Economic Assessment of Lake Macquarie Transport Interchange Project

Final Report

December 2016

Document status

Ref	Version	Approving director	Date
7206	Discussion Draft	S Bunting	27 September 2016
	Final Draft	J Franke	14 October 2016
	Final	J Franke	14 December 2016

Contents

1 Executive Summary

The Lake Macquarie Transport Interchange (LMTI) is a regionally significant infrastructure project located at the epicentre of employment and residential growth precincts in the Lower Hunter NSW; the strategic centre of Glendale and Cardiff. Stage 1 Section 1 of the LMTI is funded and under advanced construction, comprising new road extensions, improved intersections and associated infrastructure to improve access to the Glendale retail precinct. It is due for completion by the end of 2016. Completion of the LMTI requires construction of the following key infrastructure:

- Stage 1 Section 2 involves construction of the three-span Pennant Street Bridge over the Sydney to Newcastle rail line. The Pennant Street Bridge is the essential missing link to connect Glendale with the Cardiff Industrial Estate and support regional economic growth.
- LMTI Stage 2 involves construction of a bus and rail interchange at Glendale that provides an optimal range of transport solutions to meet projected future demand and supports the desired higher density development of residential and employment land in the region.

Stage 1 Section 2 also includes the connection of Munibung Road, which will provide the (presently missing) link between the eastern and western ends of Munibung Road. The Munibung Road Connection, by connecting the Cardiff Industrial Estate to Macquarie and Myall Roads at Cardiff, will alleviate travel times and congestion on the surrounding road network.

The remaining stages of the LMTI (Stage 1 Section 2 and Stage 2) and the Munibung Road Connection are important trigger projects for realising the potential for further business investment, commercial and housing development and the creation of jobs growth across the region. The proposed projects are shown on the following site map (Figure E1).

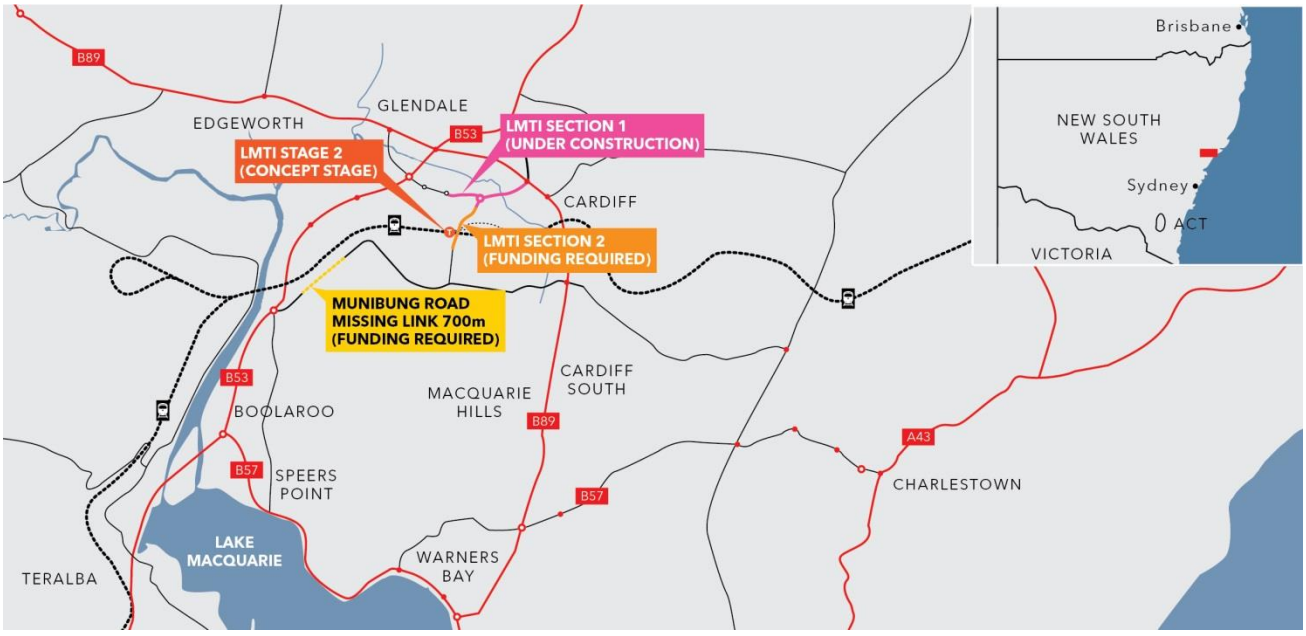

Figure E1 **Site map as supplied by Council**

The economic evaluation examined the following scenarios:

- Scenario A – Base Case: no additional infrastructure other than those committed for the LMTI Stage 1 Section 1 works
- Scenario B – Construction of the Pennant Street Bridge and Munibung Road Connection
- Scenario C – Construction of Pennant Street Bridge/Munibung Road Connection and Bus and Rail Interchange
- Scenario D – Construction of Pennant Street Bridge/Munibung Road Connection, Bus and Rail Interchange, and modifications of planning controls to increase urban density beyond current planning controls

Estimated capital costs for the scenarios are shown in Table E1.

Table E1 Capital Costs for Scenarios (2016 dollars)

Works	Scenario B	Scenario C	Scenario D
Stage 1 Section 2 - Pennant Street Bridge	$32 million	$32 million	$32 million
Munibung Road Connection	$5.4 million	$5.4 million	$5.4 million
Stage 2 - Bus and Rail Interchange		$120 million	$120 million
Total capital cost	**$37.4 million**	**$157.4 million**	**$157.4 million**

Note that above estimates are undiscounted costs.

The recurrent costs of the project are annual asset maintenance expenditure on the roads and bridge estimated at around $83,300 per annum.

The economic evaluation assessed the following benefits.

- Transport benefits resulting from shorter travel distances and less congestion. The largest components were savings on travel time and vehicle operating cost, while other benefits were identified in accordance with the methodology prescribed by Transport for NSW. Cycling benefit resulting from provision of new cycleways that would increase cycling take-up.
- Benefit of increased public transport patronage arising from the new bus and rail interchange (in Scenarios C and D). This was based on the calculated reduction of the economic costs (externalities) associated with car use.
- Increased land value resulting from development of local lands that would be unlocked by the provision of new road access and public transport facilities (in Scenarios B, C and D). These land parcels are shown in Figure E2.
  - The values of land development were estimated to increase by around $19 million for Scenario B – Construction of the Pennant Street Bridge.
  - Land development values would increase more substantially in Scenarios C and D as the public transport interchange would allow for the zoning of higher density for urban development (by around $108 million and $182 million respectively i.e. with and without modifications of planning controls).

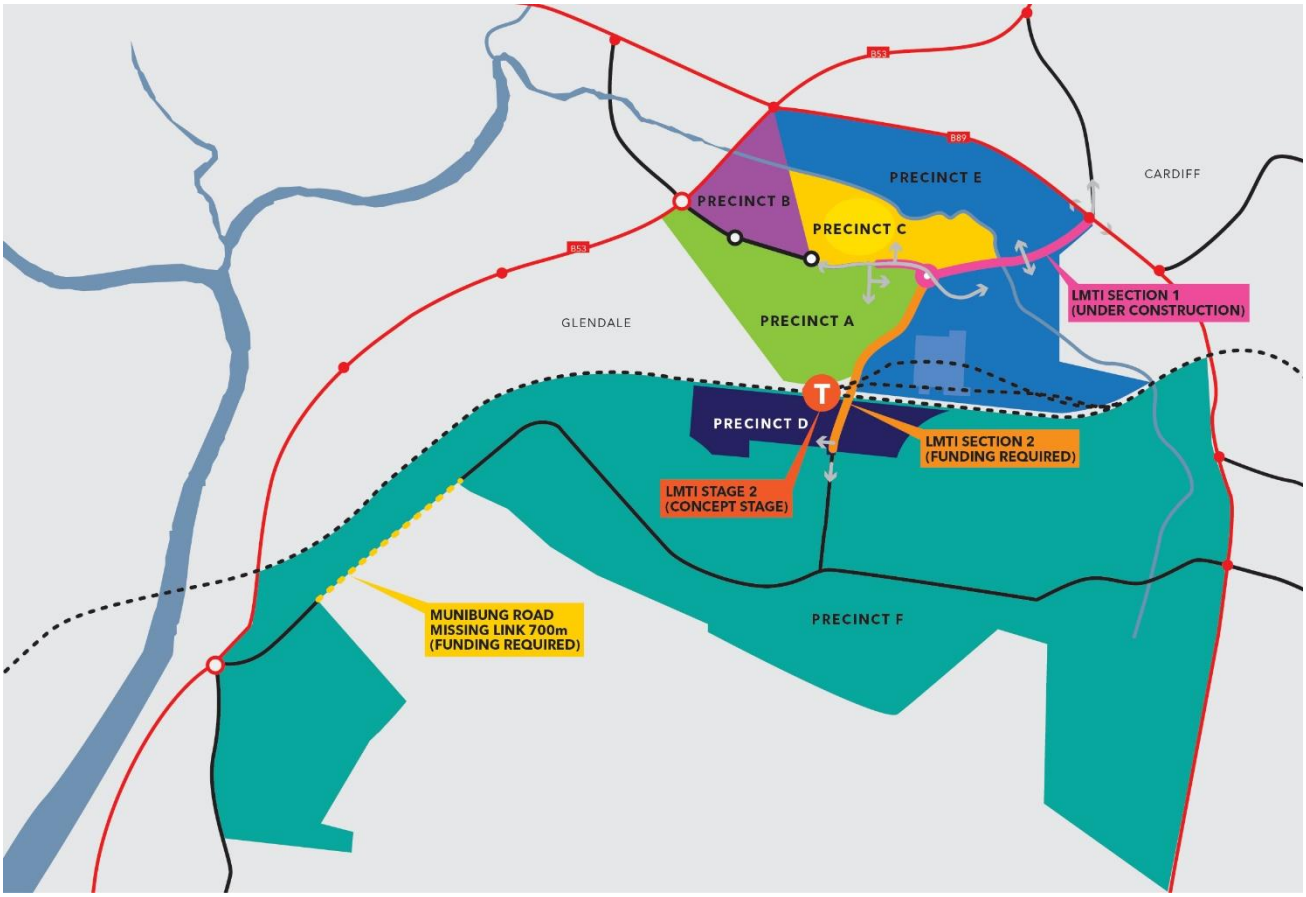

Figure E2 Precincts around the LMTI

The economic evaluation calculated the incremental impacts of the project over the Base Case, for each of the scenarios. Since Scenarios C and D represent options that are made up by adding additional works to B and C respectively, direct comparison of these scenarios is not meaningful.

Scenario B – Construction of Pennant Street Bridge and Munibung Road Connection

The results of the economic evaluation for Scenario B are shown in Table E2.

Table E2 Economic Evaluation for Scenario B (NPV) ($)

	Scenario A - Base Case (Status Quo)	Scenario B (Pennant Street Bridge and Munibung Road Connection)	Costs and Benefits Incremental to Base Case
Capital Costs			
Capital Cost	0	35,261,392	35,261,392
Total Capital Costs	0	35,261,392	35,261,392
Recurrent Costs			
Routine Maintenance Cost	0	1,116,973	1,116,973
Total Recurrent Costs	0	1,116,973	1,116,973
Total costs	**0**	**36,378,381**	**36,378,381**
Benefits			
Transport Benefits as Avoided Costs	0	100,803,539	100,803,539
Land Development Value	32,304,066	52,161,849	19,857,783
Cycling Benefit	0	11,820,715	11,820,715
LMTI Bus and Rail Interchange Patronage	0	0	0
Asset Residual Value	0	2,453,599	2,453,599
Total Benefit	**32,304,066**	**167,239,702**	**134,935,636**
Net Benefit			**98,557,255**
BCR			**3.8**

The results indicate that compared to the Status Quo, used as the Base Case, Scenario B has a net benefit of around $98.6 million in net present value (NPV) terms and a benefit cost ratio (BCR) of 3.8.

Scenario C – Construction of Pennant Street Bridge, Munibung Road Connection and Bus/Rail Interchange

The results of the economic evaluation for Scenario C incremental to the base case are shown in Table E3.

Table E3 Economic Evaluation for Scenario C (NPV) ($)

	Scenario A - Base Case (Status Quo)	Scenario C – Pennant Street Bridge and Bus/Rail Interchange	Costs and Benefits Incremental to Base Case
Capital Costs			
Capital Cost	0	143,742,482	143,742,482
Total Capital Costs	0	143,742,482	143,742,482
Recurrent Costs			
Routine Maintenance Cost	0	1,116,973	1,116,973
Total Recurrent Costs	0	1,116,973	1,116,973
Total costs	**0**	**144,859,471**	**144,859,471**
Benefits			
Transport Benefits as Avoided Costs	0	100,803,539	100,803,539
Land Development Value	32,304,066	96,292,563	63,988,497
Cycling Benefit	0	11,820,715	11,820,715
Stage 2 LMTI Bus and Rail interchange Patronage	0	14,833,713	14,833,713
Asset Residual Value	0	10,335,627	10,335,627
Total Benefit	**32,304,066**	**234,086,156**	**201,782,090**
Net Benefit			**56,922,619**
BCR			**1.4**

The results indicate that compared to the Status Quo, used as the Base Case, Scenario C has a net benefit of around $57 million in NPV terms and a BCR of 1.4.

Scenario D – As per Scenario C with modified zoning

The results of the economic evaluation for Scenario D incremental to the base case are shown in Table E4.

Table E4 Economic Evaluation for Scenario D (NPV) ($)

	Scenario A - Base Case (Status Quo)	Scenario D – Pennant Street Bridge and Bus/Rail Interchange, Modified Zoning	Costs and Benefits Incremental to Base Case
Capital Costs			
Capital Cost	0	143,742,482	143,742,482
Total Capital Costs	0	143,742,482	143,742,482
Recurrent Costs			
Routine Maintenance Cost	0	1,116,973	1,116,973
Total Recurrent Costs	0	1,116,973	1,116,973
Total costs	**0**	**144,859,471**	**144,859,471**
Benefits			
Transport Benefits as Avoided Costs	0	100,803,539	100,803,539
Land Development Value	32,304,066	132,870,051	100,565,985
Cycling Benefit	0	11,820,715	11,820,715
LMTI Bus and Rail Interchange Patronage	0	14,833,713	14,833,713
Asset Residual Value	0	10,335,627	10,335,627
Total Benefit	**32,304,066**	**270,663,644**	**238,359,578**
Net Benefit			**93,500,107**
BCR			**1.7**

The results indicate that compared to the Status Quo, used as the Base Case, Scenario C has a net benefit of around $93.5 million in NPV terms and a BCR of 1.7.

Sensitivity analysis was undertaken which shows that the positive economic evaluation is not sensitive to different discount rates (see Section 4.5).

Economic evaluation results for the different development scenarios using 7% discount rates are summarised below.

Economic Evaluation Results	Scenario B	Scenario C	Scenario D
NPV ($)	98,557,255	56,922,619	93,500,107
BCR	3.8	1.4	1.7
NPVI	2.8	0.4	0.65

In summary, the economic evaluation of the specified scenarios indicated:

- A high Benefit Cost Ratio of 3.8 was obtained for the road construction works in Scenario B (i.e. the Pennant Street Bridge and the Munibung Road Connection).
- The BCR value dropped significantly when the large cost of the rail bus interchange was included, however, it still remains larger than one (1.4 and 1.7 for Scenarios C and D respectively).

The above scenarios (B, C and D) represent progressive stages of development towards the complete establishment of a future transport interchange at Glendale, which would comprise road enhancements, rail, bus, and associated facilities. This infrastructure was identified in the Hunter Regional Plan and recognised by the Mayors of the Hunter as the highest priority infrastructure project for the Hunter region.

Wider economic benefits that will flow from the project were considered. Temporary construction benefits will increase local output and result in additional jobs over the period of construction (76 jobs for Scenario B and 321 jobs for Scenarios C and D). Permanent economic benefits to the region directly attributable to the project relate to acceleration of development of employment land, with an increase in output ($16.4 million for Scenario B, $62.9 million for Scenario C and $98.6 million for Scenario D) and additional jobs during the urban development phases (40 for Scenario B, 128 for Scenario C and 201 for Scenario D).

2 Introduction

2.1 Background

Stage 1 Section 1 of the LMTI is funded and under advanced construction, comprising new road extensions, improved intersections, and associated infrastructure to improve access to the Glendale retail precinct, and is due for completion by April 2017. Completion of the LMTI requires construction of the remaining stages, including Stage 1 Section 2, which involves construction of the three-span Pennant Street Bridge over the Sydney to Newcastle rail line, and Stage 2, which involves construction of a bus and rail interchange at Glendale. Concurrently with Stage 1 Section 2, the Munibung Road Connection is planned, to improve connectivity between the Pennant Street Bridge and suburbs to the south of Cardiff.

Council engaged Morrison Low to undertake an economic assessment of the LMTI projects to assess their financial viability.

2.2 Overview of Economic Assessment

The economic assessment of the LMTI projects focuses on:

1. A Benefit Cost Analysis of the costs and benefits directly attributable to the projects
2. An assessment of the wider economic benefits that will result from the projects (over time), where a clear nexus can be determined
3. Discussion of other benefits that are expected from the project that cannot be reliably quantified

The economic evaluation is based on four scenarios:

- Scenario A – Base Case: no additional infrastructure other than those committed for the LMTI Stage 1 Section 1
- Scenario B – Construction of the Pennant Street Bridge and Munibung Road Connection
- Scenario C – Construction of Pennant Street Bridge/Munibung Road Connection and Bus and Rail Interchange
- Scenario D – Construction of Pennant Street Bridge/Munibung Road Connection, Bus and Rail Interchange, and modifications of planning controls to increase urban density beyond current planning controls

The economic evaluation focuses on the incremental impacts of the project scenarios over the Base Case.

3 Need

3.1 Summary of Need

The Lake Macquarie Transport Interchange (LMTI) is a regionally significant infrastructure project located at the epicentre of employment and residential growth precincts in the Lower Hunter NSW; the strategic centre of Glendale and Cardiff. This Lower Hunter Regional Centre is the second largest employment zone in the Hunter Region with 11,000 employees servicing local, regional and national markets. It is located at the gateway to the Hunter on both the Sydney rail and road corridors. The Lower Hunter Regional Centre is the epicentre of the employment and residential growth precincts in the Lower Hunter, and is identified in the NSW Government's Hunter Regional Plan 2036 as a key strategic centre.

The Sydney to Newcastle rail lines splits this employment zone, meaning road access is heavily congested and significant impact upon economic growth, development and job creation.

Stage 1 of the LMTI is to be delivered in two sections.

Stage 1 Section 1 is funded and under advanced construction, comprising new road extensions, improved intersections, and associated infrastructure to improve access to the Glendale retail precinct, and is due for completion by April 2017.

Stage 1 Section 2 involves construction of the three-span Pennant Street Bridge over the Sydney to Newcastle rail line. The Pennant Street Bridge is the essential missing link to connect Glendale with the Cardiff Industrial Estate and supporting regional economic growth.

Construction of the Pennant Street Bridge and extension of Munibung Road will unlock 90 hectares of undeveloped and underdeveloped employment land with 300,000m^2 of employment floor space. Strategic planning for the Lower Hunter Regional Centre catchment area by 2030, projects an additional 4,890 people, up to 2,740 new homes, and 3,823 additional jobs in housing construction, retail, commercial and light industries. The Pennant Street Bridge, when complete, is critical to achieving these projections, as it will create further economic growth, development and employment in the region. The project will also improve road and transportation access and travel times for the daily estimate of 16,000 vehicles including 1,500 heavy vehicles, saving businesses and residents, time and money.

In alignment with projected future demand, it is envisaged that Glendale will be the optimal location for a future transport interchange, which would comprise rail, bus, and associated facilities. This infrastructure is identified as a high priority project in the Hunter Regional Plan and is recognised by the Mayors of the Hunter as the highest priority infrastructure project for the Hunter region.

The current project scope also considered the extension of Munibung Road, which would create a direct route comprising Myall Road and Munibung Road between the State Roads of the Newcastle Inner City Bypass, Macquarie Road and TC Frith Avenue.

The proposed works are shown in the LMTI site map (Figure 1).

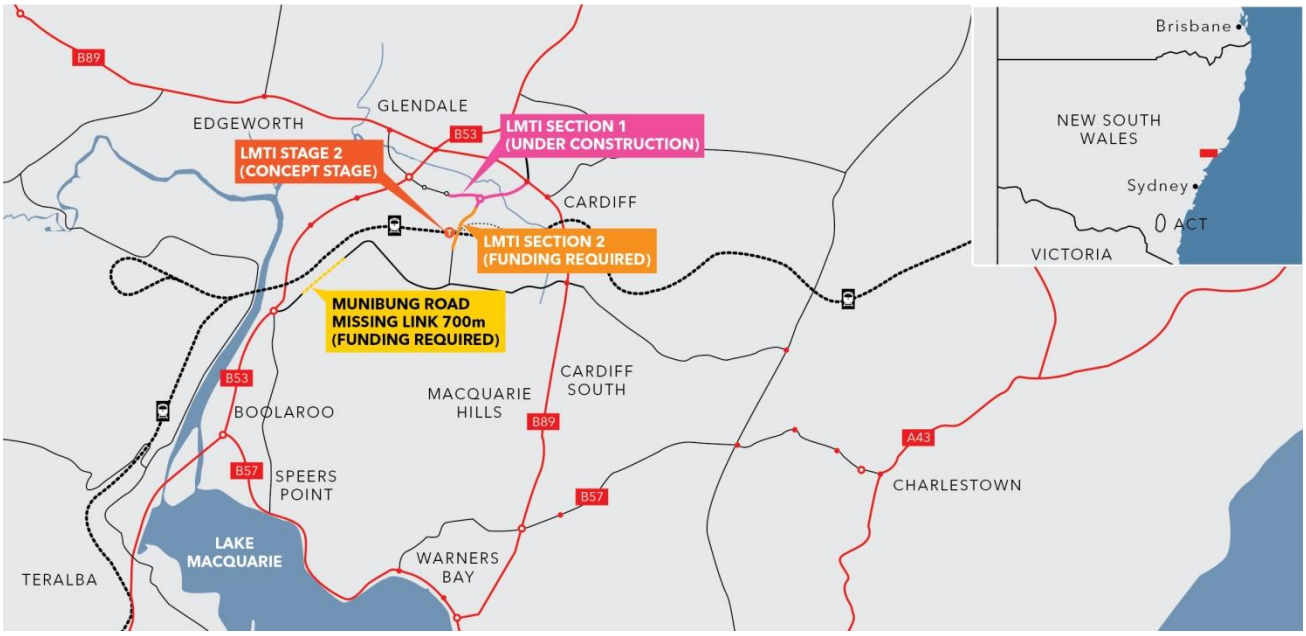

Figure 1 Site map provided by Council

The construction of the Pennant Street Bridge along with the Munibung Road extension project will provide alternative road routes and improved traffic flow between Cardiff, Glendale, Argenton and Boolaroo. Importantly, it will improve access to regional facilities including the Hunter Sports Centre, Stocklands Glendale Shopping Centre, the Cardiff Industrial Estate and Cardiff CBD, connecting the second largest employment node in the Hunter region to the broader region.

The LMTI bus and rail interchange project will link southern population centres to public transport network and further relieve traffic congestion in the employment hub. The LMTI is located near the proposed Killingworth Very Fast Train station, and ideally located to be the major interchange for transfer of very fast train passengers to the wider Hunter public transport network.

This project aligns with and delivers on the objectives of the Hunter Regional Plan to develop Glendale as a major regional centre. The LMTI projects and the Connection of Munibung Road are key to unlocking further business investment, commercial and housing development and creating jobs and supporting growth across the region.

3.2 Proposed Funding Profile

Stage 1 Section 1 of the LMTI has been jointly funded by local, state and federal governments.

Stage 1 Section 2 infrastructure works, which primarily involve the construction of the Pennant Street Bridge, are at the cost of $32 million. Confidence in this cost estimate is high, as Stage 1 Section 1 works included 100% engineering design of Stage 1 Section 2 works.

The Connection of Munibung Road project has a total cost of $6,383,850, with committed in kind contributions from Council and Ferrier Hodgson/ Pasminco Cockle Creek Service Pty Ltd of $1,928,850.

Stage 2 LMTI works to construct the rail and bus interchange are at concept design only at this stage. The cost of these works is estimated at $120 million, and would be a future NSW Government project, potentially also connecting to an expanded light rail network from Newcastle.

4 Cost Benefit Analysis

4.1 Description of Options

The economic evaluation is based on four scenarios and the marginal or incremental benefit of the options compared to Scenario A – Base Case:

1. Scenario A – Base Case: no additional infrastructure other than those committed for the LMTI Stage 1 Section 1
2. Scenario B – Construction of the Pennant Street Bridge and Munibung Road Connection
3. Scenario C – Construction of Pennant Street Bridge/Munibung Road Connection and Bus and Rail Interchange
4. Scenario D – Construction of Pennant Street Bridge/Munibung Road Connection, Bus and Rail Interchange, and modifications of planning controls to increase urban density beyond current planning controls

A summary of the economic evaluation from the economic modelling is provided as Attachment A. Financial forecasts as project cashflow is provided as Attachment B. Further detailed workings for the economic assessment can be provided on request.

4.2 Costs Assessment

4.2.1 Project Case Capital Expenditure

For Scenario A – Base Case, no new capital cost is required as funding has been committed for the LMTI Stage 1 Section 1.

For Scenario B (Munibung Road plus Stage 1 Section 2), capital costs were estimated as follows:

- $32 million for the construction of Pennant Street Bridge; and
- $5.4 million for the construction of the Munibung Road Connection.

For Scenario C – LMTI Stage 2, capital costs were those required for Scenario B plus estimated cost of $120 million for the design and construction the bus and rail interchange.

Scenario D has the same capital costs as Scenario C.

Estimated capital costs for the scenarios are shown in Table 1.

Table 1 Capital Costs for different Scenarios ($2016)

Works	Scenario B	Scenario C	Scenario D
Stage 1 Section 2 - Pennant Street Bridge	$32 million	$32 million	$32 million
Munibung Road Connection	$5.4 million	$5.4 million	$5.4 million
Stage 2 - Bus and rail interchange		$120 million	$120 million
Total capital cost	**$37.4 million**	**$157.4 million**	**$157.4 million**

Note that above estimates are undiscounted costs.

4.2.2 Project Case Operational Expenditure

The recurrent costs of the project are annual routine maintenance expenditure for the Munibung Road Extension and Pennant Street Bridge estimated at $3,300 and $80,000 per year respectively, which is based on Council's existing maintenance expenditure rates. No renewal expenditure will be required for these assets over the 30 year evaluation period.

Operating and maintenance costs associated with the bus and rail interchange are assumed to be met by the respective transport operators who will recover these costs from fare revenues. These costs therefore were not considered in this evaluation.

4.3 Benefits Assessment

4.3.1 Transport benefits

4.3.1.1 Traffic volumes

Presently, most vehicles use Main Road and Lake Road. The existing Munibung Road only serves local traffic but does not provide western access to the commercial and residential estates on the Boolaroo and Argenton side. When the LMTI Stage 1, Section 1 and Section 2 and the Munibung Road Connection are completed, the current traffic on Main Road and Lake Road is expected to be diverted to these new routes. Based on analysis in the Lake Macquarie Transport Interchange - Main Road Linear Model Traffic Modelling Report (April 2014), traffic volumes on these roads were estimated for 2016 and 2026 and shown in Table 2.

Table 2 Traffic volumes (vehicles per day)

Base Case	2016	2026 estimates (post work completion)
Main Road 217	27,700	15,000
Lake Road Argenton	27,400	22,000
Munibung Road	18,000 (present)	28,000 (connected)
LMTI Stage 1 Section 1 (when completed)		10,000
LMTI Stage 1 Section 2 (once completed)		16,000

It was estimated that cars make up 95 percent of the traffic volume with the remaining being trucks.

4.3.1.2 Travelling distance and travelling time

Under Scenarios B, C and D, the construction of the Pennant Street Bridge and the Munibung Road Connection are expected to alleviate travel times and traffic congestion on the surrounding State road network through Glendale and Cardiff.

Pennant Street Bridge

It is estimated that 16,000 vehicles per day (vpd) will use Stage 1 Section 2 of the LMTI, including 1,500 heavy vehicles (based on LMTI summary information). Construction of the Pennant Street Bridge will result in time saving for the passing-through traffic, which is assumed to be around 50 percent of the total traffic (or 8,000 vpd). Estimation of the time savings was based on analysis of the likely traffic going through Stage 1 Section 2 of the LMTI at three locations (to and from) as follows (Figure 2).

- Point 1 is Pennant Street at Munibung Road
- Point 2 is Stockland Drive at Lake Road
- Point 3 is Glendale Drive at Lake Road

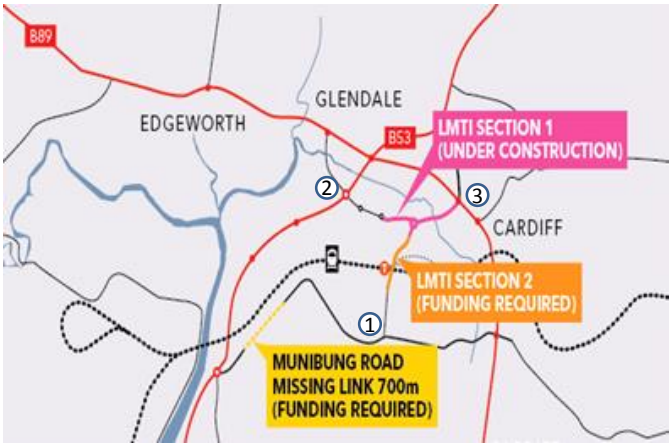

Figure 2 Start and end points for traffic passing over the Pennant Street Bridge

The resulting estimates are shown in Table 3.

Table 3 Time saving resulting from construction of Pennant Street Bridge

Origin and destination		Distance (km)	Time (mins)
Point 1 to point 2	Via Pennant Street Bridge	1.87	0:2:05
	Via Main Road	4.21	0:6:27
		Time saved	0:4:21
Point 2 to point 1	Via Pennant Street Bridge	1.87	0:3:05
	Via Main Road	4.21	0:7:50
		Time saved	0:4:45
Point 1 to point 3	Via Pennant Street Bridge	1.56	0:1:35
	Via Main Road	2.70	0:3:13
		Time saved	0:1:38
Point 3 to point 1	Via LMTI	1.56	0:2:34
	Via Main Road	2.70	0:4:30
		Time saved	0:1:56

As the Pennant Street Bridge does not currently exist, the times were estimated based on travel time on the roads that do exist on that route.

The weighted average savings for the passing-through traffic were calculated at 3.16 minutes in time and 1.7 kilometres in distance.

Munibung Road Connection

The Munibung Road Connection would create a direct route comprising Myall Road and Munibung Road between the Roads and Maritime Services (RMS) controlled State roads of Highway 23 (Newcastle Inner City Bypass), Macquarie Road, and TC Frith Avenue. Following connection, Munibung Road would be 3.8 kilometres in length, with one (1) set of traffic signals. The alternative route via Main Road and Lake Road is 5 kilometres in length, has seven (7) sets of traffic signals and one (1) roundabout.

A travel time survey conducted by Council for through vehicles was undertaken with Munibung Road hypothetically connected to the Boolaroo end.

This travel time only accounts for the expected travel time saving in travelling the route between the Macquarie Road, Myall Road and Munibung Road intersection to the intersection of Lake Road, Munibung Road, Main Road and TC Frith Avenue intersection.

The average travel time saving in the east-north direction is estimated by Council to be 4 minutes and 11 seconds. The average time saving in the west and south directions is estimated by Council to be 2 minutes and 47 seconds.

4.3.1.3 Key assumptions and benefits identified

a) Reduction in travelling distance and travelling time

Given the expected reduction in travelling distance and travelling time as well as congestion and safety issues experienced on Lake Road and Main Road, a proportion of the existing traffic on these roads is expected to transfer to the LMTI (via Pennant Street Bridge) and Munibung Road when these connections are completed. It was assumed that the transferred traffic is around 10,000 vehicle movements per day (or a proportion of 18 percent) and that 70% of these movements are through-traffic using the Munibung Road intersection i.e. the remaining traffic uses part of the Munibung Road and continues on toward the Pennant Street Bridge.

b) Crash rate

The crash dataset obtained from Transport for NSW (TfNSW) indicated that these roads have crash frequency well above the average for NSW roads.

Table 4 Lake Road: Main Road, Glendale to Main Road, Boolaroo - 2011 to 2016

Casualties	Number	Crashes	Number
Killed	0	Fatal	0
Seriously inj.	8	Serious inj.	8
Moderately inj.	12	Moderate inj.	8
Minor/Other inj.	4	Minor/Other inj.	4
Uncategorised inj.	15	Uncategorised inj.	11
^ Unrestrained	0	Non-casualty	27
Total	39		58

It is expected that the crash rates would drop to normal levels for the traffic volume that is transferred from Lake Road and Main Road to the LMTI (via Pennant Street Bridge) and Munibung Road when these connections are completed. The evaluation assessed this benefit by comparing the existing crash rates and the average NSW levels. It could be argued that with some traffic transferred, the crash rates would also drop for the remaining traffic on Lake Road and Main Road, but this benefit was not calculated.

Transport Benefit Assessment

Morrison Low has used its road construction evaluation model, which is consistent with TfNSW Guidelines[1] and adapted the parameters of TfNSW Fixing Country Roads model, to evaluate the possible benefits arising from transferring existing traffic to the LMTI (via Pennant Street Bridge) and the Munibung Road (with Connection). They include:

a) value of travel time
b) vehicle operating cost
c) air pollution
d) greenhouse gas emission
e) noise
f) water pollution
g) nature and landscape
h) upstream and downstream costs
i) fatality cost
j) injury cost
k) property damage cost.

The largest cost savings were found for reductions in value of travel time and vehicle operating cost. They are reported in NPV terms for the next 30 years as follows.

Table 5 Transport Benefits for Scenario B

	Scenario A Base Case (Status Quo)	Scenario B (Pennant Street Bridge and Munibung Road Connection)	Costs and Benefits Incremental to Base Case
Value of travel time	160,579,090	112,151,665	48,427,425
Vehicle operating cost	71,345,649	48,809,946	22,535,704
Air pollution	6,390,956	4,417,011	1,973,946
Greenhouse gas emission	12,040,890	8,074,978	3,965,912
Noise	2,175,663	1,500,856	674,807
Water pollution	1,346,323	917,400	428,924
Nature and landscape	1,123,115	740,994	382,120
Upstream and downstream costs	32,884,553	21,871,343	11,013,210
Fatality cost	6,433,465	2,193,749	4,239,716
Injury cost	21,630,041	14,998,961	6,631,080
Property damage cost	2,084,265	1,553,569	530,696
Total Transport Benefits	**318,034,011**	**217,230,471**	**100,803,539**

[1] Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives, Transport Economic Appraisal Guidelines, March 2013

Note: Upstream and downstream costs refer to the indirect costs of transport including energy generation, vehicle production and maintenance and infrastructure construction and maintenance.

Scenarios C and D will produce the same transport benefits as that calculated for Scenario B but also those associated with the rail and bus interchange.

4.3.2 Cycling benefit

The construction of the Pennant Street Bridge and the Munibung Road Connection will allow on-road cycleways to be provided to connect Cardiff and Glendale to Boolaroo.

These connections will reduce travelling distance within the area to a level suited for cycling, in particular from home to work and the region's business centre. Further, there will be significant future residential development within the area. Consequently, it was assumed that the generated cycling demand will equal 2% of expected vehicle trips on the Pennant Street Bridge and Munibung Road, once connected. This is considered a conservative estimate as the rate of cycling in the Lake Macquarie area is up to 4% of vehicle trips, as advised by Council based on the Bureau of Transport's Household Travel Survey 2011 and Lake Macquarie Parking Perceptions Survey 2016.

In Report 'Inner Sydney Regional Bicycle Network, Demand Assessment and Economic Appraisal' by AECOM (2010), the economic benefit of cycling was estimated at 84 cents per cycle kilometre (2010 prices) or $0.94 after adjusting for 12% inflation.

A total cycling distance of 3,000 km per year was calculated with a corresponding benefit value of approximately $1 million per year. Scenarios B, C and D will produce the same cycling benefit.

4.3.3 Benefit of accelerating development of employment land

4.3.3.1 Completing construction of Stage 1 Section 2 and Stage 2 of the LMTI

A major benefit of the construction of the LMTI to the region is to provide an additional direct transport access to the local land estates that have been locked away due to inadequate road access.

- The Pennant Street Bridge will provide the essential missing link to connect Glendale with the Cardiff Industrial Estate.
- Construction of the bus and train interchange will support the zoning of higher density for mixed used - retail / commercial / residential developments in local areas. The new access to public transport is also expected to lead to higher land values for these developments.

We have identified four different scenarios (see columns with headings A-D for each precinct and Figure 3 for location of precincts).

Table 6 Assessment of Additional Land Development Resulting from Munibung Road and LMTI Construction

Area	Agg. Area (m^2)	Scenario A	Scenario B	Scenario C	Scenario D
Argenton Precinct	828,236	$247,909,903	$247,909,903	$285,096,389	$296,785,757
Northern Precinct	456,173	$134,462,283	$134,462,283	$150,597,757	$159,341,725
Precinct A	176,300	$270,000,000	$270,000,000	$290,250,000	$330,750,000
Precinct B	79,104	$20,490,931	$20,490,931	$22,540,024	$25,613,663
Precinct C	95,838	$4,023,600	$4,023,600	$4,425,960	$4,425,960
Precinct D	122,860	$6,447,000	$7,736,400	$9,863,910	$11,765,775
Precinct E	390,115	$61,975,575	$79,618,600	$90,612,100	$98,590,100
Totals	2,148,626	$745,309,292	$764,241,717	$853,386,140	$927,272,980
Property value enhancement		-	**$18,932,425**	**$108,076,848**	**$181,963,688**

Under Scenario B, an additional 145,347 m^2 of commercial floor space is unlocked in Precinct F (Table 7). This is estimated to increase the value of land by around $19 million for Scenario B – Construction of the Pennant Street Bridge.

Land development values would increase more substantially in Scenarios C and D as the public transport interchange would allow for the zoning of higher density for urban development (by around $108 million and $182 million respectively i.e. with and without modifications of planning controls). This development would unlock a further 154,653 m^2 of commercial floor space and create an additional 1,158 dwellings in Precincts A-E.

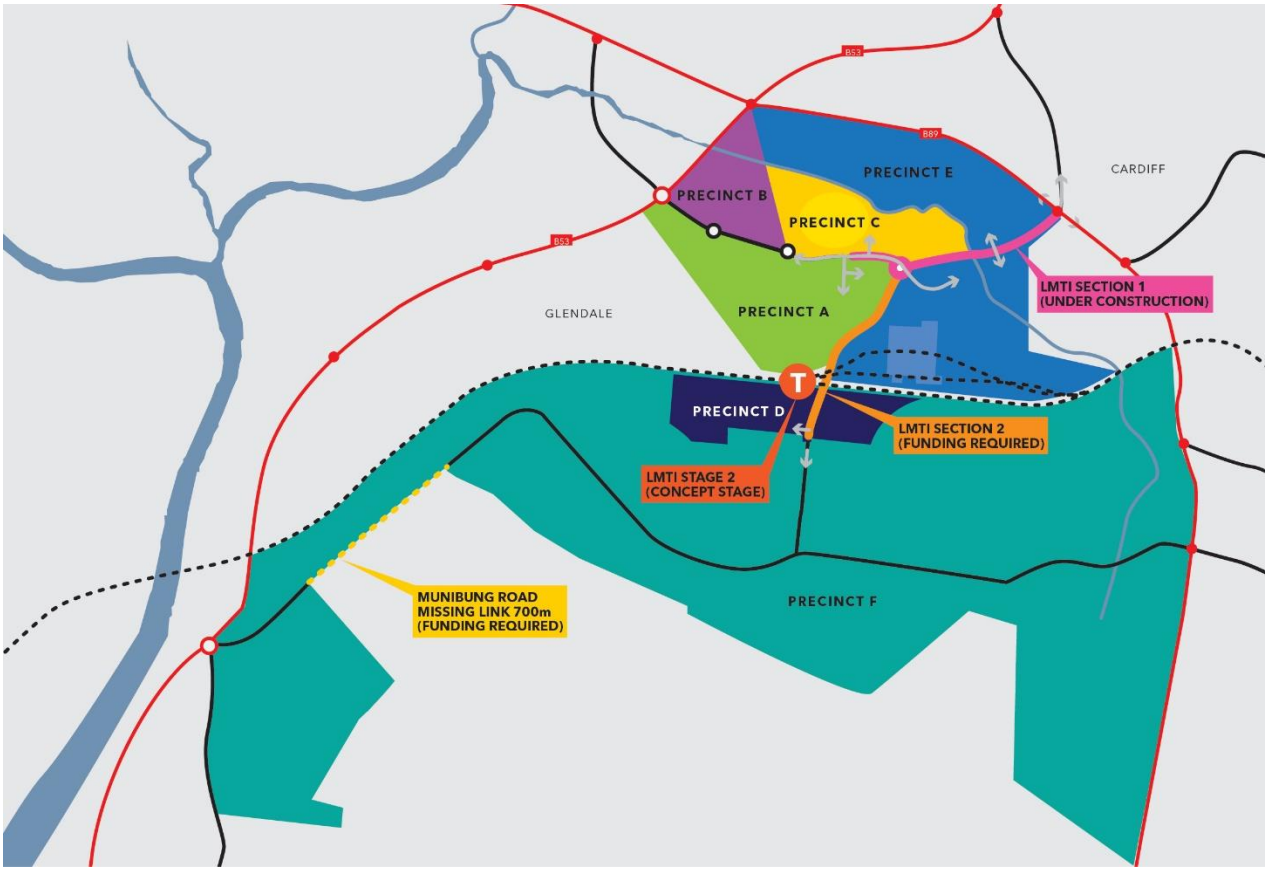

Figure 3 Precincts around the LMTI

4.3.3.2 *Munibung Road Connection*

Similarly, the proposed Munibung Road Connection will help unlock the development of local land estates that has been constrained by inadequate road access. With removal of this constraint, it was projected that development of various land blocks (in particular those in Cardiff Industrial Estate and Munibung Extension Industrial Area) into employment land would be brought forward.

The following shows the possible acceleration of land development in the project scenario on land (Precinct F) shown in Figure 3.

Table 7 Comparison of Land Development Rates in Base Case and Project Scenarios (Gross Floor Area, m^2)

Business as usual (BAU)	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Cardiff Industrial Estate	1,844	1,844	1,844	1,844	1,844	1,844	1,844	1,844	1,844	1,844
Munibung Extension Industrial	3,267	3,267	3,267	3,267	3,267	3,267	3,267	3,267	3,267	3,267
Munibung Rd Adj to Railway Industrial										
Big box 1&2					46,000					
Bunnings										
Pasminco B4					2,250	2,250	2,250			
Total Value	**5,112**	**5,112**	**5,112**	**5,112**	**53,362**	**7,362**	**7,362**	**5,112**	**5,112**	**5,112**
Munibung Road Project - Accelerated	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Cardiff Industrial Estate	3,073	3,073	3,073	3,073	3,073	3,073	3,073	3,073	3,073	
Munibung Extension Industrial	4,900	4,900	4,900	4,900	4,900	4,900	4,900	4,900	4,900	4,900
Munibung Rd Adj to Railway Industrial				2277	2277	2277	2277	2277	2277	2277
Big box 1&2					46,000					
Bunnings										
Pasminco B4					6,751					
Total	**7,973**	**7,973**	**7,973**	**10,250**	**63,001**	**10,250**	**10,250**	**10,250**	**10,250**	**7,177**

Source: Lake Macquarie City Council

Using the land value ranging from $95 to $205 per m^2 and ratio between gross floor area and land area, NPV values were calculated for the revenue cash flows associated with above development scenarios. The NPV of land values in the BAU scenario is $34.6 million compared to a NPV of $42.5 million in the Munibung Road Extension Project scenario. The value of accelerated development in the local area was therefore estimated at $7.9 million.

4.3.4 Benefit of bus and rail transport

Under Scenarios C and D, the bus and rail interchange is constructed in the proposed LMTI Stage 2.

Construction of the LMTI bus and rail interchange will provide new public transport access to local residents and employees working in the surrounding areas. The effect of this is to transfer some existing private vehicle transport to rail and bus, which will bring about the following benefits:

- savings that commuters working in the Glendale/Cardiff areas (i.e. Lower Hunter Regional Centre) can achieve by commuting to work via public transport rather than by car; and
- reduction of the economic costs associated with car use, known as externalities

Based on an estimated employment size of 11,000 for the relevant catchment and the projected patronage take-up, the additional number of trips per year was estimated to be:

- at a 2% rail patronage rate, 110,000 rail trips per year
- at a 2% bus patronage rate, 110,000 bus trips per year

An average travel distance of 10 kilometres is assumed for both rail and trips, based on implied trip lengths calculated by IPART (2014)[2].

4.3.4.1 Commuter cost savings

The study 'Commuter costs and potential savings: Public transport versus car commuting in Australia' by Dr Jian Wang, November 2013[3], identified that the main cost savings for commuters converting from car to public transport are avoidable vehicle operating cost and parking cost.

The following estimates were used:

- Vehicle operating cost of 27.6 cents per km and car occupancy of 1.7 from TfNSW
- Parking cost of $10 per day[4]
- Average fare of $3.40 per bus or train trip

The cost saving achieved by the new commuters was estimated at around $3,600 per working day or $0.9 million per year.

4.3.4.2 Reduction in externalities

The benefit of a change in transport mode to rail and bus was examined in reports 'Subsidies and the social costs and benefits of public transport' prepared by Centre for International Economics, March 2001 and 'Review of external benefits of public transport' by the NSW Independent Pricing and Regulatory Tribunal (IPART), 2014.

Transferring travel from motor vehicles to rail and bus can reduce externalities associated with car use that are described in Table 8.

2 Implied public transport trip lengths by main mode are 29.8, 9.5 and 10 for rail, bus and ferry respectively
3 CRC for Rail Innovation, Southern Cross University, For the Australasian Railway Association
4 For drivers who do not pay for parking themselves, there is still an economic cost incurred in providing a parking space.

Table 8 Types of Externalities

Type of externality	Description
Environmental externalities (air pollution and GHG emissions)	Impacts from car emissions as a result of changes in vehicle kilometres
Congestion cost (time)	Changes in transport times for existing car users as a result of changes in the amount of car travel
Congestion cost (vehicle operating cost)	Changes in vehicle operating costs (such as fuel) as a result of changes in journey times induced by changes in the amount of car travel
Congestion cost (reliability)	Changes in the variability of travel times as a result of changes in the amount of car travel
Accidents	Changes in the number and costs of accidents as a result of changing travel patterns
Active transport	Changes in health costs (borne by others such as public health system costs) as a result of changes in the amount of walking and cycling
Crowding of public transport	Changes in the amount of people standing versus seated on public transport services
Scale/frequency	Changes in the waiting times for services as they become more or less frequent in response to changes in demand
Excess burden of taxation	Changes in the costs of taxation reflecting the Government contribution to public transport services (costs less revenues)
Road user charges	Changes in road user charges (tolls, fuel excise and car parking levies)

IPART has suggested the use of the following estimates (Table 9) when calculating the benefit of reducing externalities for trips that are converted from cars to public transport.

Table 9 Estimates of Externalities by Category

Externalities by category	Rail only	Bus only	Ferry only	All modes
	$ per passenger kilometre	$ per passenger kilometre	$ per passenger kilometre	$ per passenger kilometre
Environmental externalities	0.01	0.01	0.01	0.02
Congestion cost (time)	0.18	0.19	0.20	0.22
Congestion cost (vehicle cost)	0.005	0.005	0.006	0.006
Congestion cost (reliability)	0.04	0.04	0.04	0.05
Accidents	0.0004	0.0005	0.0004	0.0006
Active transport	0.01	0.01	0.01	0.01
Crowding of public transport	na	na	na	na
Scale/frequency	na	na	na	na
Excess burden of taxation	-0.04	-0.05	-0.10	-0.06
Road user charges	-0.02	-0.03	-0.02	-0.03
Total	**0.17**	**0.18**	**0.14**	**0.21**

Source: IPART, 2014

Using the trip assumptions listed above, the benefit of reducing transport externalities was estimated at approximately $400,000 per year or $3.8 million in NPV. This would be equal to approximately half of the fare costs paid by commuters.

4.3.5 Residual Value

Residual values are calculated at the end of the 30 year evaluation period.

4.4 Cost Benefit Analysis (Economic Evaluation)

Economic evaluation was prepared for each of the Scenarios B, C and D against the Base Case as follows. Since Scenarios C and D represent options that are made up by adding additional works to Scenarios B and C respectively, direct comparison of these scenarios is not meaningful.

4.4.1 Scenario B (Pennant Street Bridge and Munibung Road Connection)

The results of the economic evaluation for Scenario B incremental to the base case are shown in Table 10.

Table 10 Economic Evaluation for Scenario B (NPV) ($)

	Scenario A - Base Case (Status Quo)	Scenario B (Pennant Street Bridge and Munibung Road Connection)	Costs and Benefits Incremental to Base Case
Capital Costs			
Capital Cost	0	35,261,408	35,261,408
Total Capital Costs	0	35,261,408	35,261,408
Recurrent Costs			
Routine Maintenance Cost	0	1,116,973	1,116,973
Total Recurrent Costs	0	1,116,973	1,116,973
Total costs	**0**	**36,378,381**	**36,378,381**
Benefits			
Transport Benefits as Avoided Costs	0	100,803,539	100,803,539
Land Development Value	32,304,066	52,161,849	19,857,783
Cycling Benefit	0	11,820,715	11,820,715
LMTI Bus and Rail Interchange Patronage	0	0	0
Asset Residual Value	0	2,453,599	2,453,599
Total Benefit	**32,304,066**	**167,239,702**	**134,935,636**
Net Benefit			**98,557,255**
BCR			**3.8**

Note: Economic evaluation was prepared for a 30 year period at a discount rate of 7% p.a. real as per NSW Treasury Guideline. Due to discounting, NPV values, expressed in year 2016, are generally lower than their corresponding cost or benefit estimates shown in cash flows.

The results indicate that compared to the Status Quo, used as the Base Case, Scenario B has a net benefit of around $98.6 million in NPV terms and a BCR of 3.8.

4.4.2 Scenario C – Construction of Pennant Street Bridge and Bus/Rail Interchange

The results of the economic evaluation for Scenario C incremental to the base case are shown in Table 11. These results are only indicative because the costing for the bus/rail interchange was based on concept design and an empirical assessment of likely public transport patronage was not available.

Table 11 Economic Evaluation for Scenario C (NPV) ($)

	Scenario A - Base Case (Status Quo)	Scenario C – Pennant Street Bridge and Bus/Rail Interchange	Costs and Benefits Incremental to Base Case
Capital Costs			
Capital Cost	0	143,742,498	143,742,498
Total Capital Costs	0	143,742,498	143,742,498
Recurrent Costs			
Routine Maintenance Cost	0	1,116,973	1,116,973
Total Recurrent Costs	0	1,116,973	1,116,973
Total Costs	**0**	**144,859,471**	**144,859,471**
Benefits			
Transport Benefits as Avoided Costs	0	100,803,539	100,803,539
Land Development Value	32,304,066	96,292,563	63,988,497
Cycling Benefit	0	11,820,715	11,820,715
LMTI Bus and Rail Interchange Patronage	0	14,833,713	14,833,713
Asset Residual Value	0	10,335,627	10,335,627
Total Benefit	**32,304,066**	**234,086,156**	**201,782,090**
Net Benefit			**56,922,619**
BCR			**1.4**

The results indicate that compared to the Status Quo, used as the Base Case, Scenario C has a net benefit of around $57 million in NPV terms, and a BCR of 1.4.

4.4.3 Scenario D – Construction of Pennant Street Bridge and Bus/Rail Interchange, and Modified Zoning

The results of the economic evaluation for Scenario D incremental to the Base Case are shown in Table 12. These results are only indicative for the same reasons given for Scenario C.

Table 12 Economic Evaluation for Scenario D (NPV) ($)

	Scenario A - Base Case (Status Quo)	Scenario D – Pennant Street Bridge and Bus/Rail Interchange, Modified Zoning	Costs and Benefits Incremental to Base Case
Capital Costs			
Capital Cost	0	143,742,482	143,742,482
Total Capital Costs	0	143,742,482	143,742,482
Recurrent Costs			
Routine Maintenance Cost	0	1,116,973	1,116,973
Total Recurrent Costs	0	1,116,973	1,116,973
Total costs	**0**	**144,859,471**	**144,859,471**
Benefits			
Transport Benefits as Avoided Costs	0	100,803,539	100,803,539
Land Development Value	32,304,066	132,870,051	100,565,985
Cycling Benefit	0	11,820,715	11,820,715
LMTI Bus and Rail Interchange Patronage	0	14,833,713	14,833,713
Asset Residual Value	0	10,335,627	10,335,627
Total Benefit	**32,304,066**	**270,663,644**	**238,359,578**
Net Benefit			**93,500,107**
BCR			**1.7**

The results indicate that compared to the Status Quo, used as the Base Case, Scenario C has a net benefit of around $93.5 million in NPV terms, and a BCR of 1.7.

4.5 Sensitivity Analysis

Sensitivity analysis was undertaken for the scenarios with different discount rates as follows.

Sensitivity to Discount Rates (Scenario B)	4%	7%	10%
NPV ($)	129,047,521	98,557,255	77,191,244
BCR	4.57	3.8	3.24
NPVI[5]	3.6	2.8	2.2

[5] NPVI: Net present value per dollar invested

Sensitivity to Discount Rates (Scenario C)	4%	7%	10%
NPV ($)	99,802,015	56,922,619	28,089,476
BCR	1.67	1.4	1.20
NPVI	0.67	0.4	0.2

Sensitivity to Discount Rates (Scenario D)	4%	7%	10%
NPV ($)	147,349,309	93,500,107	57,075,231
BCR	2.0	1.7	1.4
NPVI	1.0	0.65	0.4

The above analysis indicated that the positive outcome of the economic evaluation for the scenarios was not sensitive to changes in discount rates.

5 Assessment of Flow-On Effects

This section examines the wider economic benefits that would flow from the construction of the LMTI and the Munibung Road Connection to the region and other potential broader impacts.

5.1 Assessment of flow-on effects for Scenario B

Economic benefits are expected to result from the spending of construction capital in the local economy and from increased or accelerated urban development of residential, mixed use and employment land within the area.

5.1.1 The Construction Phase

The total capital expenditure for Scenario B (construction of the Pennant Street Bridge and the Munibung Road Connection) was estimated at $37.4 million.

The economic impact analysis for regional economies supported in Remplan enables assessment of how change in employment or output (sales) in one sector of the local economy will impact on all other sectors of the economy by modelling the flow-on effects across different industries.

The impact assessment for $37.4 million of construction spending in the Lake Macquarie local government area is shown in Table 13.

Table 13 Analysis for Construction Expenditure

Impact Summary	Direct Effect	Industrial Effect	Consumption Effect	Total Effect	Type 1 Multiplier	Type 2 Multiplier
Output ($M)	$37.4	$30.3	$9.5	$77.1	1.8	2.1
Employment (Jobs)	76	83	35	194	2.1	2.5
Wages and Salaries ($M)	$5.9	$6.3	$2.2	$14.4	2.1	2.4
Value-Added ($M)	$11.3	$10.8	$5.4	$27.5	2.0	2.4

Source: Remplan

The result is explained as follows:

- Under Scenario B, Gross Regional Product is estimated to increase by $37.4 million for the period of works construction. Contributing to this is a direct increase in output of $37.4 million, 76 additional jobs, $5.9 million in wages and salaries and a boost in value-added of $11.3 million.
- From this direct expansion in the economy, flow-on industrial effects in terms of local purchases of goods and services are anticipated. It is estimated that these indirect impacts would result in a further increase to output valued at $30.3 million, 83 more jobs, $6.3 million more paid in wages and salaries and a gain of $10.8 million in terms of value-added.
- The increase in direct and indirect output and the corresponding creation of jobs in the economy are expected to result in an increase in the wages and salaries paid to employees. A proportion of these wages and salaries are typically spent on consumption and a proportion of this expenditure is captured in the local economy. The consumption effects under the scenario are expected to further boost output by $9.5 million, 35 more jobs, wages and salaries by $14.4 million, and value-added by $27.5 million.
- Under this scenario, total output is expected to rise by $77.1 million. Corresponding to this are anticipated increases in employment of 194 jobs, $14.4 million wages and salaries, and $27.5 million in terms of value-added.

It is important to note that the above benefits of local output and employment increases will be once-off (temporary) for the road extension i.e. only occurring during the period of its construction.

5.1.2 Broader Economic Benefit to the Region

Wider economic benefits are expected to flow to the region from the Scenario B projects, mainly in the form of accelerated development of residential, mixed use and employment land within the area. The value of the latter benefit was estimated in the economic evaluation at $19.9 million (NPV). While there may be further benefits such as increase of business investment in the region and resulting employment from such business growth, due to the difficulty in establishing a clear nexus, the current assessment did not include them.

The result for the economic value of accelerated land output is shown in Table 14.

Table 14 Analysis for Land Value Appreciation

Impact Summary	Direct Effect	Industrial Effect	Consumption Effect	Total Effect	Type 1 Multiplier	Type 2 Multiplier
Output ($M)	$19.9	$16.1	$5.0	$41.0	1.8	2.1
Employment (Jobs)	40	44	18	103	2.0	2.5
Wages and Salaries ($M)	$3.2	$3.3	$1.2	$7.7	2.1	2.4
Value-Added ($M)	$6.0	$5.7	$2.9	$14.6	2.0	2.4

Source: Remplan

The result for assessing the broader economic benefit is explained as follows:

- Under Scenario B, Gross Regional Product is estimated to increase by $19.9 million for the period of works construction. Contributing to this is a direct increase in output of $19.9 million, 40 additional jobs, $3.2 million in wages and salaries, and a boost in value-added of $6 million.
- From this direct expansion in the economy, flow-on industrial effects in terms of local purchases of goods and services are anticipated, and it is estimated that these indirect impacts would result in a further increase to output valued at $16.1 million, 44 more jobs, $3.3 million more paid in wages and salaries, and a gain of $5.7 million in terms of value-added.
- The increase in direct and indirect output and the corresponding creation of jobs in the economy are expected to result in an increase in the wages and salaries paid to employees. A proportion of these wages and salaries are typically spent on consumption and a proportion of this expenditure is captured in the local economy. The consumption effects under the scenario are expected to further boost output by $5 million, 18 more jobs, wages and salaries by $1.2 million, and value-added by $2.9 million.
- Under this scenario, total output is expected to rise by $41 million. Corresponding to this are anticipated increases in employment of 103 jobs, $7.7 million wages and salaries, and $14.6 million in terms of value-added.

The above assessed benefits are projected to spread out over the period of 2018-2027 during which land development will take place in the specified area.

5.2 Assessment of flow-on effects for Scenarios C and D

Larger estimates of economic impact were obtained for Scenarios C and D.

5.2.1 The Construction Phase

The economic impacts of $157.4 million construction spending in Scenarios C and D are summarised in Table 15.

Table 15 Analysis for Construction Expenditure

Impact Summary	Direct Effect	Industrial Effect	Consumption Effect	Total Effect	Type 1 Multiplier	Type 2 Multiplier
Output ($M)	$157.4	$127.5	$39.9	$324.7	1.8	2.1
Employment (Jobs)	321	350	146	816	2.1	2.5
Wages and Salaries ($M)	$25.0	$26.4	$9.3	$60.7	2.1	2.4
Value-Added ($M)	$47.8	$45.4	$22.7	$115.8	2.0	2.4

Source: Remplan

The result is explained as follows:

- Under Scenarios C and D, Gross Regional Product is estimated to increase by $157.4 million for the period of works construction. Contributing to this is a direct increase in output of $157.4 million, 321 additional jobs, $25 million in wages and salaries and a boost in value-added of $47.8 million.
- From this direct expansion in the economy, flow-on industrial effects in terms of local purchases of goods and services are anticipated. It is estimated that these indirect impacts would result in a further increase to output valued at $127.5 million, 350 more jobs, $26.4 million more paid in wages and salaries and a gain of $45.4 million in terms of value-added.
- The increase in direct and indirect output and the corresponding creation of jobs in the economy are expected to result in an increase in the wages and salaries paid to employees. A proportion of these wages and salaries are typically spent on consumption and a proportion of this expenditure is captured in the local economy. The consumption effects under the scenario are expected to further boost output by $39.9 million, 146 more jobs, wages and salaries by $9.3 million, and value-added by $22.7 million.
- Under these scenarios, total output is expected to rise by $324.7 million. Corresponding to this are anticipated increases in employment of 816 jobs, $60.7 million wages and salaries, and $115.8 million in terms of value-added.

5.2.2 Broader Economic Benefit to the Region

5.2.2.1 Scenario C

Scenario C would produce an increase of $62.9 million (NPV) in the total value of land development. The impact of the land value increase to the region is shown in Table 16.

Table 16 Analysis for Land Value Appreciation in Scenario C

Impact Summary	Direct Effect	Industrial Effect	Consumption Effect	Total Effect	Type 1 Multiplier	Type 2 Multiplier
Output ($M)	$62.9	$51.0	$15.9	$129.8	1.8	2.1
Employment (Jobs)	128	140	58	326	2.0	2.5
Wages and Salaries ($M)	$10.0	$10.6	$3.7	$24.3	2.1	2.4
Value-Added ($M)	$19.1	$18.1	$9.1	$46.3	2.0	2.4

The result for assessing the broader economic benefit is explained as follows:

- Under Scenario C, Gross Regional Product is estimated to increase by $62.9 million for the period of works construction. Contributing to this is a direct increase in output of $62.9 million, 128 additional jobs, $10 million in wages and salaries, and a boost in value-added of $19.1 million.
- From this direct expansion in the economy, flow-on industrial effects in terms of local purchases of goods and services are anticipated, and it is estimated that these indirect impacts would result in a further increase to output valued at $51 million, 140 more jobs, $10.6 million more paid in wages and salaries, and a gain of $18.1 million in terms of value-added.
- The increase in direct and indirect output and the corresponding creation of jobs in the economy are expected to result in an increase in the wages and salaries paid to employees. A proportion of these wages and salaries are typically spent on consumption and a proportion of this expenditure is captured in the local economy. The consumption effects under the scenario are expected to further boost output by $15.9 million, 58 more jobs, wages and salaries by $3.7 million, and value-added by $9.1 million.
- Under this scenario, total output is expected to rise by $129.8 million. Corresponding to this are anticipated increases in employment of 326 jobs, $24.3 million wages and salaries, and $46.3 million in terms of value-added.

The above assessed benefits are projected to spread out over the period of 2018-2037 during which land development will take place in the specified area.

5.2.2.2 Scenario D

Scenario D would produce a larger increase of $98.6 million (NPV) in the total value of land development. The impact of the land value increase to the region is shown in Table 17.

Table 17 Analysis for Land Value Appreciation in Scenario D

Impact Summary	Direct Effect	Industrial Effect	Consumption Effect	Total Effect	Type 1 Multiplier	Type 2 Multiplier
Output ($M)	$98.6	$79.9	$25.0	$203.5	1.8	2.1
Employment (Jobs)	201	219	91	511	2.0	2.5
Wages and Salaries ($M)	$15.6	$16.5	$5.8	$38.0	2.1	2.4
Value-Added ($M)	$29.9	$28.4	$14.2	$72.6	2.0	2.4

The result for assessing the broader economic benefit is explained as follows:

- Under Scenario D, Gross Regional Product is estimated to increase by $98.6 million for the period of works construction. Contributing to this is a direct increase in output of $98.6 million, 201 additional jobs, $15.6 million in wages and salaries, and a boost in value-added of $29.9 million.
- From this direct expansion in the economy, flow-on industrial effects in terms of local purchases of goods and services are anticipated, and it is estimated that these indirect impacts would result in a further increase to output valued at $79.9 million, 219 more jobs, $16.5 million more paid in wages and salaries, and a gain of $28.4 million in terms of value-added.

- The increase in direct and indirect output and the corresponding creation of jobs in the economy are expected to result in an increase in the wages and salaries paid to employees. A proportion of these wages and salaries are typically spent on consumption and a proportion of this expenditure is captured in the local economy. The consumption effects under the scenario are expected to further boost output by $25 million, 91 more jobs, wages and salaries by $5.8 million, and value-added by $14.2 million.
- Under this scenario, total output is expected to rise by $203.5 million. Corresponding to this are anticipated increases in employment of 511 jobs, $38 million wages and salaries, and $72.6 million in terms of value-added.

The above assessed benefits are projected to spread out over the period of 2018-2037 during which land development will take place in the specified area.

5.2.3 Other Benefits

A number of potential benefits have been identified but not quantified in this evaluation, due to the difficulty in establishing nexus.

- The strategic importance of this road connection and public transport hub in realising the potential and benefits from other infrastructure projects in the lower Hunter, and supporting the growth and development of the second largest employment hub in the Hunter Region.
- Reducing the urgency for road upgrades on the State roads identified above to reduce traffic congestion and improve functionality of the road network.
- Social and environmental benefits from reductions in travel times and road congestion, including health benefits, reduction in stress, and improved local amenity.
- The road safety benefits are significant and quantified above, however it is worth emphasising that the Munibung Road Connection and Pennant Street Bridge are expected to reduce traffic accidents from current levels that are above average, to levels that are “normal” or average for NSW. This has significant health, social and economic benefits for the Lake Macquarie community.
- Future investment will be required for construction of buildings and other facilities on the employment land that would be unlocked in the LMTI development scenarios. The evaluation has not included these indirect benefits.

6 Conclusion

An economic assessment has been carried out by Morrison Low on the further stages of the LMTI and the Munibung Road Connection Project.

The economic assessment for the project scenarios was positive. Cost benefit analysis shows that benefits in reducing travel times and distances, improved road safety, cycling benefits and acceleration of land development will outweigh the capital and recurrent costs of the construction works.

Economic evaluation results for the different development scenarios using 7% discount rates are summarised in Table 18.

Table 18 Summary Economic Evaluation Results for Scenarios B- D

Economic evaluation results	Scenario B	Scenario C	Scenario D
NPV ($)	98,557,255	56,922,619	93,500,107
BCR	3.8	1.4	1.7
NPVI	2.8	0.4	0.65

In summary, the economic evaluation of the specified scenarios indicated:

- A high Benefit Cost Ratio of 3.8 was obtained for the road construction works in Scenario B (i.e. the Pennant Street Bridge and the Munibung Road Connection).
- The BCR value dropped significantly when the large cost of the rail bus interchange was included, however, it still remains larger than one (1.4 and 1.7 for Scenarios C and D respectively).

The above scenarios (B, C and D) represent progressive stages of development towards the complete establishment of a future transport interchange at Glendale, which would comprise road enhancements, rail, bus, and associated facilities. This infrastructure was identified in the Hunter Regional Plan and recognised by the Mayors of the Hunter as the highest priority infrastructure project for the Hunter region.

Wider economic benefits that will flow from the project were considered. Temporary construction benefits will increase local output and result in additional jobs over the period of construction (76 for Scenario B and 321 jobs for Scenarios C and D). Permanent economic benefits to the region directly attributable to the project relate to acceleration of development of employment land, with an increase in output ($16.4 million for Scenario B, $62.9 million for Scenario C and $98.6 million for Scenario D) and additional jobs during the urban development phases (40 for Scenario B, 128 for Scenario C and 201 for Scenario D).

Under the specified scenarios, the project is expected to deliver or contribute to a range of other benefits to the local area, including strategic alignment with other key transport projects, supporting employment growth of the second largest employment hub in the Hunter Region, improving overall amenity within the area, and a range of social, health and economic benefits from reduced travel time and greater road safety.

Appendix A Economic Evaluation Summary (using 7% Discount Rate)

Economic Evaluation Scenario B - Incremental to Base Case

COSTS	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2036-37	2041-42	2046-47	NPV
Capital Costs																				
Capital Cost	5,354,850	32,000,000	0																	35,261,408
Total Capital Costs	**5,354,850**	**32,000,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**35,261,408**
Recurrent Costs																				
Routine Maintenance Cost	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	1,116,973
Major Periodic Maintenance Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Recurrent Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual Cost																				0
Total Recurrent Costs	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**1,116,973**
TOTAL COSTS	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**1,116,973**
Economic Benefits																				
Value of Travel Time	11,975,434	11,975,434	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	112,151,665
Vehicle Operating Cost	5,320,712	5,320,712	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	48,809,946
Air pollution	476,615	476,615	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	4,417,011
Greenhouse Gas Emission	897,968	897,968	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	8,074,978
Noise	162,253	162,253	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	1,500,856
Water Pollution	100,404	100,404	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	917,400
Nature & Landscape	83,758	83,758	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	740,994
Upstream & Downstream Costs	2,452,416	2,452,416	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	21,871,343
Fatality Cost	479,786	479,786	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	2,193,749
Injury Cost	1,613,094	1,613,094	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	14,998,961
Property Damage Cost	155,437	155,437	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	1,553,569
Total Transport Benefits	**23,717,879**	**23,717,879**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**217,230,471**
Land Development Value	**0**	**3,071,384**	**4,964,627**	**4,964,627**	**5,841,780**	**26,162,688**	**5,841,780**	**5,841,780**	**5,841,780**	**5,841,780**	**4,657,989**	**2,770,396**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**52,161,849**
Cycling benefit	**0**	**0**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**11,820,715**
LMTI bus and rail interchange patronage	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Asset Residual Value																			**18,677,425**	**2,453,599**

Economic Evaluation Scenario C - Incremental to Base Case

COSTS	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2036-37	2041-42	2046-47	NPV
Capital Costs																				
Capital Cost	5,354,850	92,000,000	60,000,000																	143,742,498
Total Capital Costs	**5,354,850**	**92,000,000**	**60,000,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**143,742,498**
Recurrent Costs																				
Routine Maintenance Cost	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	1,116,973
Major Periodic Maintenance Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Recurrent Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual Cost																				0
Total Recurrent Costs	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**1,116,973**
TOTAL COSTS	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**1,116,973**
Economic Benefits																				
Value of Travel Time	11,975,434	11,975,434	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	112,151,665
Vehicle Operating Cost	5,320,712	5,320,712	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	48,809,946
Air pollution	476,615	476,615	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	4,417,011
Greenhouse Gas Emission	897,968	897,968	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	8,074,978
Noise	162,253	162,253	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	1,500,856
Water Pollution	100,404	100,404	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	917,400
Nature & Landscape	83,758	83,758	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	740,994
Upstream & Downstream Costs	2,452,416	2,452,416	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	21,871,343
Fatality Cost	479,786	479,786	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	2,193,749
Injury Cost	1,613,094	1,613,094	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	14,998,961
Property Damage Cost	155,437	155,437	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	1,553,569
Total Transport Benefits	**23,717,879**	**23,717,879**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**217,230,471**
Land Development Value	**0**	**3,071,384**	**9,421,848**	**9,421,848**	**10,299,001**	**30,619,909**	**10,299,001**	**10,299,001**	**10,299,001**	**10,299,001**	**9,115,210**	**7,227,617**	**4,457,221**	**4,457,221**	**4,457,221**	**4,457,221**	**4,457,221**	**0**	**0**	**96,292,563**
Cycling benefit	**0**	**0**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**11,820,715**
LMTI bus and rail interchange patronage	**0**	**0**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**14,833,713**
Asset Residual Value																			**78,677,425**	**10,335,627**

Economic Evaluation Scenario D - Incremental to Base Case

COSTS	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2036-37	2041-42	2046-47	NPV
Capital Costs																				
Capital Cost	5,354,850	92,000,000	60,000,000																	143,742,498
Total Capital Costs	**5,354,850**	**92,000,000**	**60,000,000**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**143,742,498**
Recurrent Costs																				
Routine Maintenance Cost	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	83,300	1,116,973
Major Periodic Maintenance Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Recurrent Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual Cost																				0
Total Recurrent Costs	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**1,116,973**
TOTAL COSTS	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**83,300**	**1,116,973**
Economic Benefits																				
Value of Travel Time	11,975,434	11,975,434	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	7,754,981	112,151,665
Vehicle Operating Cost	5,320,712	5,320,712	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	3,356,724	48,809,946
Air pollution	476,615	476,615	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	304,586	4,417,011
Greenhouse Gas Emission	897,968	897,968	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	552,339	8,074,978
Noise	162,253	162,253	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	1,500,856
Water Pollution	100,404	100,404	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	63,023	917,400
Nature & Landscape	83,758	83,758	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	50,456	740,994
Upstream & Downstream Costs	2,452,416	2,452,416	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	1,492,615	21,871,343
Fatality Cost	479,786	479,786	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	110,294	2,193,749
Injury Cost	1,613,094	1,613,094	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	1,035,195	14,998,961
Property Damage Cost	155,437	155,437	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	109,187	1,553,569
Total Transport Benefits	**23,717,879**	**23,717,879**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**14,932,844**	**217,230,471**
Land Development Value	**0**	**3,071,384**	**13,116,190**	**13,116,190**	**13,993,343**	**34,314,251**	**13,993,343**	**13,993,343**	**13,993,343**	**13,993,343**	**12,809,552**	**10,921,959**	**8,151,563**	**8,151,563**	**8,151,563**	**8,151,563**	**8,151,563**	**0**	**0**	**132,870,051**
Cycling benefit	**0**	**0**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**1,030,176**	**11,820,715**
LMTI bus and rail interchange patronage	**0**	**0**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**1,292,759**	**14,833,713**
Asset Residual Value																			**78,677,425**	**10,335,627**

Appendix B Project Cashflow

Capital expenditures for the LMTI development scenarios were based on estimates provided by Council as follows.

Cost (2016 dollars)	FY16/17	FY17/18	FY18/19
Munibung Road Extension	$5,354,850		
Stage 1 - Section 2 (Pennant Street Bridge)		32,000,000	
Stage 2 - LMTI Bus and Rail Interchange		60,000,000	60,000,000
Total Project Cost	**5,354,850**	**92,000,000**	**60,000,000**