Analysis (RUCBA) was utilised to compare preliminary Outer Link Road route options for further consideration. The aim of the analysis was to enable short listing of the preliminary options based on the degree of cost-effectiveness in terms of benefits to road users. The RTA's *Economic Analysis Manual* (1999 with 2005 update) was used as the basis for the RUCBA.

D.2 METHODOLOGY

D.2.1 Approach

The Road User cost benefit analysis (RUCBA) includes consideration of the annual costs and benefits of the following parameters:

- construction cost;
- ongoing maintenance cost;
- accident cost savings;
- vehicle operating cost savings; and
- travel time savings.

The basic calculation is a ratio of benefits divided by costs in a commensurate unit of value. These were compared to the 'do nothing' option, detailed below.

All benefits and costs were converted to year 2006 values to be consistent with 2005 values provided by the RTA plus inflation, and discounted over time using a 7% discount rate. The period of assessment was a 30-year design life.

The following elements of the CBA were utilised in this initial assessment:

- future road network scenarios in terms of travel times and travel distances for the network based on SMEC (2006);
- road construction and acquisition costs – unit rates per metre of road and per hectare of land acquisition were assumed;
- maintenance costs based on RTA (1999) and other Council analyses; and
- benefits over time calculated using methodology from RTA (1999) and use of RTA's economic analysis parameters for 2005.

D.2.2 "Do Nothing Option"

The do nothing option was selected as:

- for east-west routes: the continued use of Lake Road to link Ocean Drive with the Oxley Highway. This included the full implementation of the Lake Road (West) upgrade as proposed by Port Macquarie-Hastings Council, with a four lane divided road throughout. It was assumed that all construction costs for the road upgrade would be incurred prior to the period assessed in this CBA; and
- for north-south routes: the continued use of both Clifton Drive as the primary north-south link between the Oxley Highway and Hastings River Drive for traffic generated to the west of Clifton Drive.

It was assumed maintenance activities on these roads would continue into the future.

D.2.3 Traffic Volumes

Future traffic volumes were assumed to remain consistent with strategic-level analyses for year 2021 and 2031 conditions undertaken by SMEC (2006). The traffic generation from future Area 13 development precincts was also estimated by SMEC (2006). An annual expansion factor of 1600 was used to estimate annual traffic flows from the modelled PM peak hour scenarios.

To represent increases in traffic over time, sample traffic volumes were assumed for:

- year 2021 SMEC results: period 2021 to 2030;
- year 2031 SMEC results: period 2031 to 2040; and
- linear projection of 2031 results compares to year 2021: period of 2041 to 2051.

D.2.4 Components

Components of the CBA were calculated as outlined below:

Construction and Land Acquisition

Costs were calculated using the unit rates in *Table D.1*. The unit rates were provided by Council and are based on recent experience in the Port Macquarie area including the new Link Road from Ocean Drive to Hindman Street, the new bridge at Lake Road and upgrades to Hindman Street and Hastings River Drive. These works included costs associated with soft soils, acid sulphate soils, SEPP 14 wetlands, flood prone areas and various environmental mitigation measures and as such the unit rates take into consideration the cost of similar issues likely to be associated with the route options being considered in this CBA.

Table D.1 Unit Costs for Construction Cost and Land Acquisition: Cost Benefit Analysis

Component	Unit	Cost ($yr 2006)
Rural land Acquisition	$/ha	100,000
Residential & Industrial Acquisition	$/ha	5,000,000
SEPP 14 wetland (wetland replacement cost)	$/ha	1,500,000
Upgrade Road	$/m	6,000 (two lane) 6,000 (increase 2 to 4 lane) 7,132 (increase 4 to 6 lane)
New Road Build	$/m	6,000 (two lane dry) 8,500 (two lane wet) 8,500 (four lane dry) 11,144 (four lane wet)
Peired Bridge	$/m	29,000 (two lane) 40,000 (four lane)
Overpass	$/m	$45,000 (two lane)

Costing for east-west routes (excluding Options 1 and 4) include the construction of a link from each option to the southern end of the Lake Road Industrial Area. As this link would pass through Council owned land no additional acquisition costs were considered.

Costing for those north-south routes that originate at the existing Oxley Highway and pass through Area 13 does not include acquisition of land within Area 13, as these sections of the routes are along proposed road easements to be set aside during the development of Area 13.

Maintenance Costs

Maintenance costs were calculated per metre of road length based on a 19m road pavement, with costs over time discounted at 7% annually. Maintenance costs of the upgraded Lake Road were calculated at twice this rate due to the increased road width.

Accident Cost

Savings due to a change in accident risk were calculated based on values from the RTA economic analysis manual, as indicated in *Table D.2*.

Table D.2 Accident Costs for Roadway Types

Road Type	Unit	Rate
Local/sub-arterial	$(2006)/MVKT	69,100
Arterial	$(2006)/MVKT	45,100

1. MVKT = Million vehicle kilometres travelled

Source: RTA (1999)

All values were discounted over time to year 2006 NPV.

Vehicle Operating Costs and Travel Time Savings

Vehicle operating cost and travel time savings were estimated using unit cost values from the RTA's *Economic Analysis Manual* (1999 with 2005 update) as indicated in *Table D.3*. The SMEC (2006) data on total network vehicle travel time was used in the analysis of each option.

Table D.3 Vehicle Operating Costs and Travel Time Savings

Component	Unit	Rate
Average vehicle operating cost	$(2006)/km	0.19
Time Value per hour	$(2006)/hr	22.04

Source: based on RTA (2006)

All values were discounted over time to year 2006 NPV.

Note that benefits for N-S Link 1 (not modelled by SMEC) were estimated based on the average benefits per road user for Lake Road.

D.3 RESULTS

The results of the road user benefit cost analysis are summarised in *Table D.4* and *Table D.5* below.

The results indicated the following:

- East-West Routes:
  - With the exceptions of E-W Links 1 and 4, all link road options exhibited a net road user benefit of over 2.0 in terms of accident risk, travel time and travel cost over the analysis period; and
  - E-W Link 2B was the link with the highest calculated return on investment, with a BCR of 7.0, marginally higher than E-W Link 3A/D at 6.3.
- North-South Routes:
  - only two of the ten new link road options (N-S Links 2A and 2B) exhibited a net road user benefit of over 2.0 in terms of accident risk, travel time and travel cost over the analysis period;
  - the BCRs for N-S Links 2A and 2B where almost identical at approximately 2.9; and
  - when combined with E-W link 3B/D, N-S Link 3A exhibited BCR of 3.75, making it potentially viable.

D.4 OUTCOMES

The outcomes of the preliminary CBA are:

- it is recommended that the following options be removed from further consideration based purely on failure to perform on economic grounds:
    - East-West links: E-W Link 4; and
    - North-South Links: N-S Link 1, 2C and 4A.
- East-West Link 1 represents the only option that does not cross the Lake Innes Nature Reserve, and should therefore be retained as a route option for further examination; and
- the North-South Link 3A should only be considered in conjunction with E-W Link 3B.

Table D.4 Road User CBA, East-West Outer Link Road Preliminary Route Options

Route	Acquisition Cost *($,000s)	Total [1] Construction Cost *($,000s)	Maintenance Costs *($,000s)	Accident Cost Saving *($,000s)	Travel Time Savings *($,000s)	Operating Cost Savings *($,000s)	NPV	Benefit Cost Ratio
Base Case	0	0	706	0	0	0	-706	-
E-W Link1	2,775	17,635	1,288	-63	28,583	-268	9,330	1.5
E-W Link2A	46,726	82,391	819	4,089	303,678	17,272	241,828	3.9
E-W Link2B	10,659	45,874	841	4,089	303,678	17,272	278,323	7.0
E-W Link3A/D	10,784	47,878	881	3,162	292,398	13,357	260,157	6.3
E-W Link3A/E	31,126	79,118	1,187	3,162	292,398	13,357	228,612	3.8
E-W Link3B/D	16,477	54,468	881	4,591	271,719	19,393	240,354	5.3
E-W Link3B/E	12,986	62,902	1,227	4,591	271,719	19,393	231,573	4.6
E-W Link3C/D	15,739	62,002	1,243	4,591	271,719	19,393	232,458	4.7
E-W Link3C/E	12,234	70,431	1,590	4,591	271,719	19,393	233,682	4.1
E-W Link4	65,733	143,146	1,969	4,591	271,719	19,393	150,587	2.0

Notes: 1. Total construction costs includes acquisition costs

Table D.5 Road User CBA, North-South Outer Link Road Preliminary Route Options

Route	Acquisition Cost *($,000s)	Total [1] Construction Cost *($,000s)	Maintenance Costs($,000s)	Accident Cost Saving *($,000s)	Travel Time Savings *($,000s)	Operating Cost Savings *($,000s)	NPV	Benefit Cost Ratio
Base Case	0	0	371	0	0	0	-371	-
N-S Link1	25,900	35,131	741	-23	7,106	-98	-28,888	0.19
N-S Link2A	3,933	20,221	554	689	56,241	2,913	39,069	2.88
N-S Link2B	503	25,854	659	1,333	69,132	5,630	49,583	2.87
N-S Link2C	11,177	45,557	1,067	458	48,313	1,935	4,083	1.09
N-S Link3A	1,931	43,807	1,115	458	48,313	1,935	5,784	1.13
N-S Link3B	2,078	46,201	942	1,106	68,302	4,671	26,792	1.57
N-S Link3C	1,265	41,254	802	1,106	68,302	4,671	31,688	1.75
N-S Link3D	2,354	44,582	803	1,061	54,233	4,484	14,053	1.31
N-S Link4A	90	31,264	715	-145	11,513	-611	-21,695	0.33
N-S Link4B	126	43,488	881	343	30,941	1,450	-12,085	0.73
N-S Link 3A+ E-W Link 3B/D	18,408	98,275	1,996	5,055	349,571	21,355	275,711	3.75

Notes: 1. Total construction costs includes acquisition costs

Annex E

Multi-Criteria Assessment

Multi-Criteria Analysis

E.1 INTRODUCTION

E.1.1 Background

Multi-Criteria Analysis (MCA) is a decision-support tool used for prioritisation of alternate scenarios where there are a significant number of impacts that are not able to be incorporated into a benefit-cost analysis. Such impacts are primarily social and environmental impacts that are either impractical or impossible to value in dollar terms using information available at this point in time. This is described in economic terms as where the market price mechanism is not well-functioning, known as market failure (RTA 1999).

MCA allows for a form of multi-dimensional assessment that is unable to be achieved through traditional benefit cost analysis alone. While there is ongoing research and data collection within Australia in the field of economics to generate dollar-equivalent values for environmental externalities generated by roads (e.g. AUSTROADS 2003), such work is still quite general and based primarily on a simplistic average dollar-based cost per kilometre rate. Application of such costs would not incorporate local spatial variations in impacts and as such, an MCA technique was used to more accurately account for these externalities rather than the general illustrative methodology presented by AUSTROADS (2003).

In this project MCA was selected as an assessment technique to augment a traditional benefit cost analysis. The aim was to provide further information on externalities that are unable to be given a dollar value to allow a better-informed decision on which route option is preferred based on social and environmental grounds.

The process of MCA, as with all strategic economic analyses, is subject to limitations. These are described below in relation to this project.

E.1.2 Limitations of MCA

While the application of Benefit Cost Analysis has a relatively standard methodology for application in the evaluation of road projects, the use of MCA is still emerging as a technique. A comprehensive discussion of the limitations of Multi-criteria Analysis is provided by BTE (1999). These have been considered in the methodology adopted in this study, and are summarised in *Table E.1* below.

Table E.1 ***Summary of Limitations of the Multi-Criteria Assessment Technique and Techniques Adopted to Address Limitations***

Limitation Identified	Addressed through
Assessment methodology: MCA does not yet have a standard approach or technique for application compared to BCA	• Use of both BCA and MCA in route short listing and prioritisation • Thorough description of all methodologies used, with limitations identified.
Selection of Attributes: Attributes (impacts) selected for consideration are sometimes selected based on ability to assess (i.e. data availability or other factors)	• Consideration of all known impacts that are unable to be readily included in a detailed BCA assessment. • This limitation applies to BCA methodologies also (e.g. obtainable dollar values).
Absolute Costs and Benefits: Some methodologies do not consider absolute value/impact	• Use of both absolute (pre-weighted) and weighted results. • This limitation also applies to application of the benefit-cost ratio as an indicator.
Double Counting: MCA can be prone to double counting between attributes (impacts), magnifying some attributes compared to others	• Aim for use of mutually-exclusive criteria only. • Also applicable to BCA. methodologies
Scoring: can lead to loss of relative magnitude of attribute (impact)	• Ratio scale technique preferred
Scoring: use of qualitative (estimated) values for attributes	• Use of key indicators relevant to each measure of impact. • Clearly outline all assumptions.
Allocation of Weightings: Values based results only	• Use of both absolute and weighted results. Clearly outline all assumptions. • Undertake sensitivity test on weightings systems to determine the effects on the analysis
Value over Time: difficult to incorporate into MCA	• Use of BCA for economic attributes. • All relevant MCA attributes uniformly valued at $2006 values, where available.

Notes:
BCA – Benefit Cost Analysis
MCA – Multi-Criteria Analysis

E.2 METHODOLOGY

E.2.1 Overall Approach

Common MCA methodologies, as applied to road projects, are outlined in the RTA's *Economic Analysis Manual* (1999). These are further discussed by BTE (1999).

The primary methodology adopted in this study is based on the Goals Achievement Matrix (GAM) method, where each impact or benefit to the general community is allocated a rating. A weighting system is commonly applied in the GAM method, and has been adopted for use in this study to further provide information to prioritise road route options for short listing.

The methodology presented herein represents a revised MCA, incorporating additional components identified though initial consultation with Key Stakeholders.

The methodology adopted in this study was as follows:

1. determine a set of mutually-exclusive environmental and social criteria separate to economic and engineering parameters, considered in the BCA;

2. determine the relative impact or benefit of each Link Road route in terms of key indicators for each criterion;

3. present unweighted results in summary form;

4. determine a weighting system in conjunction with Council staff to apply a subjective set of relative values to each impact/benefit; and

5. apply weightings to the key indicators within each criterion and present results in summary .

This allows for two types of information to be considered:

- absolute impact; and

- weighted impacts based on values established by professional strategic planning staff.

E.2.2 MCA Assessment Criteria

A set of relevant key criteria was developed following a review of similar studies undertaken on major road and infrastructure projects. Environmental and social issues relevant to the study area were compiled as indicated in *Table E.2* below. Mutually exclusive criteria were developed from this list of issues.

Table E.2 ***Potential Environmental and Social Issues for Consideration in a Major Road Construction, Port Macquarie Outer Link Roads***

Environmental Issues	Social Issues
• Acid Sulphate Soils • Removal and Disturbance of Native Vegetation • Removal and Disturbance of Threatened Species Habitat • Removal and Disturbance of Threatened Species Individuals, Populations and Communities • Disruption of Flora and Fauna Movement and Propagation Corridors • Direct or Indirect Water Quality Impacts • Noise and Vibration Impacts to Flora and Fauna • Air Quality Impacts to Residences • Impacts to Flooding to Residences and Businesses • Short-term Construction Stage Impacts • Increase in Soil Erosion Risk	• Land Acquisition Impacts to Communities, including severance • Land Acquisition Impacts to Agricultural Production • Change to Road Safety Risk to Pedestrians • Pedestrian/Cyclist Access • Noise and Vibration Impacts to Residences • Air Quality Impacts to Residences • Visual Impact • Displacement of Houses • Aboriginal Heritage Impacts • Non-aboriginal Heritage Impacts • Impacts to Existing Business Operation • Access to Properties • Short-term Construction Stage Impacts • Public Transport Provision • Potential to service existing and proposed residential and commercial nodes
Note: These issues are not ordered nor mutually exclusive	

E.2.3 Key Criteria Utilised

The following mutually exclusive key criteria were adopted for use in the MCA process. Only mutually exclusive criteria can be used in the multi-criteria analysis to avoid double counting of particular parameters which may bias assessment results.

Environmental Key Criteria

Environmental Key Criteria adopted for use in the MCA focus on permanent reduction in ecological diversity and function. They are presented below in *Table E.3*.

Table E.3 ***Environmental Key Criteria Selected for Use in Preliminary Route Option Assessment***

Criteria	Factors in Consideration	Rating Range
Removal of Native Vegetation	Removal of forest, heath, swampland, fauna habitat	-10 (maximum impact) to +10 (maximum net benefit)
Disruption of Fauna Movement Corridors	Koala Movements, Fragmentation of Habitats, increasing traffic volumes in existing fauna corridors	-10 (maximum impact) to +10 (maximum net benefit)
Potential for Water Quality or wetland function impacts	Proximity to water courses, wetlands, Changes to hydrological regimes	-10 (maximum impact) to +10 (maximum net benefit)

The following environmental issues were not considered mutually exclusive from other key indicators:

- acid sulphate soils, noise impacts, air quality, soil compaction and erosion: measures to mitigate impacts of these issues are available and are included as a 'cost of mitigation' (engineering & economic analysis within the BCA); and

- impacts to biodiversity, threatened species habitats, populations and individuals is related to the conservation significance of vegetation removed/fragmentation/disturbed and disruption of corridor function.

Social Key Criteria

The key criteria selected for use as social indicators for the MCA are indicated in *Table E.4*.

Table E.4 ***Social Key Criteria Selected for Use in Preliminary Route Option Assessment***

Criteria	Factors in Consideration	Rating Range
Community Safety Risk	Increase in safety risk due to new roads adjacent to sensitive land uses.	-10 (maximum increase in safety risk) to +10 (maximum decrease of safety risk)
Property Access and Severance	Future access to property and businesses.	-10 (minimum improved access opportunities, maximum severance) to +10 (maximum benefit opportunities for access provision, minimum severance)
Visual Impact	Impacts to visual environment	-10 (maximum impact) to +10 (maximum net benefit)
Displacement of Houses and Property	Number of houses, businesses and private allotments within road reserve to be wholly or partly acquired	-10 (maximum impact) to 0 (no change)
Supports Council Adopted Planned Land Use Strategies	Existing Master Plans, proposed infrastructure and environmental conservation areas	0 (minimum compliance with strategies) to +10 (maximum compliance with strategies)
Heritage	Impacts to Aboriginal and Non-aboriginal heritage sites or artefacts	-10 (maximum potential risk of impact) to 0 (minimal risk of impact)

E.2.4 Adopted Weightings

These criteria were attributed weightings in consultation with Port Macquarie-Hastings Council staff to allow a comparison. These were provided as a percentage of the total weighting or 100% for environmental and social impacts separately.

The weightings presented *in Table E.5* were proposed for use by Council staff in consultation with ERM.

Table E.5 Proposed Weightings, Multi-criteria Analysis

Environmental		Social	
Criteria	**Wt (%)**	**Criteria**	**Wt (%)**
Removal of Native Vegetation	40	Community Safety (pedestrians, schools)	25
Disruption of Fauna Movement Corridors	40	Access	15
Potential for Water Quality or wetland function impacts	20	Visual Impact	15
		Displacement of Houses and Property	20
		Supports Planned Land Use	15
		Heritage	10
Total	**100%**	**Total**	**100%**

These weightings are not comparable between categories (i.e. environmental versus social), but provide an indication of the relative importance of each criterion in the overall consideration of impacts.

These ratings were subject to a sensitivity analysis to examine the effect of the weightings on the final results. This is further discussed below.

E.2.5 Rating Method

The method used for rating options was a scale of -10 to +10, where:

- -10 is the option with greatest negative impact to environmental or social risk;
- 0 was provided for those options with no change to risk compared to the current situation;
- +10 was attributed to the route option with most positive benefit; and
- remaining options were scaled between the values of -10 and +10, depending on their relative impacts between the minimum and maximum.

This method offers a technique to compare between route options to allow prioritisation based on non-quantifiable issues. The aim of which is to allow short listing of routes to a preferred option.

Rating methods of this type suffer from the following key limitations, which should be noted when interpreting results:

- the absolute level of impacts are not fully considered once ratings are applied due to a rating of -10 being applied to the worst case rating. Ratings are instead a relative indication of impacts; and

- ratings cannot account for absolute 'showstopper' impacts that may effectively remove options from consideration altogether.

E.2.6 Application of Ratings – Environmental Risk

Removal of Native Vegetation

This criterion recognises the importance of mature vegetation to environmental sustainability and the relationship to biodiversity, including threatened flora and fauna species, populations and communities.

Areas of vegetation to be impacted were estimated using vegetation mapping completed for Council by Cooper & Associates & ECOGRAPH (Draft, 1999). It was assumed that all vegetation within the road reserve would be removed or significantly disturbed as part of the road construction works.

Ratings for conservation value for vegetation in the study area were used to further refine the assessment and account for the various conservation priorities inherent in vegetation present. Ecological and conservation significance categories are based on those proposed by Cooper & Associates & ECOGRAPH (Draft, 1999). To allow these categories to be incorporated into a rating system, an ERM ecologist provided a relative weighting for different vegetation types. These are outlined below in *Table E.6*, with weightings for vegetation significance indicated.

Table E.6 ***Strategic Weightings Awarded for Vegetation Conservation Significance in the Study Area***

Category of Vegetation (Cooper & Associates & ECOGRAPH (Draft) 1999)	**Notes**	**Weighting Awarded for Strategic Analysis**
Existing Nature Reserves	Including Lake Innes Nature Reserve	2
Regional Significant Type 1	Includes large forested areas	1
Regional Significant Type 2	Includes Smaller Forested areas	0.8
Core Ecological Type 1	Habitat Value for Threatened Species or Endangered Ecological Communities	2
Core Ecological Type 2	Habitat Value for Threatened Species	1.5
Other Significant Area	Includes unmapped wetland areas	1.5
Isolated/Disturbed	Small Remnants or disturbed vegetation	0.5

Note: Vegetation Significance rating provided by ERM based on Cooper & Associates & ECOGRAPH (Draft, 1999).

It is noted that vegetation mapping does not account for some key wetland areas in the Partridge Creek Catchment not mapped as 'Coastal Wetlands' under NSW SEPP No. 14. These areas have been studied in several reports (ERM 2002a, DLWC 2002) with the presence of several threatened species reliant on the wetland and grassland habitat present in this area. An additional calculation to include such areas in the 'Other Significant Area' category was undertaken for relevant North-South links. Additional assessment is included for potential impacts relating to wetland function, as described below.

Also, there have been several listings of Endangered Ecological Communities since 2002, being consistent with swamp forest/casuarina and wetland communities. These were added to Core Ecological Type 1 where relevant.

Results

A summary of the result from the comparative analysis of effects to vegetation is provided below in *Table E.7*.

The results, after applying the strategic weightings to the vegetation removed under each option, indicated:

- E-W Link 1 is preferable for the east-west links, with links involving sub-link E posing a greater loss of more significant vegetation; and
- N-W Links 4A the most preferable, particularly when compared to those links crossing significant Partridge Creek wetland areas.

Table E.7 Comparison of Outer Link Road Preliminary Route Options: Native Vegetation Removal

Link	Sub link	NPWS	Regionally Significant Areas (ha)		Core Ecological Areas (ha)		Isolated/ Disturbed (ha)	Total Vegetation Removed (ha)	Rated Significance of Ecological Impact	Rating Awarded
			Type 1	Type 2	Type 1	Type 2				
Base Case		0						0.00	0	0.0
E-W Link1 (Upgraded)	-	0.816			0.05			0.87	1.732	-1.5
E-W Link2	E-W Link2A	1.759		1.11	0.472			3.34	5.35	-4.7
	E-W Link2B	1.759		1.8	0.472			4.03	5.902	-5.2
E-W Link3	E-W Link3A/D	1.04			0.79			1.83	3.66	-3.2
	E-W Link3A/E	1.04			4.489			5.53	11.058	-9.8
	E-W Link3B/D	1.04			0.89			1.93	3.86	-3.4
	E-W Link3B/E	1.04			4.598			5.64	11.276	-10.0
	E-W Link3C/D	1.03		0.72	0.18			1.93	2.996	-2.7
	E-W Link3C/E	1.03		0.72	3.6			5.35	9.836	-8.7
E-W Link4	-	0.07	6.13	0.67	0.64			7.51	8.086	-7.2
Base case	-	0						0.00	0	0.0
N-S Link1	-	0						0.00	0	0.0
N-S Link2	N-S Link2A	0			2.47			2.47	4.94	-5.2
	N-S Link2B	0			4.09			4.09	8.18	-8.7
	N-S Link2C	0	1.16		4.09		0.2	5.45	9.44	-10.0
N-S Link3	N-S Link3A	0	2.98	0.55	0.97	1.01		5.51	6.875	-7.3
	N-S Link3B	0	2.98	0.55	1.21	0.58		5.32	6.71	-7.1
	N-S Link3C	0	2.98		0.45	0.76		4.19	5.02	-5.3
	N-S Link3D	0	2.98		1.59	0.14		4.71	6.37	-6.7
N-S Link4	N-S Link4A	0		0.32	0.23	0.11		0.66	0.881	-0.9
	N-S Link4B	0	0.97		1.69	1.45	1.27	5.38	7.16	-7.6

E.2.7 Disruption of Fauna Movement Corridors

Methodology

A subjective analysis was undertaken to compare the potential effects of each route in terms of impacts to fauna movement corridors. It has been established that roads pose impediments to fauna movements in terms of:

- road attributed mortality (road kill) - related to traffic volumes, speed, awareness of drivers, and habitat near roadways;
- physical barriers to movement – fencing, road batters;
- physiological effects – traffic noise and headlights disrupt certain species; and
- fragmentation – some species have limited gap acceptance and will not cross significant habitat gaps.

As fragmentation of habitat has been assessed in consideration of vegetation removal, this assessment will focus on the other barriers to movement posed by a new or upgraded road.

Primary species of concern that have been recognised as present in the study area are detailed in *Table E.8*.

Table E.8 Potential Species Subject to Corridor Impacts

Species/Fauna Groups	Notes	Examples of Status
Koala	Commonly observed in the locality	Threatened Species
Possums and Larger Marsupials	A range of relatively common terrestrial and arboreal marsupial species present	Generally Common throughout
Small Marsupials and Native Rodents	Several threatened species present	Threatened Species: • Eastern Chestnut Mouse – Partridge Creek • Brush-Tailed Phascogale – Forested Areas
Nocturnal Birds Species	Several threatened species of Owl are known to be present in the locality	Threatened Species: • Eastern Grass Owl – Partridge Creek • Powerful, Barking, Masked Owl – Forested areas
Reptiles & Amphibians	Several species of threatened frog occurs throughout the area	Threatened Species: • Green & Golden Bellfrog • Green Thighed Frog • Wallum Froglet

Of particular importance in terms of corridor function is the local movements of Koalas. Ecological investigations conducted as part of the EIS for the proposed Link Road identified core koala habitat within that study area (ERM 2000). This determination was based on the presence of adult males and females, and juveniles within the study area, suggesting the occurrence of a resident breeding population. Previous surveys in the study area by NPWS (1994) also recorded the presence of koalas, providing further evidence of a resident population.

Connell Wagner (2000) mapped the location of important regional and local habitat links for koalas within the coastal area of Hastings LGA. There are several points at which preliminary routes cross such links:

- Kooloonbung Creek – a local link extends along the creek between Lake Innes and Port Macquarie CBD; and

- Partridge Creek area – Koala movement corridors north-south and east-west from the forested area immediately west of the airport are identified as local links.

These movement corridors are indicated on *Figure 19*.

It is noted that the potential impact of a new road varies according to the level of mitigation possible. This includes fauna under/overpasses, exclusion fencing and bridge structures. It was assumed that mitigation potential was limited in areas with relatively flat topography, which includes much of the study area.

The intensification of an existing road route (e.g. Lake Road) was assumed to have a lesser effect than the construction of a new road.

Results

The results of the subjective assessment are summarised in *Table E.9*.

Table E.9 Comparison of Outer Link Road Preliminary Route Options: Wildlife Corridor

Link	Sub link	Upgrade Road (m)	New Road (m)	Bridges (m)	Notes – including known corridors	Potential for Mitigation	Rating
Base Case		0	0	0		none	0
E-W Link1 (Upgraded)	-	2069	0	0	Interface between NR and Urban Areas	none	-2.0
E-W Link2	E-W Link2A	1000	1400	425	New Kooloonbung Creek Crossing	Bridge Over Kooloonbung Ck	-4.2
	E-W Link2B	555	1910	425	New Kooloonbung Creek Crossing	Bridge Over Kooloonbung Ck	-5.0
E-W Link3	E-W Link3A/D	494	2089	290	New Kooloonbung Creek Crossing	Bridge Over Kooloonbung Ck	-5.3
	E-W Link3A/E	362	3115	290	New Kooloonbung Creek Crossing	Bridge Over Kooloonbung Ck	-7.4
	E-W Link3B/D	244	2338	290	New Kooloonbung Creek Crossing	Bridge Over Kooloonbung Ck	-5.7
	E-W Link3B/E	112	3485	290	New Kooloonbung Creek Crossing	Bridge Over Kooloonbung Ck	-8.0
	E-W Link3C/D	427	3215	290	New Kooloonbung Creek Crossing	Bridge Over Kooloonbung Ck	-7.7
	E-W Link3C/E	295	4363	290	New Kooloonbung Creek Crossing	Bridge Over Kooloonbung Ck	-10.0
E-W Link4		2255	3516	270	New Kooloonbung Creek Crossing	Bridge Over Kooloonbung Ck	-9.6
Base case	-	0	0	0	-	-	0.0
N-S Link1		1086	0	0	Urban Areas	none	0.0
N-S Link2	N-S Link2A	1058	28	0	Crossing Binnacle Land	none	-0.9
	N-S Link2B	820	1553	500	Crossing Binnacle Land	Bridge along Oxley Highway	-4.5
	N-S Link2C	1058	1315	0	Crossing Binnacle Land	none	-0.4
N-S Link3	N-S Link3A	755	3813	0	Crosses Partridge Ck, utilises existing airport boundary	underpasses possible	-10.0
	N-S Link3B	755	4021	0	Crosses Partridge Ck, utilises existing airport boundary	underpasses possible	-10.5
	N-S Link3C	755	3281	0	Crosses Partridge Ck, utilises existing airport boundary	underpasses possible	-8.7
	N-S Link3D	755	2679	0	Crosses Partridge Ck, utilises existing airport boundary	underpasses possible	-7.2
N-S Link4	N-S Link4A	1680	1758	0	Crosses Partridge Ck (west)	underpasses possible	-5.7
	N-S Link4B	755	2683	0	Crosses Partridge Ck (west)	underpasses possible	-0.7

E.2.8 Potential for Water Quality and/or Wetland Function

Methodology

An assessment of the potential impact of a new road route through or adjacent to wetland areas was undertaken given the occurrence of significant wetland areas (Kooloonbung Creek, Partridge Creek) in the locality

In the assessment it was assumed that the potential impact to wetlands and water quality is directly related to:

- the area of disturbance of wetlands, as defined by SEPP 14 boundaries, assumed by calculating the area of road reserve of each option within these areas;
- areas of wetlands known to exist that are outside SEPP 14 wetland boundaries (e.g. Partridge Creek wetlands); and
- the number of creek crossings.

Results

A summary of wetland assessment results are provided in *Table E.10*.

These indicate greater potential impacts posed by those routes with greater crossing lengths over Kooloonbung Creek (East-West Links) or through Partridge Creek Areas (North-South Links.)

Table E.10 Comparison of Outer Link Road Preliminary Route Options: Potential Water Quality and Wetland Impacts

Link	Sub link	SEPP 14 Areas (ha)	Culv -erts	Other wetland Areas	Notes	Rating
Base Case		0	0		none	0
E-W Link1 (Upgraded)	-	0.00	1		Minor encroachment on Kooloonbung Creek	-1
E-W Link2	E-W Link2A	1.30	1		Bridge over Kooloonbung Creek ~425m	-10
	E-W Link2B	1.30	4		Bridge over Kooloonbung Creek ~425m	-9
E-W Link3	E-W Link3A/D	0.87	1	Dams near Greenmeadows Dr	Bridge over Kooloonbung Creek ~290m	-6
	E-W Link3A/E	4.05	1	Dams near Greenmeadows Dr	Bridge over Kooloonbung Creek ~290m	-7
	E-W Link3B/D	0.87	0	Dams near Greenmeadows Dr	Bridge over Kooloonbung Creek ~290m	-6
	E-W Link3B/E	4.05	0	Dams near Greenmeadows Dr	Bridge over Kooloonbung Creek ~290m	-7
	E-W Link3C/D	0.85	1	Dams near Greenmeadows Dr	Bridge over Kooloonbung Creek ~290m	-6
	E-W Link3C/E	4.03	1	Dams near Greenmeadows Dr	Bridge over Kooloonbung Creek ~290m	-7
E-W Link4		0.82	4		Bridge over Kooloonbung Creek ~270m	-5
Base case	-	0	0		none	0
N-S Link 1		0	0	-	Urban areas	0
N-S Link2	N-S Link2A	0.18	2	Binnacle wetland	Creek across Boundary St	-3
	N-S Link2B	0.18	2	Binnacle wetland	Creek across Boundary St	-3
	N-S Link2C	2.44	5	Binnacle wetland	Creek across Boundary St	-10
N-S Link3	N-S Link3A	0.99	3	2.3km across Sthn Partridge Ck wetlands	Creek at Tuffins Lane	-7
	N-S Link3B	1.30	4	1.2km across Sthn Partridge Ck wetlands	Creek at Tuffins Lane	-8
	N-S Link3C	0.76	3	0.6km across Sthn Partridge Ck wetlands	Creek at Tuffins Lane	-6
	N-S Link3D	1.49	2	0.6km across Sthn Partridge Ck wetlands	Creek at Tuffins Lane	-9
N-S Link4	N-S Link4A	0	2		Partridge Creek Crossing	-2
	N-S Link4B	0	4	0.6km across Sthn Partridge Ck wetlands	Two Partridge Creek Crossings, Tuffins La	-9

E.3 SOCIAL KEY CRITERIA

E.3.1 Community Safety

Methodology

In comparing between the various route options, it was considered that new roads near to larger-scale, sensitive land uses may pose increased risk to the community in terms of pedestrian and general community safety. Such land uses would include:

- **Schools,** including St Paul's Catholic, St Columba Anglican, Port Macquarie Adventist and the new approved school adjacent to Major Innes Drive,
- **residential areas,** including the areas of Greenmeadows, Sanctuary Springs, Major Innes, Kingfisher Road, Lady Nelson Drive and Sherwood Estate; and
- existing and approved **aged care facilities**.

Separation of pedestrian generating land uses was also considered, including links between residential areas and school, commercial areas and between residential areas.

Results

The results of the comparison of community safety between route options is presented in *Table E.11*.

Table E.11 Comparison of Outer Link Road Preliminary Route Options: Community Safety

Link	Sub link	Adjacent to Sensitive Land Uses	Separating pedestrian-generating Land Uses	Rating
Base Case		Oxley Highway Residential areas	Catholic School campus, Lake Road Commercial Land Use	0
E-W Link1 (Upgraded)	-	Oxley Highway Residential areas	Catholic School Campus, Lake Road Commercial Land Use	0.0
E-W Link2	E-W Link2A	Catholic School campus, Kingfisher Road and Greenmeadows (north) residential areas	Catholic School-residential areas	-7.0
	E-W Link2B	Catholic School, Greenmeadows (north) Residential area	Catholic School-residential areas	-6.0
E-W Link3	E-W Link3A/D	To rear of Anglican School, Greenmeadows Residential Area (central)	Greenmeadows Residential Area	-4.0
	E-W Link3A/E	To rear of Anglican School, Greenmeadows Residential Area (south), Adventist School	negligible impact	-6.0
	E-W Link3B/D	To rear of St Anglican School, Greenmeadows Residential Area (central)	Greenmeadows Residential Area, Innes Peninsula Residential Area, Anglican School	-7.0
	E-W Link3B/E	To rear of St Anglican School, Greenmeadows Residential Area (south), Adventist School	Innes Peninsula Proposed Residential Area, Anglican School-Innes Residential areas	-7.0
	E-W Link3C/D	Anglican School, Greenmeadows Residential Area (central)	Greenmeadows Residential Area, Anglican School-Innes Residential areas	-8.0
	E-W Link3C/E	Anglican School, Greenmeadows Residential Area (south), Adventist School	Innes Peninsula Proposed Residential Area, Anglican School-Innes Residential areas	-7.0
E-W Link4		Emerald Drive and Innes Peninsula Residential Areas, Anglican School	Emerald Drive and Innes Peninsula Residential Areas, Anglican -Innes Peninsula Residential Areas	-10.0
Base case	-	Clifton Drive & Widderson Street Residential Areas, Westport Primary	Clifton Drive & Widderson Street Residential Areas, Westport Primary-Residential Areas	0
N-S Link1		Clifton Drive Residential Area	Clifton Drive Residential Area	-10.0
N-S Link2	N-S Link2A	Lady Nelson Drive Residential Areas, Racecourse	Racecourse-Residential Areas	-5.0
	N-S Link2B	Raceview Cl Residential Areas, Racecourse	Racecourse-Residential Areas	-4.0
	N-S Link2C	Sherwood Estate Residential Areas, Racecourse	minor impact	-3.0
N-S Link3	N-S Link3A	Tuffins Lane Residential Areas, Lindfield Park Road	minor impact	-2.0
	N-S Link3B	Tuffins Lane Residential Areas	minor impact	-2.0
	N-S Link3C	Tuffins Lane Residential Areas	minor impact	-2.0
	N-S Link3D	Tuffins Lane Residential Areas	minor impact	-2.0
N-S Link4	N-S Link4A	minor impact	minor impact	-1.0
	N-S Link4B	minor impact	minor impact	-1.0

E.3.2 Access

Methodology

An assessment of impacts to access resulting from the Outer Link Road Route construction was undertaken in terms of:

- impacts to property and business access;
- disruption to existing local road access; and
- in rural areas of N-S Link options, driveways to residences.

The level of impact was related to the number of residential and commercial allotments affected, both directly and indirectly.

This assessment excluded all properties marked for potential land acquisition as a result of the particular route adoption. This reduces the number of properties directly affected by the routes significantly.

Indirect effects were noted where access intersections from the proposed arterial route to local roads would be required. This was considered to pose a reduced amenity to the future residents of such areas.

It was also assumed that:

- the Lake Road route option for east-west links would pose impacts to business access from increased traffic volumes and the construction of a divided carriageway;
- north-south road links would generally retain property accesses directly to the road in rural areas; and
- development in Area 13 and existing large allotments in residential zones would be constructed so as to avoid road frontage for new developments.

Results

An overall value for each option was awarded given the findings of key indicators summarised in *Table E.12*

Table E.12 Comparison of Outer Link Road Preliminary Route Options: Potential Access Impacts

Link	Sub link	No Residential Lots Directly Affected	No Commercial Lots Affected	No Residential Lots Indirectly Affected	Other Notes	Rating
Base Case		-	-		-	0
E-W Link1 (Upgraded)	-	1	33	57	Number of commercial a premises higher number	-3.5
E-W Link2	E-W Link2A	0	3	38	Catholic School Intersection	-1.5
	E-W Link2B	0	3	24	Catholic School Intersection	-1.0
E-W Link3	E-W Link3A/D	0	2	114+ mobile home park	Aged Care Facility Access	-6.5
	E-W Link3A/E	0	1	49	-	-2.0
	E-W Link3B/D	2	1	65+ mobile home park	Severs proposed residential area	-4.5
	E-W Link3B/E	2	1	0	Severs proposed residential area	-0.5
	E-W Link3C/D	1	2	250+ mobile home park	Anglican School Access	-10.0
	E-W Link3C/E	1	2	0	-	-0.5
E-W Link4		0	1	approx 500	Anglican School Access	-10.0
Base case	-	-	-		-	0
N-S Link1		-	5	74+	road alterations, Clifton Area reduced car parking area, racecourse	-10.0
N-S Link2	N-S Link2A	5	12	0	Racecourse Access	-3.0
	N-S Link2B	5	12	0	-	-2.5
	N-S Link2C	5	12	0	-	-2.0
N-S Link3	N-S Link3A	8	2	0	-	-1.5
	N-S Link3B	5	2	0	-	-1.0
	N-S Link3C	5	2	0	-	-1.0
	N-S Link3D	5	2	0	-	-1.0
N-S Link4	N-S Link4A	2	0	0	-	-0.5
	N-S Link4B	5	2	-	-	-1.0

It was found that the greatest access impacts for East-West link options were likely to occur along those options through the Greenmeadows Drive area. For North-South links, Route 2A was found to pose the greatest potential access disruption, primarily due to effects on the racecourse.

E.3.3 Visual Impact

Methodology

Impacts to visual environment posed by each option were assessed and compared. The assessment of visual significance of areas potentially affected by potential route options is relevant to:

- the proximity and density of sensitive viewpoints to the route; and
- the level and type of change to the visual environment.

Sensitive viewpoints can be regarded as locations from which people view a given site that forms a visually significant element to the existing landscape character. These locations typically include roads, houses, tourist destinations, and beaches, parks and other areas frequented by the public.

It is noted that both new roads and road upgrades would be subject to landscaping and incorporation of vegetation screens to other development where possible.

Results

Results of the comparison between route options is summarised in *Table E.13*.

In terms of visual impact, E-W Link Routes incorporating sub-links 3C and 3E were rated as the highest impact, and the Lake Road upgrade with the minimum impact. For N-S Links, those routes closer to residential areas and the racecourse were rated at higher impact than those through rural areas.

Table E.13 Comparison of Outer Link Road Preliminary Route Options: Visual Assessment

Link	Sub link	Sensitive viewpoints	Impact Type	Impact Level	Rating
Base Case					
E-W Link1 (Upgraded)	-	none	Road Intensification	Low	-2
E-W Link2	E-W Link2A	Greenmeadows Drive & Kingfisher Rd Residential Areas;	Road Intensification & New Road	Med-Low	-4
	E-W Link2B	Greenmeadows Drive Residential Areas;	Road Intensification & New Road	Med-Low	-3
E-W Link3	E-W Link3A/D	Greenmeadows Drive Residential Areas, Anglican School;	Road Intensification & New Road	Medium	-5
	E-W Link3A/E	Greenmeadows Residential Village and Residential Areas, Anglican School;	Primarily New Road	High	-8
	E-W Link3B/D	Greenmeadows Drive Residential Areas, Anglican School;	Road Intensification & New Road	Medium	-5
	E-W Link3B/E	Greenmeadows Village and Residential Areas, Anglican School;	Primarily New Road	High	-8
	E-W Link3C/D	Innes Peninsula and Greenmeadows Residential Areas, Anglican School;	Primarily New Road	Very High	-9
	E-W Link3C/E	Innes Peninsula and Greenmeadows Village and Residential Areas, Anglican School;	Primarily New Road	Very high	-10
	E-W Link4	Emerald Drive and Innes Peninsula Residential Areas	Road Intensification & New Road	Very High	-10
Base case	-	-	none		0
N-S Link1		Clifton Residential Areas	Road Intensification	Medium	-5
N-S Link2	N-S Link2A	Racecourse, Clifton Residential Areas	Primarily New Road	High	-8
	N-S Link2B	Racecourse, Sherwood Estate Residences	Primarily New Road	Very High	-9
	N-S Link2C	Racecourse, Sherwood Estate Residences	Primarily New Road	High	-10
N-S Link3	N-S Link3A	Lindfield Park Road	Primarily New Road	High	-8
	N-S Link3B	Area 13	Primarily New Road	Medium	-5
	N-S Link3C	Area 13	Primarily New Road	Medium	-5
	N-S Link3D	Area 13	Primarily New Road	Medium	-6
N-S Link4	N-S Link4A	Area 13, Fernbank Creek Road	Road Intensification & New Road	Medium-Low	-3
	N-S Link4B	Area 13, Fernbank Creek Road	Primarily New Road	Med-High	-7

E.3.4 Displacement of Houses and Property

Methodology

It is recognised that the acquisition of land for a road route may pose social impacts in terms of displacement of residents and severance of properties. It is these two parameters that were used in the assessment of this criterion.

Results

The results of the assessment are provided in *Table E.14*.

Table E.14 Comparison of Outer Link Road Preliminary Route Options: Potential Displacement of Houses and Property Impacts

Link	Sub link	Acquisition		Partially Affected		Other Notes	Rating
		Residences	Commercial & Civic Properties	Residences	Commercial & Civic Properties		
Base Case		0	0				
E-W Link1 (Upgraded)	-	0	0	0	13	various commercial properties affected	-1
E-W Link2	E-W Link2A	34	1	1	2	Kingfisher Road Residences	-7
	E-W Link2B	14	1	1	2		-4
E-W Link3	E-W Link3A/D	13	1	3	2	Some loss of primary production	-4
	E-W Link3A/E	1* (see note)	1	3	1	Impacts to residential village, Some loss of primary production	-2
	E-W Link3B/D	13	2	3	1	Impact to approved School Site, some loss of primary production	-3
	E-W Link3B/E	1* (plus residential village)	1	3	1	Impact to approved School Site plus residential village	-2
	E-W Link3C/D	13	1	11	1	Impact to School Site, Golf Course, some loss of primary production	-3
	E-W Link3C/E	1* (plus residential village)	1	7	1	Impact to School Site, Golf Course, residential village	-2
E-W Link4		90	0	16	3		-10
Base case	-	0					0
N-S Link1		58	0	0	5		-10
N-S Link2	N-S Link2A	9	0	3	9		-6
	N-S Link2B	0	0	3	9		-1
	N-S Liunk2C	0	0	3	9	Potential impacts to mobile home village	-1

Link	Sub link	Acquisition		Partially Affected		Other Notes	Rating
N-S Link3	N-S Link3A	4	0	3	3		-3
	N-S Link3B	2	0	3	2		-2
	N-S Link3C	2	0	3	2		-2
	N-S Link3D	2	0	3	2		-2
N-S Link4	N-S Link4A	0	0	2	2		-1
	N-S Link4B	0	0	3	2		-1

Taking into consideration the impact to current properties, the E-W-link 2A (Kingfisher Road) would displace the most number of dwellings. Of north-south links, N-S Link 2A (via Lady Nelson Drive) was found to have the greatest potential impact in this criterion.

E.3.5 Supports Planned Land Use

Methodology

Lands occupied by proposed routes are subject to various land use strategies used by Council. The plans that apply at the time of writing this document are:

- SMEC Hastings Roads and Traffic Study 2001;
- *Hastings LEP 2001*;
- Port Macquarie Airport Master Plan and further planning;
- Area 13 Master Plan;
- DCP 27 - Airport Lands: The Binnacle Project; and
- DCP 45 – Innes Peninsula.

Routes were assessed on their compliance (from 0 to 10), indicating potential benefits of the routes in achieving strategic planning outcomes.

Results

The relevant assessment results are indicated in *Table E.15*.

Table E.15 Comparison of Outer Link Road Preliminary Route Options: Consistency with Existing Planning Strategies and Documents

Link	Sub link	Compliance with Strategic Planning	Value Awarded
Base Case			
E-W Link1 (Upgraded)	-	None, Does not provide Outer Link Road (as per SMEC), would provide traffic relief	1
E-W Link2	E-W Link2A	Allows 'Outer Link' Road (different location) and Jindalee Road extension. Does not allow for Kingfisher Road residential land use	4
	E-W Link2B	Allows 'Outer Link' Road (different location) and Jindalee Road extension.	5
E-W Link3	E-W Link3A/D	Allows 'Outer Link' Road (Innes Peninsula DCP).	10
	E-W Link3A/E	Allows 'Outer Link' Road (Innes Peninsula DCP), winding alignment	9
	E-W Link3B/D	Allows 'Outer Link' Road (SMEC), Not in accordance with Innes DCP	6
	E-W Link3B/E	Allows 'Outer Link' Road (SMEC), winding alignment, Not in accordance with Innes DCP	5
	E-W Link3C/D	Allows 'Outer Link' Road (SMEC), Not in accordance with Innes DCP	4
	E-W Link3C/E	Allows 'Outer Link' Road (SMEC), Not in accordance with Innes DCP, winding alignment	3
E-W Link4		Allows 'Outer Link' Road (SMEC), Not in accordance with Innes DCP, winding alignment	2
Base case	-	none	0
N-S Link1		none	1
N-S Link2	N-S Link2A	Could link to airport expansion, Not linked directly to E-W link	3
	N-S Link2B	Could link to airport expansion, Not linked directly to E-W link	3
	N-S Link2C	Could link to airport expansion, Allows 'Outer Link' Road (SMEC)	8
N-S Link3	N-S Link3A	Allows 'Outer Link' Road (SMEC), Potential conflict with Airport and Rifle Range	4
	N-S Link3B	Provides for Area 13, Potential conflict with Airport and Rifle Range	4
	N-S Link3C	Provides for Area 13, Potential conflict with Airport and Rifle Range	4
	N-S Link3D	Provides for Area 13, Potential conflict with Airport and Rifle Range	4
N-S Link4	N-S Link4A	Provides for Area 13 (indirect), Proposed Sancrox Industrial Area, Proposed Sporting fields	10
	N-S Link4B	Provides for Area 13 (indirect), Proposed Sporting fields	8

E.3.6 Heritage

Methodology

Previous heritage investigations and predictive models developed for Area 13 by Collins (1995) were used to compare the potential for heritage impacts posed by each route.

Sites and items of aboriginal heritage significance are present throughout the Partridge Creek area. Predictive modelling indicated the potential for sites across the floodplain and in areas where disturbance due to urban development, fruit cultivation, grazing and complete vegetation clearance had not occurred.

It is noted that as part of the approval process for any new road construction or road upgrade that an assessment of heritage significance is required under the *National Parks & Wildlife Act 1974*. The comparison between routes is only to gauge the comparative risk of heritage impacts to areas which may or may not occur along a particular route.

It was considered that the risk of disturbance to heritage sites and artefacts is related to several key indicators:

- area of road reserve in undisturbed areas;
- area of vegetation removal required; and
- traversing known areas of heritage significance.

It was assumed no non-aboriginal heritage impacts are likely from any of the routes under consideration given:

- no known heritage items are located near the proposed routes: and
- existing residences potentially affected by the routes were constructed within the last 50 years, representing negligible potential for heritage values.

Results

A comparison of the potential risk of impacts sites or items of heritage significance is provided in *Table E.16*.

The E-W Link 3C/E and E-W Link B/E were determined to pose the greatest risk to heritage of the east-west links. Of north-south routes, several links through the Partridge Creek area posed the greatest risk.

Table E.16 Comparison of Outer Link Road Preliminary Route Options: Potential for Aboriginal Heritage Impacts

Link	Sub link	Length of new road	Area of Vegetation to be Removed (ha)	Other Notes	Rating
Base Case		0	0.00		0
E-W Link1 (Upgraded)	-	0	0.87		-1
E-W Link2	E-W Link2A	1400	3.34	Impacts to Kooloonbung Creek	-4.5
	E-W Link2B	1910	4.03	Impacts to Kooloonbung Creek	-5.5
E-W Link3	E-W Link3A/D	2089	1.83	Impacts to Kooloonbung Creek	-3.5
	E-W Link3A/E	3115	5.53	Impacts to Kooloonbung Creek	-8
	E-W Link3B/D	2338	1.93	Impacts to Kooloonbung Creek	-4
	E-W Link3B/E	3485	5.64	Impacts to Kooloonbung Creek	-8
	E-W Link3C/D	3215	1.93	Impacts to Kooloonbung Creek	-4.5
	E-W Link3C/E	4363	5.35	Impacts to Kooloonbung Creek	-9
E-W Link4		3516	7.51	Impacts to Kooloonbung Creek	-10
Base case	-	0	0.00		0
N-S Link1		1086	0.00		-1
N-S Link2	N-S Link2A	2373	2.47		-4
	N-S Link2B	2821	4.09		-4.5
N-S Link3	N-S Link3A	4568	5.51	Partridge Creek Areas	-10
	N-S Link3B	4776	5.32	Partridge Creek Areas	-9.5
	N-S Link3C	4036	4.19	Partridge Creek Areas	-9
	N-S Link3D	3434	4.71	Partridge Creek Areas	-1.6
N-S Link4	N-S Link4A	3438	0.66	Partridge Creek Areas	-2
	N-S Link4B	3062	5.68	Partridge Creek Areas	-8.6

E.4 OVERALL RESULTS

Results from each criterion were compiled to form separate matrices for environmental and social parameters. The results are indicated below.

E.4.1 Summary of Environmental Impacts

The following table (*Table E.17*) summarises the overall ratings and the weighted value awarded to each impact as a result of the analyses described above.

Table E.17 Overall Results, Comparison of Environmental Assessment Criteria

Link	Sub link	Removal of Native Vegetation	Disruption of Fauna Movement Corridors	Potential for Water Quality or wetland function impacts	Weighted Rating
	Weighting:	**0.4**	**0.4**	**0.2**	
Base Case		0	0.0	0	**0.0**
E-W Link1 (Upgraded)	-	**-1.5**	**-2.0**	**-1**	**-1.6**
E-W Link2	E-W Link2A	-4.7	-4.2	-10	**-5.6**
	E-W Link2B	-5.2	-5.0	-9	**-5.9**
E-W Link3	E-W Link3A/D	-3.2	-5.3	-6	**-4.6**
	E-W Link3A/E	-9.8	-7.4	-7	**-8.3**
	E-W Link3B/D	-3.4	-5.7	-6	**-4.8**
	E-W Link3B/E	-10.0	-8.0	-7	**-8.6**
	E-W Link3C/D	-2.7	-7.7	-6	**-5.3**
	E-W Link3C/E	-8.7	-10.0	-7	**-8.9**
E-W Link 4		-7.2	-9.6	-5	**-7.7**
Base case	-	0.0	0.0	0	**0.0**
N-S Link1		**0.0**	**0.0**	**0**	**0.0**
N-S Link2	N-S Link2A	-5.2	-0.9	-3	**-3.1**
	N-S Link2B	-8.7	-4.5	-3	**-5.9**
	N-S Link2C	-10.0	-0.4	-10	**-6.2**
N-S Link3	N-S Link3A	-7.3	-10.0	-7	**-8.3**
	N-S Link3B	-7.1	-10.5	-8	**-8.6**
	N-S Link3C	-5.3	-8.7	-6	**-6.8**
	N-S Link3D	-6.7	-7.2	-9	**-7.4**
N-S Link4	N-S Link4A	-0.9	-5.7	-2	**-3.1**
	N-S Link4B	-7.6	-0.7	-9	**-5.1**

Note: Orange Cells indicate most preferred options

The assessment of potential environmental impacts indicated the following:

- for East-West Links:
  - upgrading Lake Road (E-W Link1) provided the least environmental impacts (overall rating -1.6), being preferred across all three environmental criterion;
  - E-W Link3A/D produced the next best rating (-4.6), with Link 3 posing the second preferred crossing points of Kooloonbung Creek given the existing disturbance to the creek posed by the utility services easement; and
  - Routes involving Sublink 'E' of E-W Link 3 posed the greatest environmental impacts.

- For North-South Links:
    - N-S Link 1 was preferable overall and in terms of all environmental criterion;
    - N-S Link 2A and 4A were ranked equal overall in terms of preference; and
    - Route based on N-S Link 3 (west of the airport) posed the greatest environmental impacts.

E.4.2 Summary of Social Impacts

The following table (*Table E.18*) indicates the value awarded to each impact as a result of the analyses described above.

The assessment of potential social impacts indicated the following:

- for East-West Links:
    - upgrading Lake Road provided the most reduced social impacts in terms of community safety, visual impacts and heritage. It also was preferred overall (rated -2.4) compared to the other route options;
    - the second most preferred route was the E-W Link 3A/D, rated at -3.0; and
    - E-W link 3C/D posed the greatest level of social impact (-7.0).
- For North-South Links:
    - N-S Link 4A poses little potential social impacts (rated 0.1), being preferred over five of the six social criteria and overall;
    - generally western routes through rural land (N-S Links 3 and 4) posed limited potential for social impacts as they generally avoided residences, although with some potential risk to heritage;

N-S Link 1 posed the greatest potential social impacts due to impacts top Clifton Drive. N-S Link 2A posed the secondmost greatest social impacts due to proximity to Lady Nelson Drive and the Racecourse.

Table E.18 Overall Results, Comparison of Social Assessment Criteria

Link	Sub link	Comm-unity Safety	Access	Visual Impact	Displace-ment of Houses and Property	Supports Planned Land Use	Heritage	Total
	Weighting	**0.25**	**0.15**	**0.15**	**0.2**	**0.15**	**0.1**	
Base Case		0	0	0	0	0	0	0.0
E-W Link1	-	**0**	-3.5	**-2**	-1	1	**-1**	**-1.0**
E-W Link2	E-W Link2A	-7	-1.5	-4	-7	4	-4.5	-3.8
	E-W Link2B	-6	-1	-3	-4	5	-5.5	-2.7
E-W Link3	E-W Link3A/D	-4	-6.5	-5	-4	**10**	-3.5	-2.4
	E-W Link3A/E	-6	-2	-8	**-2**	9	-8	-2.9
	E-W Link3B/D	-7	-4.5	-5	-3	6	-4	-3.3
	E-W Link3B/E	-7	**-0.5**	-8	**-2**	5	-8	-3.5
	E-W Link3C/D	-8	-10	-9	-3	4	-4.5	-5.3
	E-W Link3C/E	-7	**-0.5**	-10	**-2**	3	-9	-4.2
E-W Link4	-	-10	-10	-10	-10	2	-10	-8.2
Base case	-	0	0	0	0	0	0	0
N-S Link1	-	-10	-10	-5	-10	0	-1	-6.9
N-S Link2	N-S Link2A	-5	-3	-5	-4	3	-4	-3.2
	N-S Link2B	-4	-2.5	-8	**-1**	3	-4.5	-2.8
	E-W Link 2C	-3	-2	-9	**-1**	8	-10	-2.4
N-S Link3	N-S Link3A	-2	-1.5	-10	-3	4	-10	-3.2
	N-S Link3B	-2	-1	-8	-2	4	-9.5	-2.6
	N-S Link3C	-2	-1	-5	-2	4	-9	-2.1
	N-S Link3D	-2	-1	-5	-2	4	**-1.6**	-1.4
N-S Link4	N-S Link4A	**-1**	**-0.5**	-6	**-1**	**10**	-2	**-0.1**
	N-S Link 4B	**-1**	-1	**-3**	**-1**	8	-8.6	-0.7

Note: Orange Cells indicate most preferred options

E.5 SENSITIVITY ANALYSIS

E.5.1 Methodology

It is recognised that the above ratings are subject to influence from the weightings selected across criteria in the summary tables.

As such, a sensitivity analysis was undertaken to determine the effects of the weightings. This was undertaken adopting equal weightings for each criterion to examine the effects on the overall ratings awarded.

Additionally, an assessment was undertaken discarding the social criterion 'supports planned land use'. This was undertaken to reflect the difference between actual social impacts (e.g. displacement, access) compared to this particular criterion which could be argued as having a limited actual influence on actual social attributes. To ensure it is not unreasonably influencing the remainder of the analysis, a scenario was completed with it removed from the weightings system. Weightings were left unchanged between the remaining route options.

E.5.2 Results

Results of the sensitivity analyses are provided in *Table E.19* below.

Table E.19 ***Sensitivity Test 1 Comparison of Environmental Assessment Criteria Under an Equal Weighting System***

Link	Sub link	Removal of Native Vegetation	Disruption of Fauna Movement Corridors	Potential for Water Quality or wetland function impacts	Weighted Rating
	Weighting:	**0.33**	**0.33**	**0.33**	
Base Case		0.0	0.0	0	0.0
E-W Link1 (Upgraded)	-	**-1.5**	**-2.0**	**-1**	**-1.5**
E-W Link2	E-W Link2A	-4.7	-4.2	-10	**-6.3**
	E-W Link2B	-5.2	-5.0	-9	**-6.3**
E-W Link3	E-W Link3A/D	-3.2	-5.3	-6	**-4.8**
	E-W Link3A/E	-9.8	-7.4	-7	**-8.0**
	E-W Link3B/D	-3.4	-5.7	-6	**-5.0**
	E-W Link3B/E	-10.0	-8.0	-7	**-8.3**
	E-W Link3C/D	-2.7	-7.7	-6	**-5.4**
	E-W Link3C/E	-8.7	-10.0	-7	**-8.5**
E-W Link 4		-7.2	-9.6	-5	**-7.2**
Base case	-	0.0	0.0	0	**0.0**
N-S Link1		**0.0**	**0.0**	**0**	**0.0**
N-S Link2	N-S Link2A	-5.2	-0.9	-3	**-3.0**
	N-S Link2B	-8.7	-4.5	-3	**-5.3**
	E-W Link 2C	-10.0	-0.4	-10	**-6.7**

Link	Sub link	Removal of Native Vegetation	Disruption of Fauna Movement Corridors	Potential for Water Quality or wetland function impacts	Weighted Rating
N-S Link3	N-S Link3A	-7.3	-10.0	-7	**-8.0**
	N-S Link3B	-7.1	-10.5	-8	**-8.5**
	N-S Link3C	-5.3	-8.7	-6	**-6.6**
	N-S Link3D	-6.7	-7.2	-9	**-7.6**
N-S Link4	N-S Link4A	-0.9	-5.7	-2	**-2.8**
	N-S Link4B	-7.6	-0.7	-9	**-5.7**

Note: Orange Cells indicate most preferred options

This analysis indicated no change to the preferred options for each link (E-W Link1, N-S Link 4A). The ratings were slightly varied by the change in weightings, but generally the results were still similar when examined in relative terms.

Table E.20 Sensitivity Test 2: Comparison of Social Assessment Criteria Under an Equal Weighting System

Link	Sub link	Comm-unity Safety	Access	Visual Impact	Displace-ment of Houses and Property	Supports Planned Land Use	Heritage	Total
	Weighting	**0.163**	**0.163**	**0.163**	**0.163**	**0.163**	**0.163**	**0.98**
Base Case		0	0	0	0	0	0	**0.0**
E-W Link1 (Upgraded)	-	0	-3.5	-2	-1	1	-1	**-1.1**
E-W Link2	E-W Link2A	-7	-1.5	-4	-7	4	-4.5	**-3.3**
	E-W Link2B	-6	-1	-3	-4	5	-5.5	**-2.4**
E-W Link3	E-W Link3A/D	-4	-6.5	-5	-4	10	-3.5	**-2.1**
	E-W Link3A/E	-6	-2	-8	-2	9	-8	**-2.8**
	E-W Link3B/D	-7	-4.5	-5	-3	6	-4	**-2.9**
	E-W Link3B/E	-7	-0.5	-8	-2	5	-8	**-3.3**
	E-W Link3C/D	-8	-10	-9	-3	4	-4.5	**-5.0**
	E-W Link3C/E	-7	-0.5	-10	-2	3	-9	**-4.2**
E-W Link4		-10	-10	-10	-10	2	-10	
Base case	-	0	0	0	0	0	0	**0.0**
N-S Link1	-	-10	-10	-5	-10	0	-1	**-5.9**
N-S Link2	N-S Link2A	-5	-3	-5	-4	3	-4	**-2.9**
	N-S Link2B	-4	-2.5	-8	**-1**	3	-4.5	**-2.8**
	E-W Link 2C	-3	-2	-9	**-1**	8	-10	**-2.8**

Link	Sub link	Comm-unity Safety	Access	Visual Impact	Displace-ment of Houses and Property	Supports Planned Land Use	Heritage	Total
N-S Link3	N-S Link3A	-2	-1.5	-10	-3	4	-10	**-3.7**
	N-S Link3B	-2	-1	-8	-2	4	-9.5	**-3.0**
	N-S Link3C	-2	-1	-5	-2	4	-9	**-2.4**
	N-S Link3D	-2	-1	-5	-2	4	**-1.6**	**-1.2**
N-S Link4	N-S Link4A	**-1**	**-0.5**	-6	**-1**	**10**	-2	**-0.1**
	N-S Link4B	**-1**	-1	**-3**	**-1**	8	-8.6	**-1.1**

Note: Orange Cells indicate most preferred options

In a similar fashion to the change in environmental ratings, this analysis indicated no change to the preferred option (Lake Road Upgrade, rated -1.9) in social terms. Other rankings were affected, however, with E-W Link 2B being second preference as the second-ranked overall rating.

Table E.21 Sensitivity Test 3: Comparison of Social Assessment Criteria Without Support Planned Land Use Criterion

Link	Sub link	Commu-nity Safety	Access	Visual Impact	Displacement of Houses and Property	Heritage	Total
	Weighting	**0.25**	**0.15**	**0.15**	**0.2**	**0.1**	**0.85**
Base Case		0	0	0	0	0	**0.0**
E-W Link1 (Upgraded)	-	0	-3.5	-2	-1	-1	**-1.1**
E-W Link2	E-W Link2A	-7	-1.5	-4	-7	-4.5	**-4.4**
	E-W Link2B	-6	-1	-3	-4	-5.5	**-3.5**
E-W Link3	E-W Link3A/D	-4	-6.5	-5	-4	-3.5	**-3.9**
	E-W Link3A/E	-6	-2	-8	-2	-8	**-4.2**
	E-W Link3B/D	-7	-4.5	-5	-3	-4	**-4.2**
	E-W Link3B/E	-7	-0.5	-8	-2	-8	**-4.2**
	E-W Link3C/D	-8	-10	-9	-3	-4.5	**-5.9**
	E-W Link3C/E	-7	-0.5	-10	-2	-9	**-4.6**
E-W Link4		-10	-10	-10	-10	-10	**-8.5**
Base case	-	0	0	0	0	0	**0.0**
N-S Link1	-	-10	-10	-5	-10	**-1**	**-6.9**
N-S Link2	N-S Link2A	-5	-3	-5	-4	-4	**-3.7**
	N-S Link2B	-4	-2.5	-8	**-1**	-4.5	**-3.2**
	E-W Link 2C	-3	-2	-9	**-1**	-10	**-3.6**
N-S Link3	N-S Link3A	-2	-1.5	-10	-3	-10	**-3.8**
	N-S Link3B	-2	-1	-8	-2	-9.5	**-3.2**
	N-S Link3C	-2	-1	-5	-2	-9	**-2.7**
	N-S Link3D	-2	-1	-5	-2	-1.6	**-2.0**
N-S Link4	N-S Link4A	**-1**	**-0.5**	-6	**-1**	-2	**-1.6**
	N-S Link4B	**-1**	-1	**-3**	**-1**	-8.6	**-1.9**

The removal of this criterion from consideration did not change the two preferred options in terms of minimal social impacts (Lake Road Upgrade and N-S Link 4A). The relative ratings of the options were affected in terms of:

- a general lowering of all ratings due to the removal of the calculated benefit (scaled from 0 to +10); and

- E-W Link2B was found to be the second-most preferable of the east-west links (rated -3.5) under this scenario compared to the previous second-most rated option E-W LinkA/D (rated -3.9).

E.5.3 Discussion of Overall Results

The MCA assessment of potential environmental and social impacts of the preliminary Outer Link Road routes indicates the following:

East-West Links

Route E-W Link 1 (upgrade of Lake Road) poses most preferable route in terms of minimising potential environmental and social impacts. It has the advantage, in environmental terms, of being the only existing crossing of Kooloonbung Creek and hence poses reduced a reduced overall environmental impact.

Of the remaining options, E-W Link 3A/D was the next preferable options in terms of potential environmental and social impacts. This route is fairly direct and allows for a crossing of Kooloonbung Creek at the existing utility crossing ("Corduroy").

Other options exhibited poorer environmental and social performance due to alternate creek crossing points (Links 2A, 2B), additional potential impacts to residences and access and/or not following adopted strategic planning instruments.

North-South Links:

N-S Link 4A was found to be the most preferable Link Road route in terms of minimising social impacts. This has the advantage of a large proportion of the route alignment being located along an existing access track through Council-owned land. Additionally, it is located in a rural area and would link to the Area 13 residential growth area.

N-S Link 1 posed minimal environmental impacts, being situated within an existing urban area. However social impacts were the greatest of North-South options considered due to the disturbance to the Clifton area.

The eastern Link Road Routes 2A and 2B also have a reduced environmental impact but impose greater potential social impacts due to proximity to existing residential development and recreational facilities (racecourse).

Annex F

Modelling and Traffic Analysis of Proposed East-West Link (SMEC 2008)

Document / Report Control Form

Project Name: **Modelling and Traffic Analysis of Proposed East-West Link**

Project number: **3002102**

Report for: **Port Macquarie Hastings Council**

PREPARATION, REVIEW AND AUTHORISATION

Revision #	Date	Prepared by	Reviewed by	Approved for Issue by
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Contents

1 Introduction

In 2006, SMEC was commissioned to investigate the options for an outer link road system for Port Macquarie. The outer link road system was to consist of a North-South link connecting the Oxley Highway near Area 13 to Hastings River Drive and an East-West link connecting the Oxley Highway to Ocean Drive. These links were intended to allow traffic to bypass the roads closer in to the CBD.

The original SMEC study determined the option that provided the best traffic operability in relative terms.

The SMEC study used the model of Port Macquarie that was generated as part of the Hastings Road Study in 2001. The model was not significantly updated but it was felt at that time that the model was sufficient to determine the best option in relative terms. As a result of this screening modelling exercise, the East-West link 3A/3/3D was recommended to be the option that provided better traffic operability.

SMEC was recently commissioned to conduct a scoping modelling exercise for the East-West link option based on the work that had been carried out for the Area 13 and Sancrox Traffic Study. This required updating the strategic transport model. The changes to the model included network changes, refined zoning for Area 13 & Sancrox, land use changes, new growth factors and recalibration of the origin/destination matrix based on traffic counts conducted between 2001 and 2006. This work is intended to provide a better indication of the traffic that will be expected to use the E-W link 3A/3/3D. These results will also be used in the generation of an Environmental Impact Statement.

2 SMEC Model Updates

The strategic traffic model of Port Macquarie created and maintained by SMEC was updated significantly for the Area 13 and Sancrox Traffic Study. Port Macquarie Hastings Council then requested that a re-investigation of the Outer Link Road Study be carried out with this new model. For the purpose of this report, the model has been divided up into regions to allow for easier visualisation and reporting. The regions are shown in Figure 2-1.

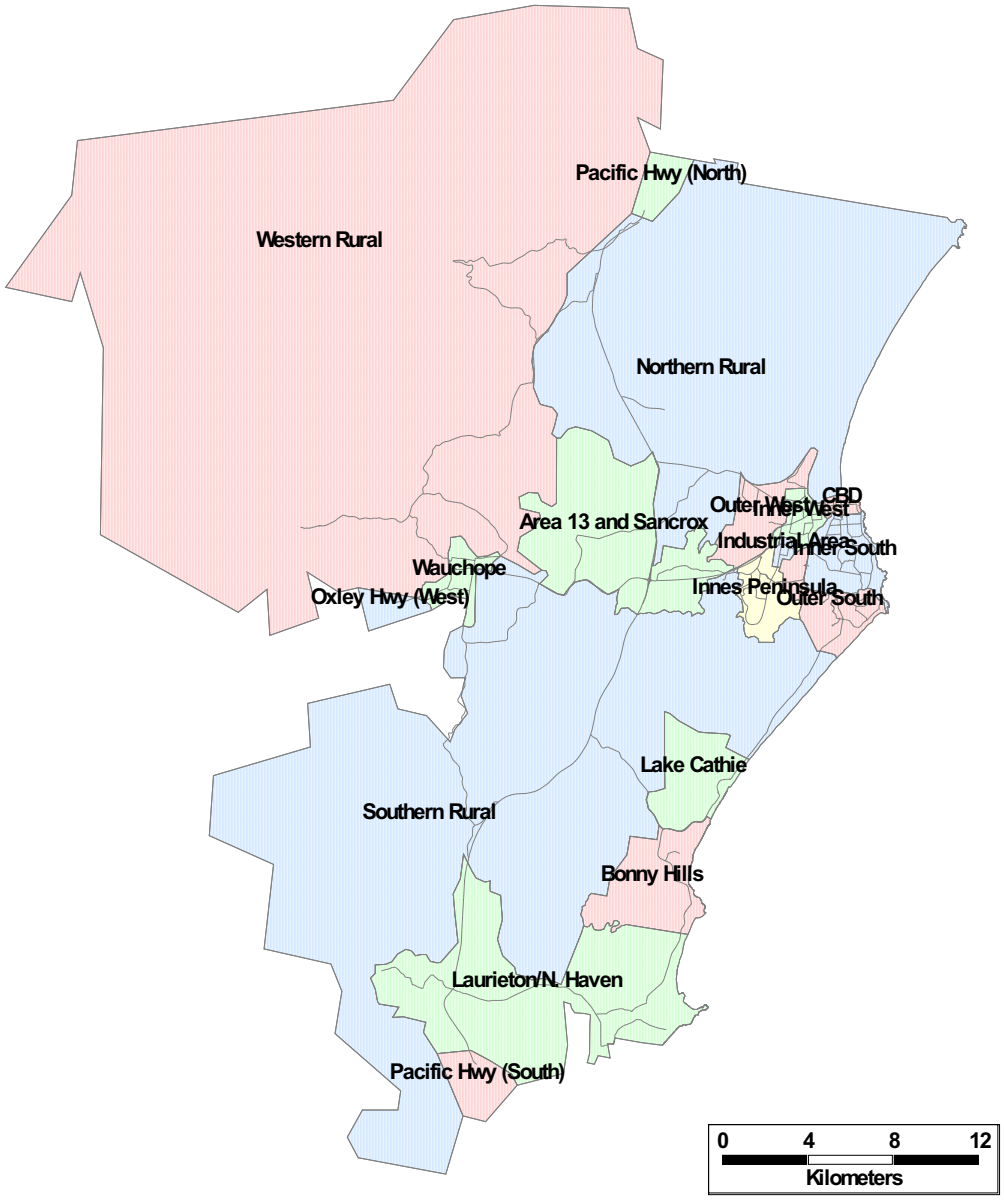


Figure 2-1: Regional Map of Port Macquarie

2.1 Updates to the Network

The network changes were not very significant. However, the earlier model had a slightly different alignment for the proposed Oxley Highway Upgrade and the connections with the current Oxley Highway were different. In addition, the earlier model did not have a proper network for Area 13 and Sancrox. The road network for 2031 in the central area of the model is shown in Figure 2-2

Figure 2-2: Expected 2031 Road Network for Port Macquarie

2.2 Updates to the Land use

The land use used for this current modelling is shown in Table 2-1.

Table 2-1: 2031 Land use for Port Macquarie Region

Region	Population	Employment	Students	Beach Visits
Laurieton and North Haven	12,195	3,614	4,226	563
Bonny Hills	5,156	383	918	324
Lake Cathie	3,660	559	353	88
Southern Rural	6,514	594	606	0
Western Rural	5,160	346	256	0
Northern Rural	1,720	274	0	0
Wauchope	7,067	4,308	3,266	0
Area 13 and Sancrox	13,893	1,944	2,100	0
Outer West	6,485	1,719	576	0
Inner West	9,504	6,915	6,249	0
CBD	3,728	7,483	2,415	810
Inner South	22,111	3,925	1,527	656
Outer South	12,787	1,545	3,305	324
Industrial Area	712	3,165	0	0
Innes Peninsula	6,446	1,100	1,059	0
Highways	233	106	225	0
Total	**117,371**	**37,980**	**27,081**	**2,764**

2.3 Updates to the Origin/Destination Matrix

As part of the preparatory work for the Area 13 and Sancrox Study, a large number of traffic counts from around the Port Macquarie region were used to re-calibrate the O/D matrix that was developed in 2001. The location of these traffic counts is shown in Figure 2-3.

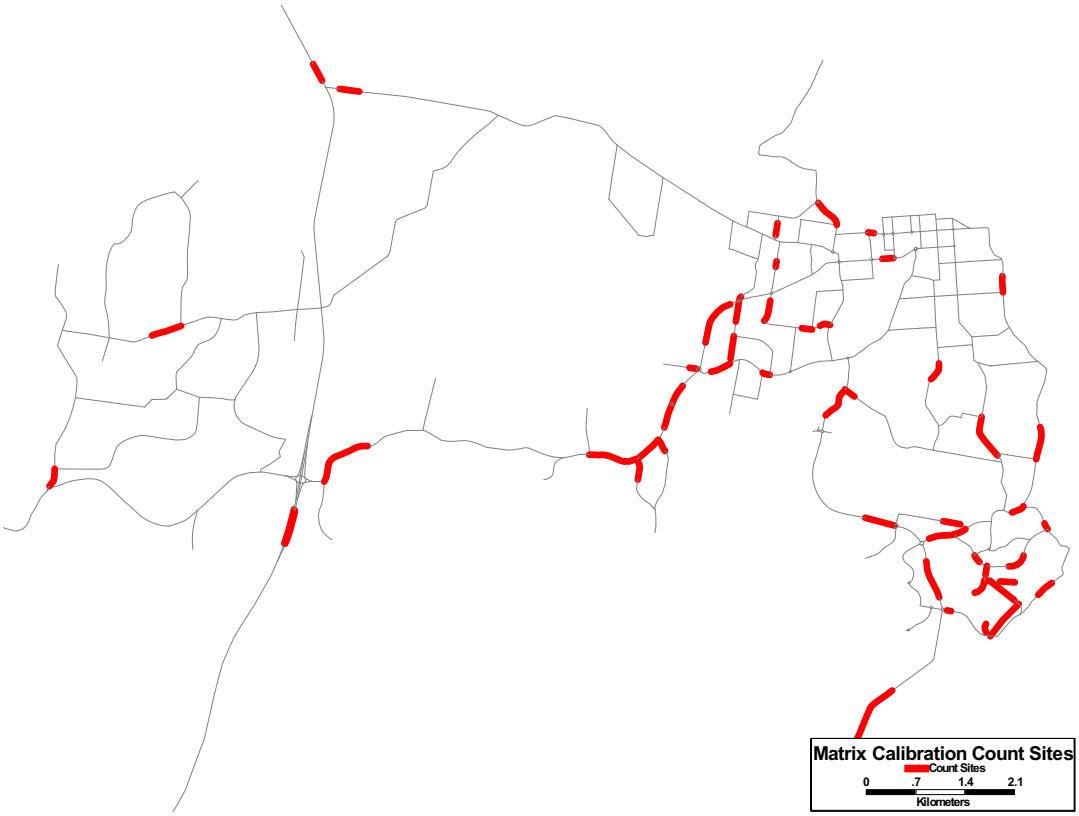


Figure 2-3: Count Locations for O/D Matrix Calibration

2.4 Future Socio Economic and Land use Inputs

Port Macquarie-Hastings Council supplied SMEC with estimated growth rates for future years. 2006 was used as the base year and the growth factor applied exponentially to determine population for future years. These growth rates are shown in Table 2-2.

Table 2-2: Exponential Growth factors supplied by Port Macquarie-Hastings Council

Period	Growth (%)
2006 – 2011	1.77
2011 – 2016	1.63
2016 – 2021	1.51
2021 – 2026	1.20
2026 – 2036	1.04

3 Results

3.1 Select Link Analysis (SLA) Results

A Select Link Analysis (SLA) was conducted on the East-West link to determine where the traffic using the link was coming from and going to. As this model is a PM peak model, it is expected that the majority of the trips in the model will be made by workers travelling back to their residences.

Table 3-2 shows the Origins and destinations of traffic that is expected to use the East-West link in the 2031 PM peak period.

The Origin/Destination matrix is to be read in the following way, referring to Table 3-1 for each example.

The green highlight shows the traffic produced FROM Zone 3 (Z value). The red highlight shows the traffic attracted TO Zone 2 (Y Value). The blue highlight shows the traffic produced FROM Zone 3 that is going TO Zone 2. So it can be seen that there are X number of cars going from Zone 3 to Zone 2.

The row and column labelled "Total" shows the total number of trips going to and from a zone. For example, there are Z trips coming from Zone 3. There are Y trips going to Zone 2.

The row and column labelled "Proportion" show the proportion of the total trips using the link are coming from or going to a zone. It can be seen that A% of the total trips are going to Zone 2. Similarly, B% of the trips are coming from Zone 3.

Table 3-1: Sample O/D Matrix

	Zone 1	Zone 2	Zone 3	Total	Proportion
Zone 1					
Zone 2		0			
Zone 3		X		Z	B%
Total		Y			
Proportion		A%			

Referring to Table 3-2, it can be seen that the major generator of traffic using the East-West link is the industrial area. This is a major employment area directly next to the East-West link so it is to be expected that it will produce a significant amount of the traffic.

It can also be seen that the majority of the traffic is going to both the Inner South and the Outer South. As these are primarily residential areas, it is logical that they will be attracting a significant amount of traffic in the PM peak period.

Table 3-2: 2031 Origins/Destinations Matrix of Traffic using East-West Link 3A-3-3D

2031 PM	Laurieton and North Haven	Bonny Hills	Lake Cathie	Southern Rural	Western Rural	Northern Rural	Wauchope	Area 13 and Sancrox	Outer West	Inner West	CBD	Inner South	Outer South	Industrial Area	Innes Peninsula	Highways	Total	Proportion
Laurieton and North Haven	0	0	1	0	0	0	0	0	0	0	0	2	14	0	0	0	**17**	**1.56%**
Bonny Hills	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0.01%**
Lake Cathie	0	0	0	0	0	0	0	0	1	0	0	0	0	0	18	0	**20**	**1.86%**
Southern Rural	0	0	1	0	0	0	0	0	1	0	0	1	27	0	0	1	**32**	**2.92%**
Western Rural	0	0	0	0	0	0	0	0	0	0	0	2	8	0	0	0	**10**	**0.91%**
Northern Rural	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	**0.03%**
Wauchope	0	6	5	0	0	0	0	0	0	0	0	3	11	0	0	0	**25**	**2.33%**
Area 13 and Sancrox	0	2	10	0	0	0	0	0	0	0	0	2	2	0	0	0	**16**	**1.44%**
Outer West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0.06%**
Inner West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	**13**	**1.17%**
CBD	0	0	0	0	0	0	0	0	0	0	0	0	0	1	30	0	**30**	**2.81%**
Inner South	1	0	0	0	2	2	0	0	0	0	0	0	0	0	0	41	**46**	**4.29%**
Outer South	4	0	0	3	8	1	0	0	14	0	0	0	0	1	0	91	**123**	**11.39%**
Industrial Area	0	0	2	1	0	0	0	0	0	48	32	498	37	0	0	0	**618**	**57.28%**
Innes Peninsula	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	**5**	**0.42%**
Highways	0	0	6	0	0	0	0	0	0	0	0	2	117	0	0	0	**124**	**11.52%**
Total	**5**	**8**	**26**	**4**	**10**	**3**	**0**	**0**	**15**	**48**	**32**	**512**	**217**	**2**	**61**	**133**	**1080**	
Proportion	**0.48%**	**0.76%**	**2.42%**	**0.38%**	**0.97%**	**0.27%**	**0.04%**	**0.03%**	**1.43%**	**4.49%**	**2.98%**	**47.41%**	**20.12%**	**0.21%**	**5.67%**	**12.35%**		

3.2 Options Comparison

From the results presented in the previous section, SMEC noted that the traffic volumes along the East-West link may not be sufficient to justify the construction of East-West Link 3A/3/3D as a supporting alternative to Lake road. In this context SMEC investigated a number of options for catering for the traffic in other ways. It was felt that the two main East-West roads in the area are Lake Road and the East-West link itself. The East-West demand can be catered for by increasing the capacity on either of these roads. The three future 2031 options investigated are presented below.

The Levels of Service reported in the tables are based on the Volume/Capacity ratio (V/C) and have been developed from the Highway Capacity Manual (HCM) and Austroads. Lake Road is taken to be an urban road while the East-West link is taken to be a rural road.

Table 3-3: Level of Service Criteria by V/C Ratio

Level of Service	Urban Road	Rural Road
A	0.00-0.20	0.00-0.14
B	0.21-0.40	0.15-0.26
C	0.41-0.60	0.27-0.42
D	0.61-0.80	0.43-0.63
E	0.80-0.99	0.64-0.96
F	>1	>0.97

3.2.1 Option 1

This is a base "do nothing" option that does not include the East-West link and retain the current Lake Road configuration as one lane in each direction for the 2031. As noted from Table 3-4 that the PM peak Level of Service expected by 2031 for this option is E for the Lake road.

Table 3-4: Option 1 Average Volumes and Levels of Service

	Option 1							
Road	Volume		Capacity		V/C		LoS	
	AB	BA	AB	BA	AB	BA	AB	BA
Lake Rd	1228	1146	1400	1400	0.88	0.82	E	E
EW Link	-	-	-	-	-	-	-	-

3.2.2 Option 2

This option consists of upgrading Lake Road configuration to become two lanes in each direction by 2031. As noted from Table 3-5 that the PM peak Level of Service expected by 2031 for this option is C for the Lake road.

Table 3-5: Option 2 Average Volumes and Levels of Service

	Option 2							
Road	Volume		Capacity		V/C		LoS	
	AB	BA	AB	BA	AB	BA	AB	BA
Lake Rd	1267	1258	2400	2400	0.53	0.52	C	C
EW Link	-	-	-	-	-	-	-	-

3.2.3 Option 3

This option includes Lake Road being retained as one lane in each direction as well as constructing an East-West link 3A/3/3D with one lane in each direction. As noted from Table 3-6 that the PM peak Level of Service expected by 2031 for this option is D for the Lake road and D for East-West Link.

Table 3-6: Option 3 Average Volumes and Levels of Service

	Option 3							
Road	**Volume**		**Capacity**		**V/C**		**LoS**	
	AB	**BA**	**AB**	**BA**	**AB**	**BA**	**AB**	**BA**
Lake Rd	580	830	1200	1200	0.48	0.69	C	D
EW Link	509	694	1400	1400	0.36	0.50	C	D

4 Conclusions

Based on the above study, SMEC concludes that the majority of traffic expected to use the East-West link is traffic from the industrial area. This traffic is expected to have the inner south and the outer south as main destinations. SMEC investigated a number of options to cater for such traffic as well as to relieve the expected traffic congestion along Lake road. The results have shown that the upgrading of Lake road or alternatively the construction of an East-West link can both cater for the expected future traffic movements during the PM peak period.

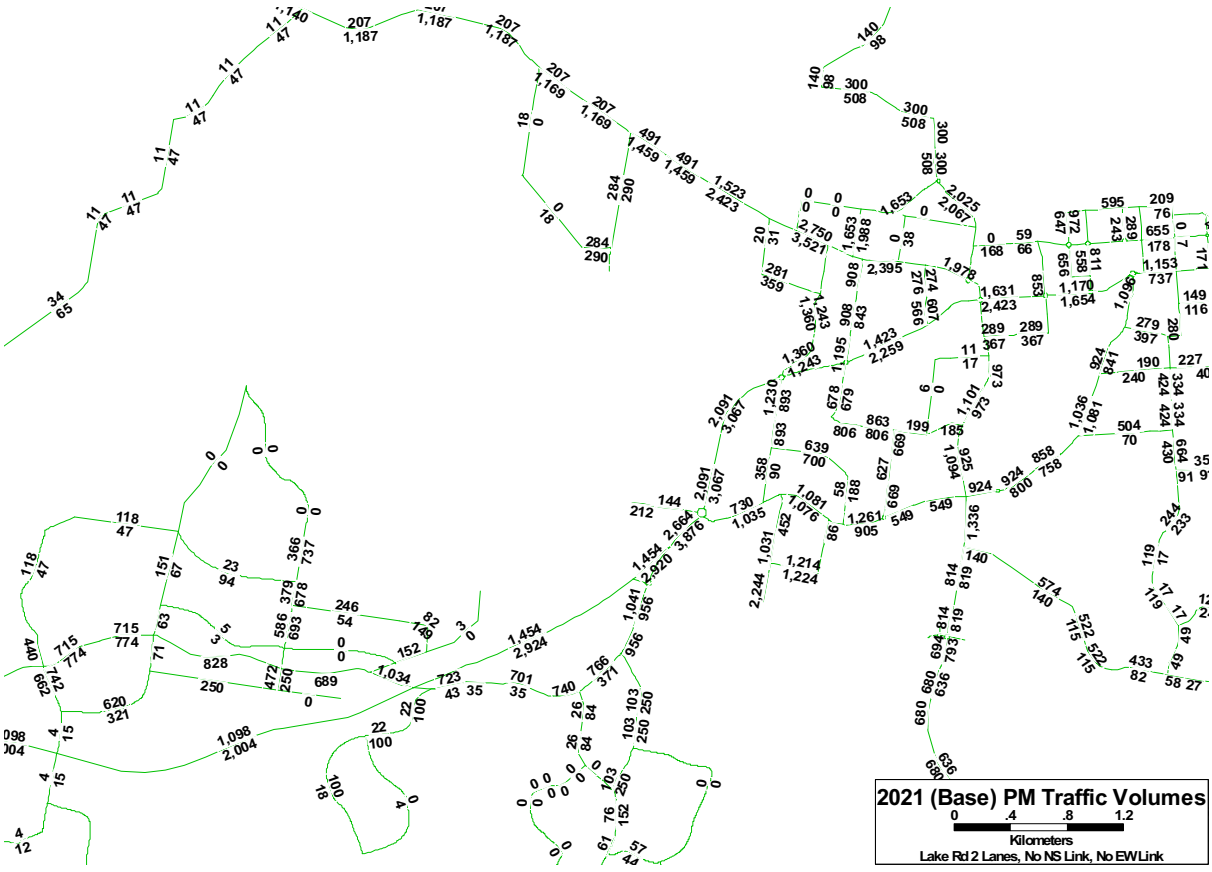
Options Considered

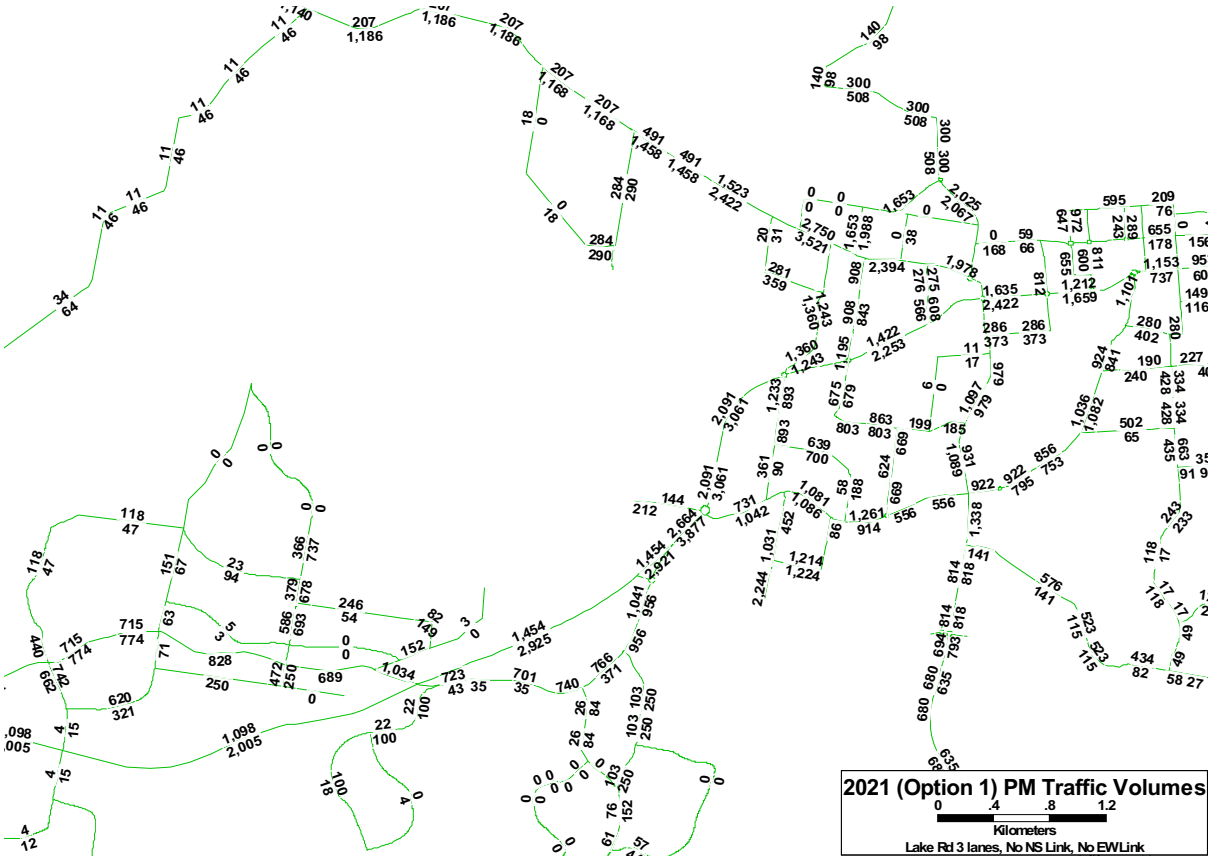
Road	2021 (Base)	2021 (Option 1)	2021 (Option 2)	2031 (base)
Lake Road	2 lanes/direction	3 lanes/direction	2 lanes/direction	3 lanes/direction
E_W Link	-	-	2 lanes/direction	-

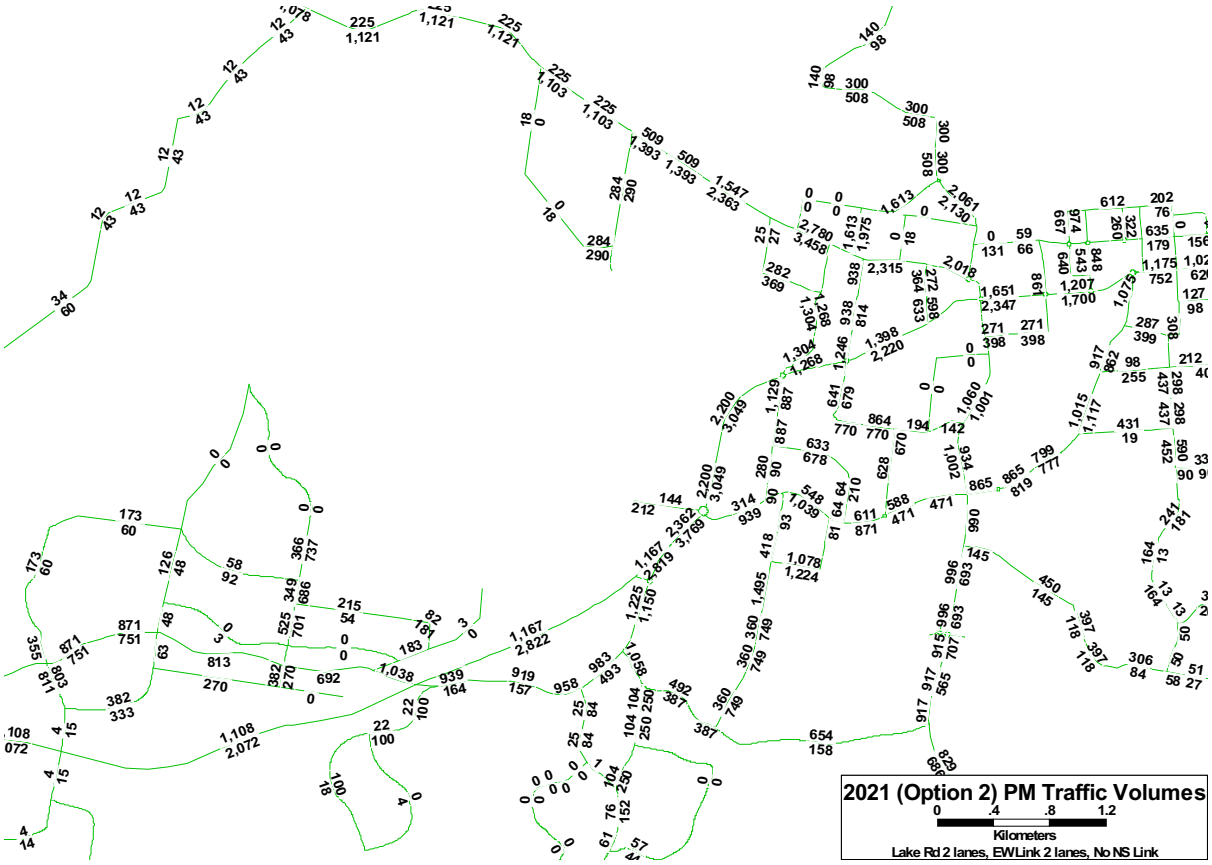
Road Network Indicators

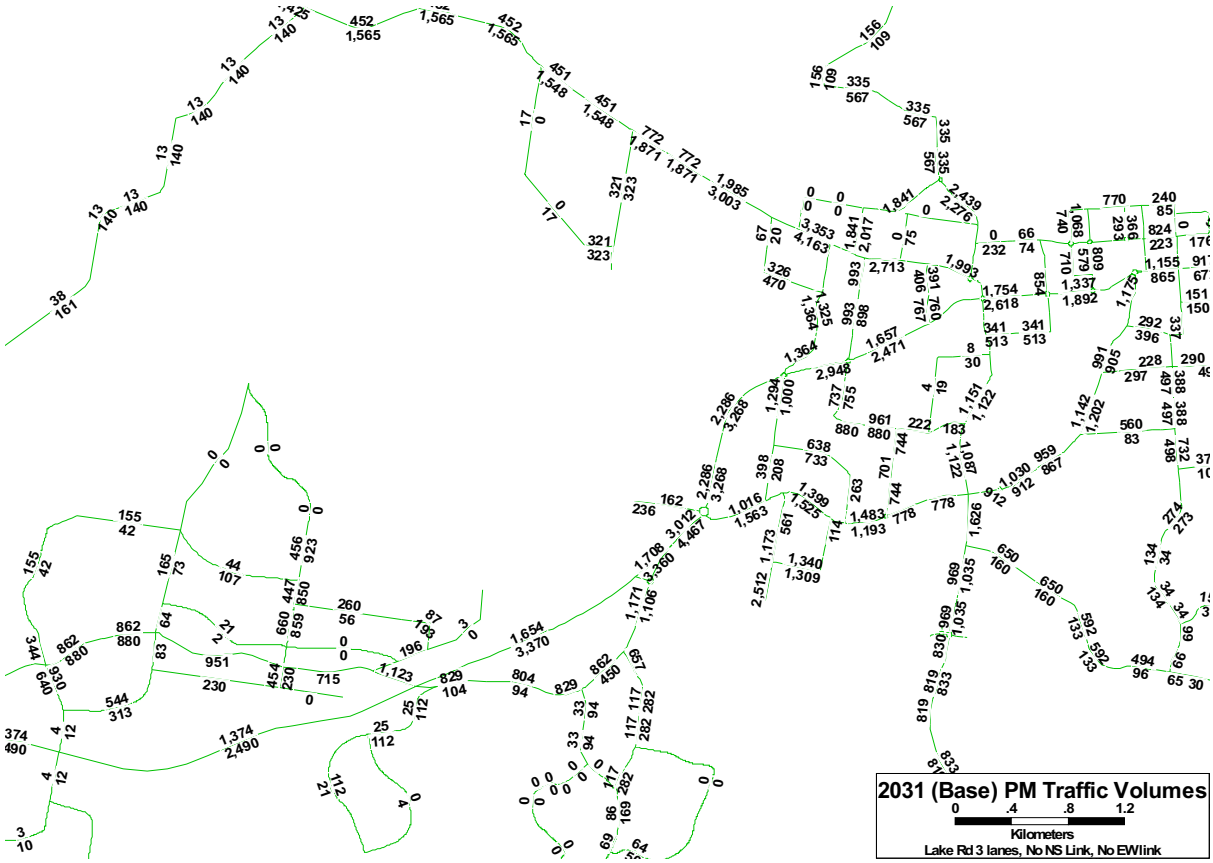
Road	2021 (Base)	2021 (Option 1)	2021 (Option 2)	2031 (base)
VKT	468,399	468,400	469,265	586,045
VHT	683,691	683,672	664,770	932,422
Trips	59,425	59,425	59,425	67,899

Traffic Forecasts (Future Loaded Networks)




2021 (Option 1) PM Traffic Volumes
0 .4 .8 1.2
Kilometers
Lake Rd 3 lanes, No NS Link, No EWLink


2021 (Option 2) PM Traffic Volumes
0 .4 .8 1.2
Kilometers
Lake Rd 2 lanes, EWLink 2 lanes, No NS Link


2031 (Base) PM Traffic Volumes
0 .4 .8 1.2
Kilometers
Lake Rd 3 lanes, No NS Link, No EW link

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