

Thornton North Master Plan

Volume 3 - Traffic Impact Assessment Report

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Maitland City Council



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Abbreviations and Acronyms

NEH	New England Highway
PB	Parsons Brinckerhoff
RTA	Roads & Traffic Authority
NTP	Northern Transport Planning
RSME	Root Mean Square Error
LoS	Level of Service
DoS	Degree of Saturation

Executive Summary

This traffic assessment presents the findings of investigations into the traffic implications of the proposed Thornton North Master Plan. The report documents a review of existing traffic conditions, the development of a road network traffic model, the determination of future traffic demand and a traffic assessment of the proposed short listed future network options with full development.

Most trips in the Thornton area are undertaken by car. Journey to work data shows that cars account for 72 percent of journey to work trips, with five percent using bus or train. Buses are mostly used for local trips, particularly employment areas near and in Maitland. The only bus service in Thornton is Blue Ribbon Bus Company's route 186 service, which operates once per hour on weekdays between Thornton and Greenhill shops. Access to Maitland requires passengers to change buses at Greenhills shopping centres. Trains are mostly used by employees to Newcastle CBD, Hamilton/Broadmeadow and Maitland. The rail stations nearest the study area are Thornton and Metford, both of which are under-used relative to other CityRail stations. Train service frequencies range from three per hour during peak hours to two per hour during non-peak periods.

Access to the Thornton North investigation area is available via Raymond Terrace Road, Thornton Road, Government Road and through the existing Somerset Park Estate road network. The New England Highway is the major east-west arterial road through Maitland LGA and is a four-lane dual carriageway south of Thornton. Traffic congestion is apparent at the intersections of the New England Highway with Thornton Road and Weakleys Drive. PM peak periods are more congested than other times of the day; therefore, this period was used for modelling purposes.

The proposal assumes approximately 280 hectares for urban development. The usable land area would result in approximately 3,600 dwellings. Estimates on the number of persons per dwelling were based on Somerset Park, which has approximately 2.6 persons per dwelling. Based on these targets and assumptions, the population of Thornton North would be approximately 9,500 people.

A maximum of 3,000 peak hour vehicle trips generated from full development was assumed in the model. The forecasts indicate that the proposal would result in a significant impact in overall traffic generated in the long term (2016) on the existing network. The regional network, comprising Raymond Terrace Road, Metford Road, Weakleys Drive, and New England Highway, is expected to accommodate the greatest long-term increase in additional traffic as a result of the full proposal.

Locally, the analysis indicates there would be increased use of local area streets in Thornton including Government Road, Railway Avenue, Edwards Avenue, Haussman Drive, Taylor Avenue, Thornton Road, and Anderson Drive by the development traffic seeking to access the New England Highway and Raymond Terrace Road. Haussman Drive would have maximum impact as it would provide a more direct route to and from the proposal. The railway overbridge at Thornton railway station would be a critical threshold due to capacity constraints at the bridge. It is unlikely that this rate of increase in traffic could be sustained unless the key intersections and roads serving the proposed development are significantly upgraded.

In the short term, with the completion of Thornton Link Road and expected prohibition of right turn from Weakleys Drive, a maximum of 200 dwellings could be developed in the Thornton North area, provided the intersection of Thornton Road/New England Highway is upgraded to a reasonable level. The intersection upgrade would consist of one additional westbound right turn bay on the New

England Highway into Thornton Road. This upgrade work is essential prior to approving any development in 2005 in Thornton North.

Five options were tested to assess their impact on improving traffic conditions in 2016 with full development. These options demonstrated that:

- *Weakleys Drive interchange is the most critical upgrade in regard to the intersection of New England Highway with Weakleys Drive. Without this interchange, the full development of the Thornton North area cannot proceed. At the time of preparing this report, it was envisaged that Weakleys Drive interchange would be constructed by 2007. Therefore this interchange was assumed to be a committed project.*
- *The current railway bridge at Thornton Station will constrain development and needs to be duplicated, either adjacent to the existing bridge or by providing a new crossing with Haussman Drive. Either option would provide adequate railway crossing capacity and the decision regarding the preferred option should be made during the project evaluation phase.*
- *The National Highway extension (F3 to Branxton) has some capacity benefits, but is not an essential element in providing network capacity for the Thornton North development.*

When due allowance is made for all potential developments in the study area that access the surrounding arterial and local road system, it is evident that significant road network improvements will be required. In terms of road and intersection capacity (assuming Weakleys Drive interchange would be part of the future network), the following roads and intersections would require upgrading (See Diagram 7.1):

- *Weakleys Drive Interchange and associated works.*
- *Widening of existing Thornton Road bridge to four lanes.*
- *Potential road upgrade to four lanes:*
 - ▶ Raymond Terrace Road between Government Road and Haussman Drive;
 - ▶ Haussman Drive between Raymond Terrace Road and Railway Avenue;
 - ▶ Thornton Road between Glenroy Street and Glenwood Drive;
 - ▶ Thornton Link Road between Thornton Road and Connection Road; and
 - ▶ Connection Road between Weakleys Drive interchange and Link Road (assumed four lanes as part of the Weakleys Drive interchange)
- *Upgrade of regional intersections:*
 - ▶ Raymond Terrace Road with Government Road; and
 - ▶ Raymond Terrace Road with Haussman Drive.
- *Upgrade of local area intersections:*
 - ▶ Railway Avenue with Glenroy Street;
 - ▶ Haussman Drive with Taylor Avenue;
 - ▶ Haussman Drive with Government Road/Glenroy Street;



- ▶ Thornton Road with Glenwood Drive/Thornton Link Road;
- ▶ Thornton Link Road with Connection Road (between interchange and Thornton Link Road).

- *Internal road system serving proposed development– likely to be two lanes.*

- *Five proposed access points on Raymond Terrace Road and McFarlanes Road.*

- *Possible future road extension through quarry and two access points with Government Road and Haussman Drive.*

The package of road and intersection upgrade works described above would deliver sufficient capacity to the arterial and local network to accommodate the full Thornton North development.

Introduction

Parsons Brinckerhoff (PB) has been engaged by Maitland City Council (Council) to prepare a Master Plan for a 900-Hectare site referred to as Thornton North. The Master Planning process identifies key opportunities and constraints associated with the study area and recommends future land uses and management strategies. As part of the Master Plan, PB has assessed the impact of the proposed development (proposal) for the road network and appropriate management measures, determined in consultation with Council and the RTA.

This traffic assessment presents the findings of investigations into the traffic implications of the proposed Master Plan. The report documents a review of existing traffic conditions, the development of a road network traffic model, the determination of future traffic demand and a traffic assessment of the proposed short listed future network options with full development.

1.1 The Study Area

The traffic study area has been identified as extending from the New England Highway (NEH) west of Anderson Drive to NEH east of East Maitland. The traffic model includes the urban development areas of Thornton, East Maitland, Greenhills, Metford, Tenambit and Morpeth. Other surrounding areas, including Beresfield and the Maitland CBD, have been incorporated through external zone links into the traffic model. *Diagram 1.1* shows the study area and the road network.

1.2 The Proposal

The proposal assumes approximately 280 hectares for urban development. Typical gross housing densities range from 10 to 18 dwellings per hectare, with 12 dwellings per hectare considered a realistic average target for Thornton North. The usable land area would therefore result in approximately 3,600 dwellings. Estimates on the number of persons per dwelling were based on Somerset Park, which has approximately 2.6 persons per dwelling. Based on these targets and assumptions, the population of Thornton North would be approximately 9,360 people. For the purpose of this traffic assessment, Thornton North's population was assumed to be 9,500 people.

Other likely developments include:

- a primary school (one primary school is required for every 1,500–2,000 homes, with some capacity still in surrounding schools);
- child care centres/pre-schools; and
- a small shopping centre (possibly a large general store/small supermarket, plus up to six smaller shops/medical rooms — maximum 50 jobs).

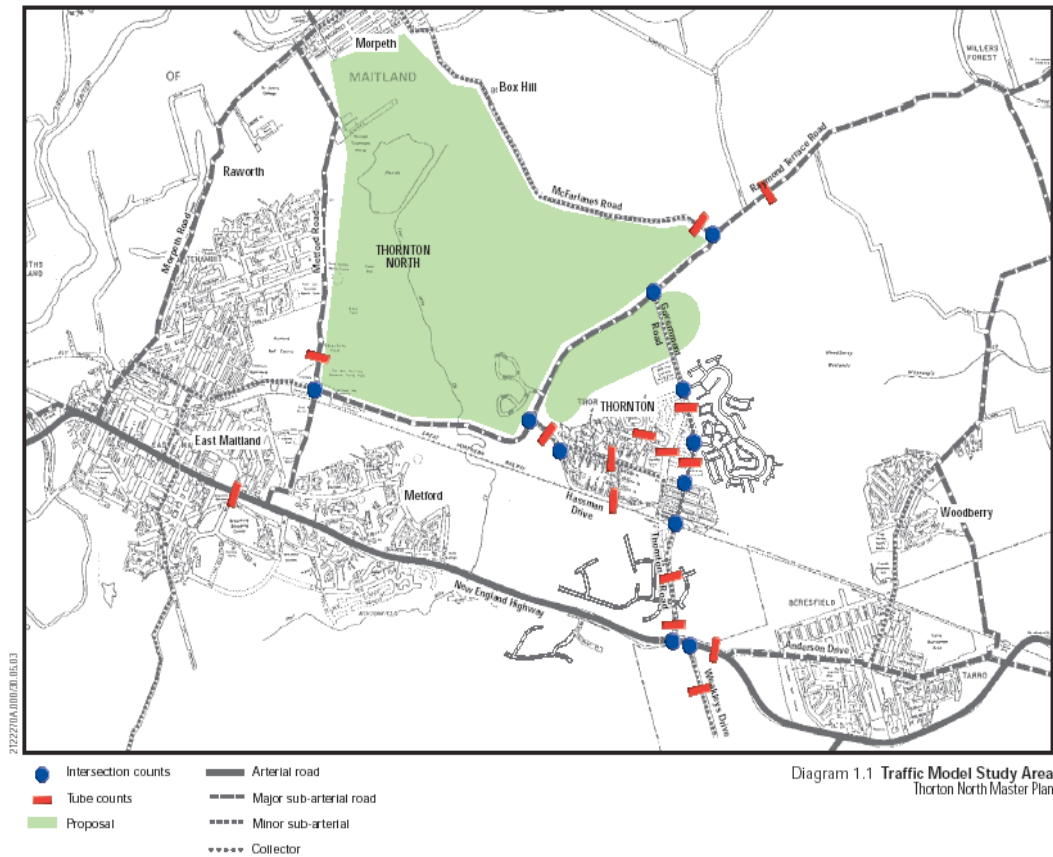


Diagram 1.1 Traffic Model Study Area
Thornton North Master Plan

Diagram 1.1 Traffic Model Study Area

1.3 Study Objectives and Process

The purpose of the traffic study is to assess existing traffic patterns, undertake traffic projections for the study area and to conduct an evaluation of the traffic implications of the proposed development. The study includes an analysis of local and through traffic in Thornton and the surrounding areas.

A micro-scale sub area travel demand model was developed for the study area using a GIS and transportation planning package “TransCAD”⁽¹⁾. The Tmodel2 model¹ network developed for Council was converted to TransCAD and updated to 2003 base model for the purpose of this study.

The major shortcoming of the Tmodel2 trip table was its inability to assess the impact of major regional road projects, such as National Highway-New England Highway extension. As a result of this, trip tables for this project were obtained from the Hunter

(1) TransCAD modelling software is used for transport planning studies, either at a detailed or at a strategic level. The software combines digital mapping and geographic database management with standard transport modelling techniques. TransCAD has been successfully used in Sydney, for the Western Sydney Orbital (WSO) and Lane Cove Tunnel toll modelling studies conducted by PB.

(2) The Tmodel2 Model was developed by PPK in 1996 for the purpose of assessing the needs for a Town Centre traffic improvements for Maitland for short, medium and long-term periods.

regional traffic model (Tranplan), which was developed by the RTA. Sub area trip tables was developed by Northern Transport Planning (NTP) using the RTA's Tranplan model, and PB converted the trip tables into a TransCAD zoning system for the purpose of this study.

This report summarises the findings of the following investigations:

- assessment of existing travel patterns and network capacity at Thornton;
- TransCAD road network model development (detailed modelling approach is discussed in section 3 of this report);
- traffic projections for the study area in 2016 with full development in Thornton North and in conjunction with the National Highway-NEH link;
- impact assessment on key intersections in 2007 prior to construction of the Weakleys Drive interchange;
- impact assessment on network capacity in 2016 with full development plus Weakleys Drive interchange; and
- impact assessment of alternative options and develop preferred option for the Master Plan.

The process and traffic study tasks are shown in *Diagram 1.2*. The options for traffic assessment in the study area were developed in consultation with Council and the RTA. A more extensive evaluation relating to traffic and transport issues raised by the community will be documented elsewhere in the Master Plan report.

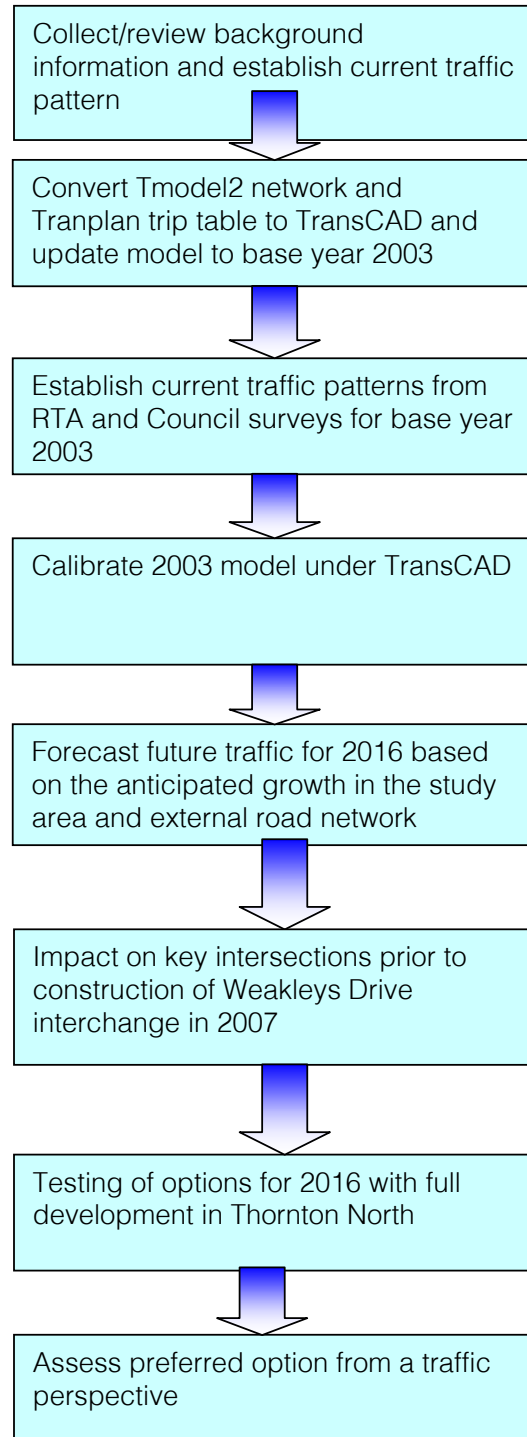


Diagram 1.2: Traffic Assessment Process.

1.4 Report Structure

This report has the following structure:

- *Section 1:* Introduction- background of the study area and the process and objectives of this study.
- *Section 2:* Existing Traffic Context- existing traffic conditions and network capacity.
- *Section 3:* Traffic Model-modelling methodology and the process of network calibration for year 2003.
- *Section 4:* Transport Impact-identifies opportunities to maximise the existing public transport system.
- *Section 5:* Future Network Capacity-future network and intersection performance in 2016.
- *Section 6:* Options Assessment-opportunities for achieving maximum network capacity with the full proposal.
- *Section 7:* Master Plan Assessment-assesses the Master Plan in the light of new access points. A preferred network option has been proposed to mitigate adverse impacts.
- *Section 8:* Conclusions.

2. Existing Travel Characteristics

2.1 Transport Demand

Details of the existing travel and transport statistics for the study area were assessed using three sources:

- 1996 ABS Census Journey to Work survey data from Department of Transport NSW;
- 1999 barrier counts provided by the State Rail Authority; and
- bus patronage data provided by Blue Ribbon Bus Company in Thornton.

Journey to Work

Since the majority of development in the Thornton North investigation area would be residential, the journey-to-work database was accessed to establish work-trip destination and modes for the existing residential area in the Thornton travel zone. The Thornton travel zone includes the residential areas of Thornton and Woodberry. This area, and the approximate location of the study area, is shown in *Diagram 2.1*.

Based on 1996 journey-to-work data for the Thornton travel zone (the 2001 dataset was not available at the time of this analysis), approximately 3,700 people journey from Thornton to their place of work each day. Key travel characteristics for an average weekday on the survey day were:

- the majority of these trips (72 percent) were undertaken in a car;
- four percent were using a train (139 trips);
- one percent were using a bus (32 trips);
- other forms of travel, which include walking and cycling, accounted for six percent of all trips;
- walking was shown to account for two percent of work trips (78 trips); and
- bicycles accounted for less than one percent of work trips (21 trips).

Employment for some Thornton residents is located in nearby locations. *Diagram 2.2* shows the key destinations for Thornton residents on their journey to work for all modes. The following employment patterns were noted:

- Beresfield, Thornton, Ashtonfield, Metford, East Maitland, and Maitland CBD accounted for a fairly high proportion of Thornton jobs. Overall, approximately 26 percent of Thornton workers are employed in the Maitland local government area (LGA);
- approximately half of all jobs (46 percent) are located in the Newcastle LGA. These jobs are dispersed throughout the Newcastle suburban area, with small concentrations found in Mayfield and Newcastle's CBD; and

- a few Thornton residents travel beyond the Hunter region for employment.

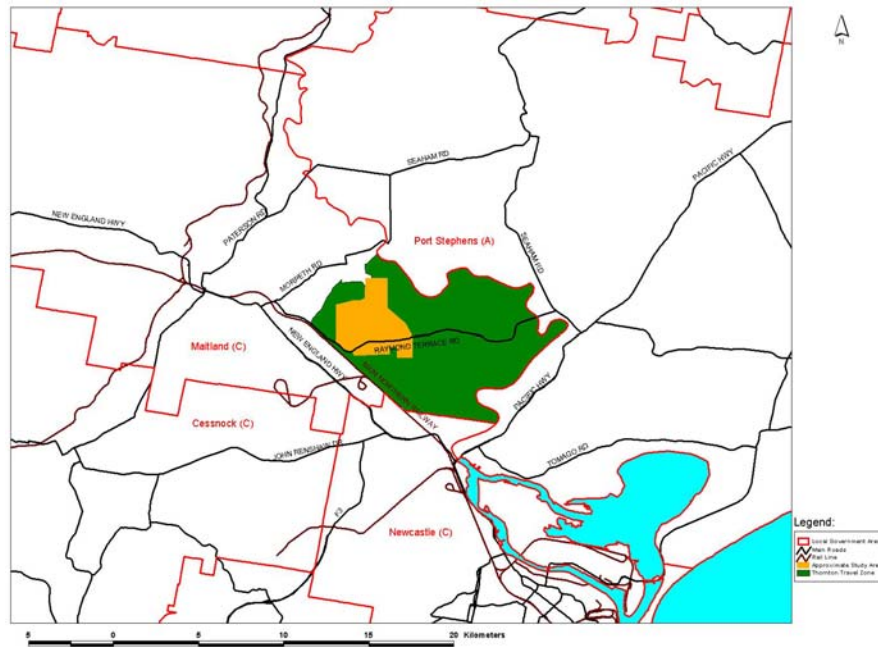


Diagram 2.1: Thornton Travel Zone in the context of Journey to Work Trips

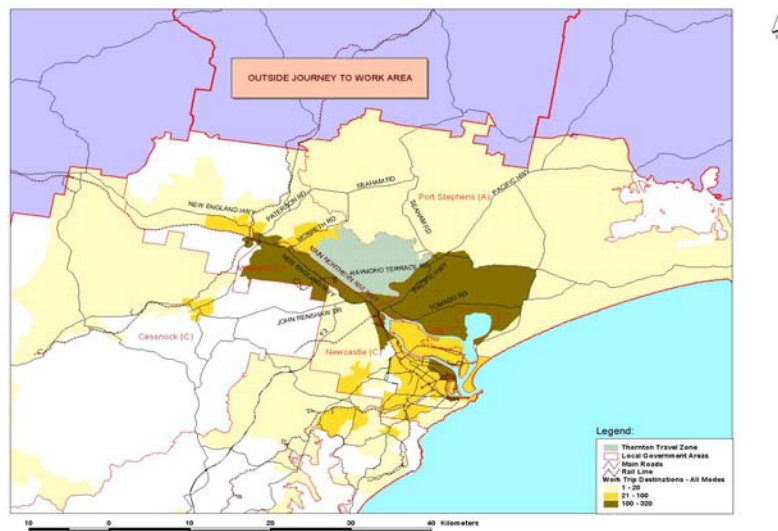


Diagram 2.2: Key destinations for Thornton residents on their journey to work - all modes.

Bus Patronage

Blue Ribbon Bus Company provides the only regular service through Thornton. They indicated that the demand for bus services through Thornton is low. No patronage data on individual bus routes through Thornton were available.

Buses were significantly under-utilised by Thornton workers. Of the 32 bus users from Thornton, the most popular destination was Maitland and areas to its north (e.g. Bolwarra and Lorn) and west (e.g. Telarah and Rutherford). Other destinations include Thornton, Hexham and Newcastle CBD. *Diagram 2.3* shows the key destinations used by Thornton bus commuters on their journey to work.

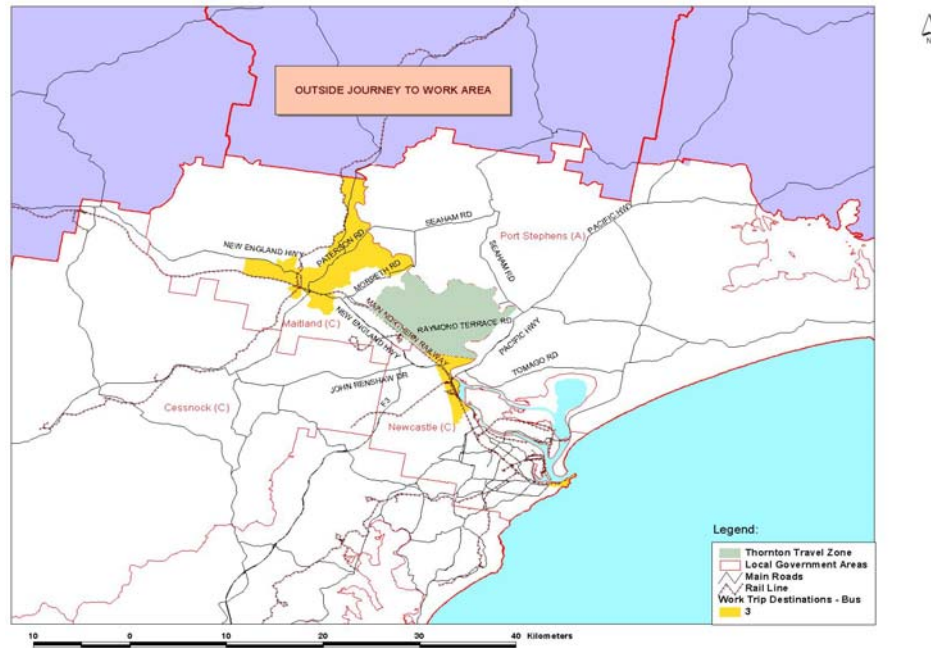


Diagram 2.3: Key destinations used by Thornton bus commuters on their journey to work.

Train Patronage

The geographic spread of work destinations significantly reduces when assessed in terms of work trips by rail. The most significant destination is Newcastle CBD, which has 53 rail trips (representing 1.4 percent of work trips to Thornton). Other significant rail destinations include Hamilton/Broadmeadow (west of Newcastle’s CBD) and Maitland. Destinations greater than two kilometres from the rail line were rarely accessed using rail. *Diagram 2.4* shows the key destinations used by Thornton rail commuters on their journey to work.

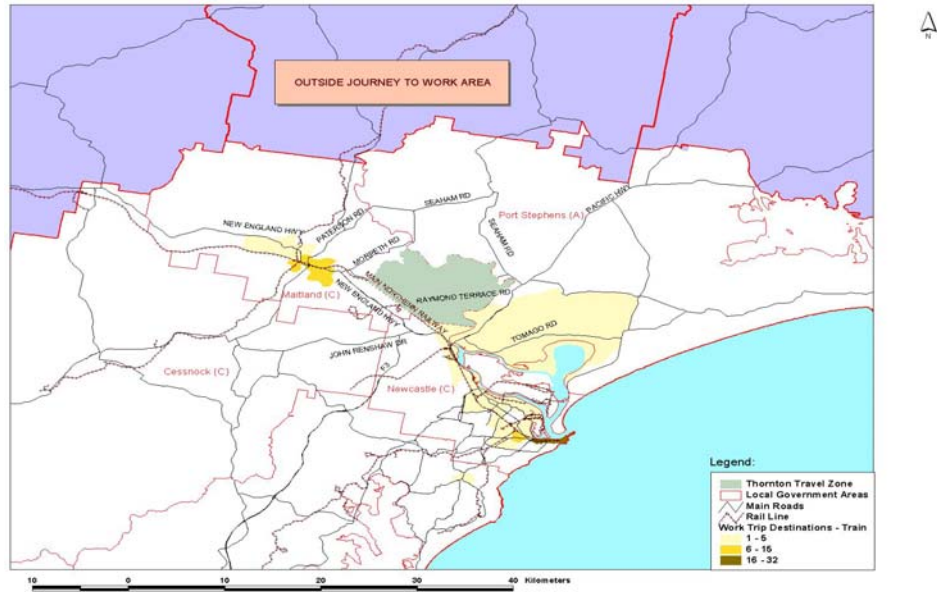


Diagram 2.4: Key destinations used by Thornton rail commuters on their journey to work.

State Rail Authority has records of daily entry and exit data for Stations throughout their network. The following table outlines entry and exit data for the two closest rail stations to the study area: Thornton and Metford.

Table 2-1: Daily Entry and Exits for Thornton and Metford Rail Stations.

Station	6.00–9.30 AM Peak		9.30–15.00 Day		15.00–18.30 PM Peak		18.30–6.00 Evening		All Day	
	In	Out	In	Out	In	Out	In	Out	In	Out
Thornton	130	30	50	70	40	140	20	10	240	240
Metford	60	20	60	50	40	80	10	20	170	170
Total	190	50	110	120	80	220	30	30	410	410

Source: State Rail, 1999

The entry and exit data shows low rail use at each station, with approximately 800 people using the three closest stations to Thornton. Both stations rank between 220 and 250 in terms of volume on State Rail’s network (out of 293 stations). Peak rail use occurs in the traditional peak times in the morning and afternoon.

2.1.1 Public Transport Supply

Analysis of the existing public transport infrastructure has focused mainly on trains and buses. Other options, including the implications of *Draft SEPP 66 – Integration of Land Use and Transport*, will be considered in the Master Plan options phase to maximise the

use of walking, cycling and public transport. Maitland City Council has a 'Cycle Plan'. This plan is currently being reviewed.

Trains

The nearest rail stations to the study area are Thornton and Metford. These stations are located on the Hunter Line, which provides a service between Scone and Newcastle via the main centres of Muswellbrook, Singleton and Maitland.

Most services to Newcastle begin at Telarah, with almost all stopping at Thornton and Metford. The following table shows the number of services to Newcastle that stop at these two stations for various time periods throughout a weekday.

Table 2.2: Train Frequencies to Newcastle from Thornton Stations

Origin	6.00–9.30 AM Peak	9.30–15.00 Day	15.00–18.30 PM Peak	18.30–6.00 Evening	All Day
Scone/ Muswellbrook	1	1	0	2	4
Dungog	1	1	2	1	5
Telarah/ Maitland	8	12	6	12	38
Total	10	14	8	15	47
Trains/Hour	2.9	2.5	2.3	1.3	2.0

Source: State Rail, 1999

The highest frequency of eastbound trains occurs during the morning peak, reflecting the greater rail demand for eastbound rail trips during this period. The frequency of eastbound trains decreases throughout the day. The frequency of trains also affects the average time between train services. In the morning peak period eastbound trains depart on average every 21 minutes, whereas in the afternoon peak period the average time between trains is 26 minutes.

The destination of westbound trains is usually Telarah, with some services continuing to Dungog and Scone. All westbound services originate in Newcastle. *Table 2.3* shows the number of services from Newcastle that stop at the two stations for various time periods throughout a weekday.

Table 2-3: Train Frequencies from Newcastle to Thornton Stations

Destination	6.00–9.30 AM Peak	9.30–15.00 Day	15.00–18.30 PM Peak	18.30–6.00 Evening	All Day
Scone/ Muswellbrook	1	0	2	1	4
Dungog	1	1	2	1	5
Telarah/ Maitland	8	10	7	13	38
Total	10	11	11	15	47
Trains/Hour	2.9	2.0	3.1	1.3	2.0

Source: State Rail, 1999

The highest frequency of westbound trains occurs during the afternoon peak, reflecting the greater rail demand for westbound trips in this period. Frequency is almost as high as in the morning peak period, reflecting high demand for afternoon trips to the western centres of Maitland and Telarah.

Trip frequencies for westbound trains in the middle of the day are significantly lower than morning and afternoon peak periods. Average waiting times between services is approximately 20 minutes in the peak periods and 30 minutes in the middle of the day.

The nearest station to the study area, Metford, provides 53 free parking spaces (including two disabled spaces), a bus stop and a kiss and ride facility. This station only has access from the Metford side of the tracks, potentially restricting use by residents on the northern side of the rail line. Thornton Station provides 63 parking spaces (including two disabled spaces), a bus stop (to connect with local bus services; see next section) and a kiss and ride facility. Both stations provide wheelchair access to the platforms. A visit to each station on a typical workday showed Metford's car park nearly empty while Thornton's car park was approximately 85 percent full. This difference possibly reflects Thornton Station's closer proximity to existing residential areas and a preference by commuters to park at this station due to perceived increased safety due to higher levels of use.

Buses

Blue Ribbon Bus Company operates the only bus service through Thornton. Route 186 links the residential district of Thornton with Thornton Rail Station and Greenhills Shopping Centre. In the past, Thornton has had a direct service to Maitland; however, this service was discontinued some time ago. Bus passengers can access other destinations, such as Maitland, by changing services to either route 181 or 183 at Greenhills Shopping Centre.

Route 186 operates as a loop service that runs continuously throughout the day between Thornton and Greenhill shops. The service begins at Thornton Rail Station at 7.25 am and conducts nine trips through the loop during the day until termination at Thornton Station at 6.07 pm. The only deviations from this loop occur at 10.00 am and 3.25 pm when the service provides access to the Thornton Industrial Centre. There are no services on weekends. On average, the bus service conducts a loop approximately once per hour, thus reducing its effectiveness in meeting the travel needs of Thornton residents.

An alternative to Blue Ribbon Bus Company's service is the community transport service run by Maitland Council. Funded by the State Government, this on-call bus service provides mostly local trips to people with limited mobility, although passengers can pay extra for a trip to and from Newcastle. Passengers generally book at least one day in advance. The service has five vehicles: an 18 seater, a 10 seater and three station wagons.

2.1.2 Road Network/Access

Access to the Thornton North investigation area is available via Raymond Terrace Road, Thornton Road, Government Road and through the existing Somerset Park Estate Road network. The NEH is the major east-west arterial road through Maitland LGA and is a four-lane dual carriageway south of Thornton. Traffic congestion is apparent at the intersections of the NEH with Thornton Road and Weakleys Drive. Recent studies conducted by the RTA² indicated that high turning volumes at Thornton Road and Weakleys Drive intersections created delays and congestion during peak periods. Queues on the approaches to these intersections cause partial blockage of through-traffic on the NEH.

Traffic Volumes

Traffic data was obtained from a number of sources and included counts undertaken by Council and RTA. All traffic counts for this study was undertaken prior to the opening of Thornton Link Road. *Table 2.4* shows historic AADT on key arterial roads obtained from the "RTA Traffic Volume Data for Hunter Region".

Table 2.4 Historic Traffic Volumes — AADT on Regional Road Network

Station Name	Year of counts							
	1984	1986	1988	1990	1992	1995	1998	2001
05.058 New England Highway, west of Thornton Road	20890	22146*	23478	25058*	26744*	29489	34752	42140
05.057 New England Highway, east of Weakleys Drive	21780	22611*	23473	26693	27448*	28621*	29844	32199
V*05.150 Raymond Terrace Rd, west of Irrawang Bridge	4090	4840	4875	5402	6300	6458	6578	6687
05687 Weakleys Drive, south of New England Hwy			4723	5470	7215*	10928	13478	16826

Note: * indicates estimated AADT from actual counts

Table 2.5 shows traffic growth based on the AADT shown in *Table 2.4*.

Table 2.5: Annual Compound Traffic Growth Rates

Station Name	1984–1990	1990–1995	1995–2001	1998–2001
05.058 New England Highway, west of Thornton Road	3.1%	3.3%	6.1%	6.6%
05.057 New England Highway, east of Weakleys Drive	3.4%	1.4%	2.0%	2.6%
V*05.150 Raymond Terrace Rd, west of Irrawang Bridge	4.7%	3.6%	0.6%	0.5%
05687 Weakleys Drive, south of New England Hwy	-	14.8%	7.5%	7.7%
Average for all Roads	3.8%	5.8%	4.0%	4.4%

² Weakleys Drive Interchange; Report on Beresfield/Thornton Link Road Options; RTA, May 2001

Based on *Table 2.5*, the average daily growth rate on the NEH was estimated to be 4.6 percent per annum from 1998 to 2001. This growth is based on daily traffic volume. During peak hours, the growth would not be as high.

Daily Variations

Daily counts were undertaken in February 2003 at the following three mid block locations:

- Raymond Terrace Road, east of Eales Road;
- McFarlanes Road, north of Raymond Terrace Road; and
- Metford Road, north of Raymond Terrace Road.

Additional surveys were conducted in March 2003 to supplement the above data at the following three locations:

- New England Highway, west of Mitchell Drive;
- Weakleys Drive, south of New England Highway; and
- New England Highway, east of Weakleys Drive.

The above count locations were selected to establish regional traffic patterns near the Thornton North study area. To assess local traffic impact as a result of the proposed development, supplementary traffic counts were conducted in July 2003 on the followings roads:

- Edwards Avenue north of Singleton Avenue;
- Government Road south of Somerset Drive;
- Government Road north of Blakewell Crescent;
- Thomas Cooke Drive south of John Arthur Avenue;
- Hauszman Drive south of Raymond Terrace Road;
- Hauszman Drive west of Forshaw Close;
- Taylor Avenue west of Thomas Cooke Drive;
- Thornton Road north of Glenwood Drive; and
- Thornton Road north of NEH.

The survey results are summarised in *Table 2.6*.

Table 2-6: Weekday Versus Weekend Traffic (Two-Way) in 2003

Roads	Weekday	Weekend
Raymond Terrace Road, East of Eales Road	6,382	5,796
Metford Road, North of Raymond Terrace Road	7,525	6,653
McFarlane Road, North of Raymond Terrace Road	1,176	1,046
New England Highway, west of Mitchell Drive	39,187	29,767
Weakleys Drive, south of New England Highway	18,164	13,920
New England Highway, east of Weakleys Drive	34,857	25,285
Edwards Avenue north of Singleton Avenue	4,920	4,225
Government Road south of Somerset Drive	3,495	2,966
Government Road north of Blakewell Crescent	1,949	1,746
Thomas Cooke Drive south of John Arthur Avenue	1,801	1,641
Hausman Drive south of Raymond Terrace Road	5,726	4,375
Hausman Drive west of Forshaw Close	3,088	1,509
Taylor Avenue west of Thomas Cooke Drive	3,982	3,332
Thornton Road north of Glenwood Drive	12,860	10,283
Thornton Road north of NEH	17,285	11,173

Source: Automatic Tube Counts in February, March and July 2003

The results indicate that the NEH carries approximately 40,000 vehicles per day on weekdays, decreasing to approximately 30,000 vehicles per day during weekends. Weekday traffic is approximately 35 percent higher than weekend traffic. Thornton Road, a key collector road, carries approximately 13,000 to 18,000 vehicles per weekday. Weekday traffic is approximately 20 percent to 35 percent higher than weekend traffic on this road. Local roads carry approximately 2,000 to 6,000 vehicles per day.

Truck Traffic Composition

An analysis of truck numbers and proportions was undertaken on major approach routes to Thornton in 2003. In terms of daily truck traffic, *Table 2.7* shows average truck traffic as a percentage of total vehicles.

Table 2-7: Truck Traffic Proportions

Heavy Vehicle Measure	Weekday		Weekend	
	Eastbound	Westbound	Eastbound	Westbound
Raymond Terrace Road, east of Eales Road				
Trucks as a proportion of total daily traffic	7%	7%	3%	2%
Proportion of truck in AM peak	8%	7%	2%	1%
Proportion of truck in PM peak	4%	4%	2%	3%
New England Highway, east of Weakleys Drive				
Trucks as a proportion of total daily traffic	4%	4%	1%	1%
Proportion of truck in AM peak	3%	5%	2%	2%
Proportion of truck in PM peak	3%	4%	1%	1%
Weakleys Drive, south of New England Highway				
Trucks as a proportion of total daily traffic	6%	7%	2%	3%
Proportion of truck in AM peak	6%	6%	4%	5%
Proportion of truck in PM peak	5%	4%	1%	1%

Table 2.7 shows that on the NEH at Thornton the proportion of trucks is fairly high. Detailed analysis of truck traffic data indicates that:

- on average, truck traffic contributes approximately four to seven percent of the total traffic for a typical weekday;
- the proportion of trucks as a percentage of daily traffic is uniformly distributed in either direction; and
- trucks contribute approximately three to five percent of total traffic volume during peak periods on weekdays.

As expected, weekend truck traffic is less than weekday traffic.

Hourly Variations

Diagrams 2.5 to 2.7 show the average weekday 24-hour traffic profile at the following selected locations:

- NEH west of Mitchell Drive,
- Raymond terrace Road east of Eales Road, and

- Metford Road, north of Raymond Terrace Road.

From these figures, it can be seen that:

- the evening peak is dominant over the morning peak, and generally the evening peak occurs over a longer period; and
- the evening peak period has higher traffic volume than the morning peak period.

Therefore the traffic impact assessment focused on the evening peak hour volume.

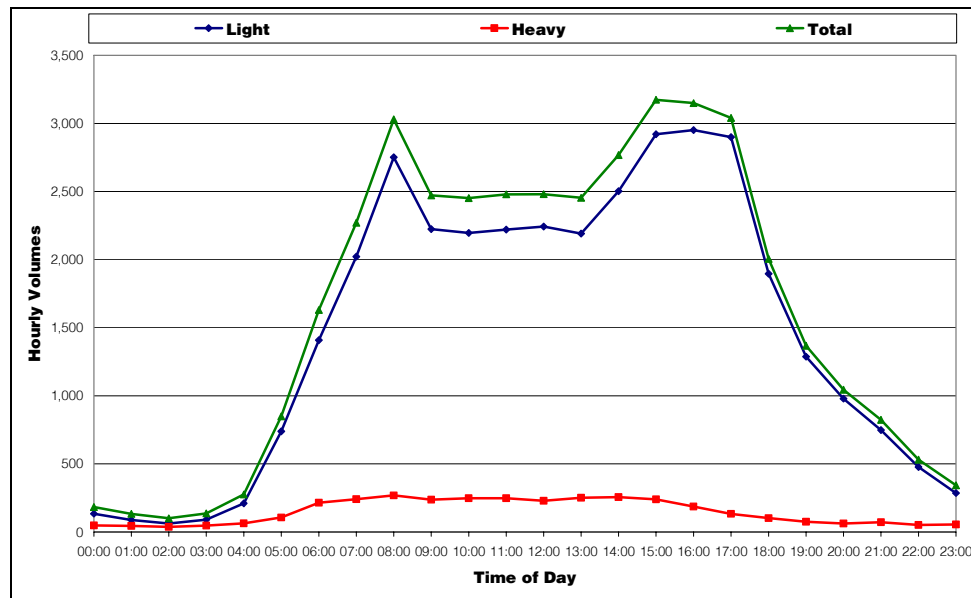


Diagram 2.5: 24-Hour Traffic Profile at New England Highway, West of Mitchell Drive

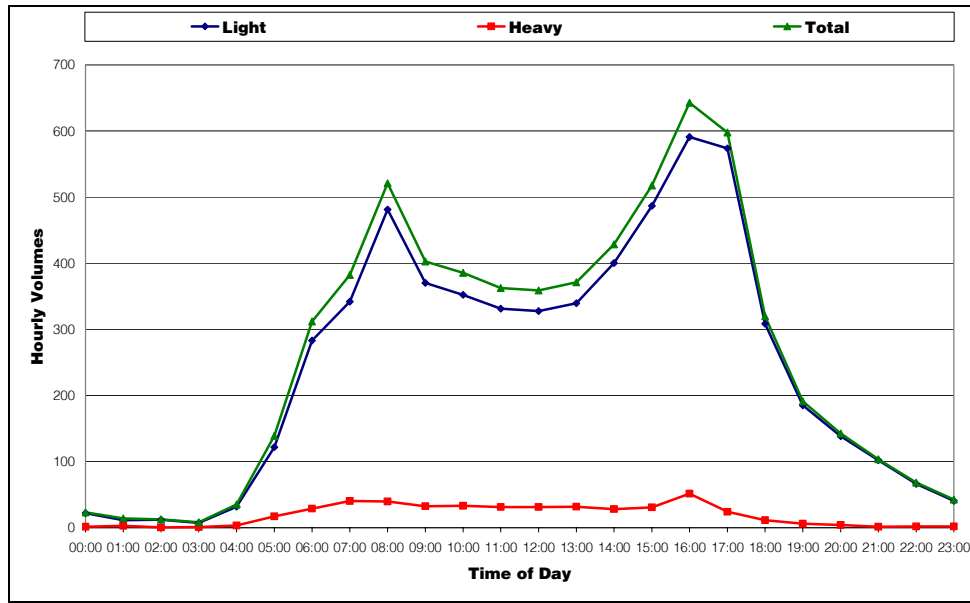


Diagram 2.6: 24-Hour Traffic Profile at Raymond Terrace, East of Eales Road

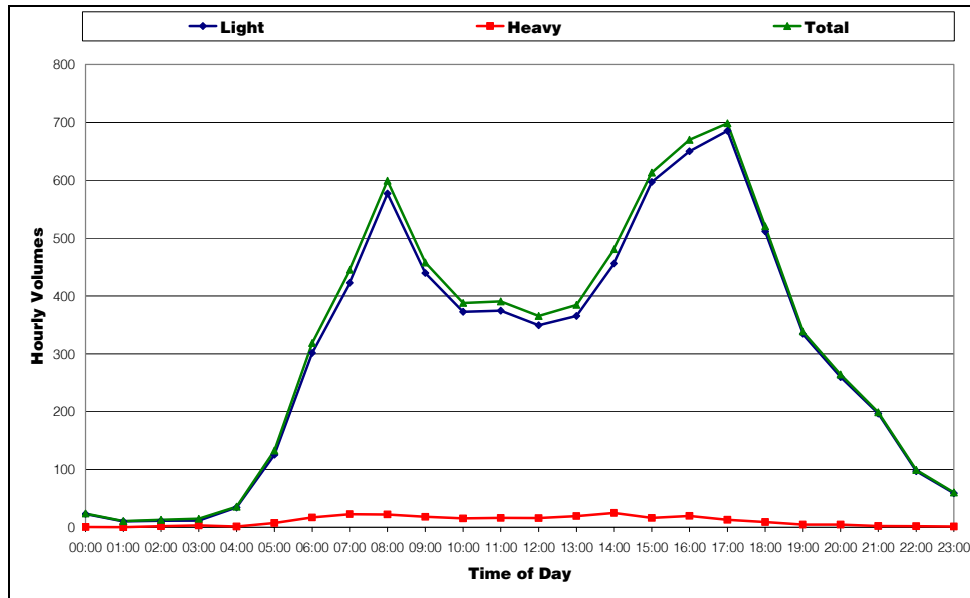


Diagram 2.7: 24-Hour Traffic Profile at Metford, North of Raymond Terrace

Peak Hour Volume and Capacity

PM peak hour peak flows were assembled for all sites indicated in the previous section. *Table 2.8* summarises peak hour flows. An analysis of traffic data in *Table 2.8* reveals that:

- the NEH carries between 3,600 and 4,400 vehicles per hour (two way). Eastbound PM peak traffic flows on this road is about 20 percent higher than westbound flows;
- Raymond Terrace and Metford Road carry approximately 700 to 1,000 vehicles per hour (two way) during PM peak hour;
- Thornton Road carries approximately 900 to 1200 vehicles during peak hour; and
- local roads carry lower volumes in the range of approximately 200 to 500 vehicles during PM peak hour.

The nominal road capacity (AUSTROADS, 1988) detailed in *Table 2.8* is a useful indicative guide and is based on the Austroads assessment criteria that includes road function, carriageway type, speed limit and roadside friction factors (parking, intersection operations, overtaking lanes and property access). For instance the midblock capacity for a two lane urban undivided road is 900 vehicles per lane per hour. This capacity may increase to 1,200 to 1,400 vehicles per lane per hour assuming there is adequate capacity at the intersections. The maximum capacity (see *Table 2.8*) is used to identify capacity deficiencies of roads in the Thornton North study area and is based on a level of service "E".

The hourly flows in *Table 2.8* indicate that currently all roads serving the Thornton area operate below the maximum capacity for a level of service "E" during peak periods. The midblock peak hour demand indicates that some surplus capacity is available to accommodate future traffic growth.



Table 2-8: PM Peak Hour Traffic Flows in 2003

Road Section	Effective Number of Lanes per Direction	Surveyed PM Peak Volumes			Maximum Nominal Capacity per hour per Direction	Does Volume Exceed Capacity for LoS "E"
		Eastbound/Northbound	Westbound/Southbound	Total 2 Way		
Raymond Terrace Road West of Eales Road	2U	267	349	616	1500	No
Raymond Terracse Road East of Government Road	2U	306	367	673	1500	No
Raymond Terrace Road East of Haussman Drive	2U	325	304	629	1500	No
Raymond Terrace Road West of Haussman Drive	2U	562	487	1049	1500	No
Raymond Terrace Road East of Metford Road	2U	562	487	1049	1500	No
Raymond Terrace Rd West of Metford Road	2U	348	280	628	1300	No
Metford Road North of Raymond Terrace Road	2U	446	416	862	1000	No
Metford Road South of Raymond Terrace Road	2U	443	335	778	1000	No
McFarlanes Rd North of Raymond Terrace Road	2U	78	53	131	1100	No
Government Road South of Raymond Terrace Road	2U	152	176	328	900	No
Edwards Avenue north of Singleton Avenue	2U	188	171	359	900	No
Government Road south of Somerset Drive	2U	219	206	425	900	No



Road Section	Effective Number of Lanes per Direction	Surveyed PM Peak Volumes			Maximum Nominal Capacity per hour per Direction	Does Volume Exceed Capacity for LoS "E"
		East bound/North bound	West bound/South bound	Total 2 Way		
Government Road north of Blakewell Crescent	2U	163	48	211	900	No
Hausman Drive south of Raymond Terrace Road	2U	322	268	590	900	No
Hausman Drive west of Forshaw Cl	2U	127	170	297	900	No
Taylor Avenue west of Thomas Coke Drive	2U	184	203	387	900	No
Thornton Road north of Glenwood Drive	2U	450	449	899	900	No
Thornton Road north of New England Highway	2U	468	705	1173	900	No
Weakleys Drive south of NEH	2U	1010	829	1839	1600	No
New England Highway east of Thornton Road	4D	2440	1939	4379	2700	No
New England Highway west of Thornton Road	4D	1970	1706	3676	2700	No

Note: 2U=2 lanes undivided carriageway, 4D=4 lanes divided carriageway

Source: Traffic Counts in 2003, AUSTRROADS, 1998, Road Capacity

2.1.3 Intersection Counts

Intersection counts were conducted in February 2003 at the following four intersections:

- Raymond Terrace Road/McFarlanes Road;
- Raymond Terrace Road/Government Road;
- Raymond Terrace Road/Taylor Avenue; and
- Raymond Terrace Road/Metford Road.

Additional intersection counts were sourced from a previous study (*Traffic & Cost Details for at Ground Options for NEH at Thornton Road, Weakleys Drive and Anderson Drive Intersections*, RTA Hunter Region) at the following intersections:

- New England Highway/Thornton Road; and
- New England Highway/Weakleys Drive.

These were conducted in October 2000. Using growth factors derived from *Table 2.5* and additional recent counts for 2003 on the NEH/Weakleys Drive, year 2000 counts were adjusted to 2003 volumes.

Six local intersections were counted in July 2003 for the following intersections:

- Railway Avenue/Glenroy Street;
- Edwards Avenue/Railway Avenue/Eurimbla Street;
- Edwards Avenue/Somerset Drive;
- Government Road/Eurimbla Street;
- Haussman Drive/Taylor Avenue and
- Thomas Coke Drive/Edwards Avenue/ Somerset Drive

The intersection capacity as described in the following section is based on the 2003 PM peak traffic volumes prior to the opening of Thornton Link Road.

2.1.4 Road Network Capacity

Assessment of the existing performance of intersections provides a good indication of the level of congestion and existing capacity on a road network. The performance of the road network is normally dependent on the capacity of intersections rather than on the capacity of the road links between intersections.

The operational performance of the system of intersections along the NEH under the existing road geometry, traffic control and critical PM peak traffic demand circumstances was modelled.

Table 2.9 provides an interpretation of the relationship between the average delay and different level of service according to the RTA *Guide to Traffic Generating Developments*

(December 1993). In general, there are six levels of service, from A to F, with level of service "A" representing the best operating condition and level of service "F" the worst.

Table 2-9: Intersection Performance Criteria

Level of Service	Average Delay (second/vehicle)	Level of Service Interpretation
Signals and Roundabouts		
A	<=14.0	Good operation
B	15 to 28	Good with acceptable delays and spare capacity
C	29 to 42	Satisfactory
D	43 to 56	Operating near capacity
E	57 to 70	At capacity; at signals, incidents will cause excessive delays
F	>70	Above capacity, long queues and excessive delays

Source: RTA Guide to Traffic Generating Development (December 1993)

The results of key intersection performance on regional roads are summarised in *Table 2.10*.

Table 2-10: Regional Intersections Performance in 2003

Intersections/Critical Movements	Traffic Control	PM PEAK	
		Delay ¹	LoS ²
New England Highway/Weakleys Drive	Signal	22	B
<i>Critical movement-northbound right turn from Weakleys Drive into NEH</i>		>70	F
<i>Critical movement- eastbound right turn from NEH into Weakleys Drive</i>		46	D
Raymond Terrace Road/Metford Road	Roundabout	10	A
<i>Critical movement-right turn from Raymond Terrace Road eastbound into Metford Road</i>		18	B
Raymond Terrace Road/Government Road	Sign	6	A
<i>Critical movement-right turn from Government Road northbound into Raymond Terrace Road</i>		15	B
Raymond Terrace Road/Haussman Drive	Sign	7	A
<i>Critical movement-right turn from Raymond Terrace Road eastbound into Haussman Drive</i>		15	B
Raymond Terrace Road/McFarlanes Road	Sign	3	A
<i>Critical movement-left turn from McFarlanes Road southbound into Raymond Terrace Road</i>		15	B
New England Highway/Thornton Road	Signal	57	E
<i>Critical movement-right turn from New England Highway westbound Thornton Road</i>		>70	F

Source: SIDRIVEA intersection model.

Notes: (1) These are average delays in seconds per vehicle.

(2) See *Table 2.9* for LoS definition.

From the analysis results, the two signalised intersections on the NEH currently operate with an average intersection level of service (LoS) of “B” and “E” for Weakleys Drive and Thornton Road intersections respectively. The followings critical movements at both intersections are operating either at or above capacity levels:

- right turn movement from NEH westbound to Thornton Road;
- right turn movement from NEH eastbound to Weakleys Drive; and
- right turn movement from Weakleys Drive northbound to NEH.

The level of service for these critical movements are “D” to “F”, indicating that very limited or virtually no spare capacity is available for any additional traffic demand under existing conditions.

All other sign and roundabout controlled intersections that were modelled for this study operated at a good level of service (“A”), indicating a good operation and spare capacity during PM peak periods.

Local intersections performance in Thornton is summarised in *Table 2.11*. All intersections currently operate at a good level of service “A” to “B”, with adequate spare capacity to accommodate future growth.

Table 2.11 Local Intersections Performance in 2003

Intersections	Traffic Control	PM Peak	
		Delay	LoS
Railway Avenue/ Glenroy Street	Sign	17	B
Edward Avenue/Eurimbla Street	Roundabout	10	A
Government Road/Eurimbla Street	Sign	12	A
Hausman Drive/Taylor Avenue	Sign	10	A
Edwards Avenue/Somerset Drive	Roundabout	7	A
Thomas Coke Drive/ Somerset Drive	Roundabout	6	A

2.1.5 Current Transport Implications

The existing operation of the Thornton Road and Weakleys Drive intersections with the NEH confirms problems identified by the RTA and Council. Some key issues are:

- the NEH currently has adequate capacity for through-traffic movements, although considerable traffic congestion is occurring during peak periods at both Thornton and Weakleys Drive intersections as a result of turning movements (refer *Table 2.10*);



- the extent of future development in the Thornton North investigation area depends on the capacity of the key intersections at Thornton Road and Weakleys Drive along the NEH; and
- the construction of the Weakleys Drive Interchange will therefore be an important issue for the Thornton North Master Plan strategy.

3. Traffic Model

3.1 Overview

In view of the size and the potential impact of medium and long-term growth in Thornton North and the requirements for evaluation of alternative traffic management options, a computer model was developed for the study area. This effectively allows the assessment of future estimated traffic conditions and their probable impact on the operation of the road network.

The traffic modelling process requires three key elements as follows:

- a representation of the physical road network system. The network used for the PB model adopts the Council's Tmodel2 network. The network was updated for current 2003 road conditions;
- a representation of the trips that take place on that system. Trip tables were used from the Hunter regional traffic model Tranplan to quantify the demand for travel across the entire model area between each small geographic area (travel zone or TZ); and
- a software package that can assign the demand to the network in a way that accurately reflects the constraints of the network, and the economic and behavioural decisions made by motorists.

For calibration purposes, the model was constructed for a "current" year using the most recently available traffic count data (2003). The model was calibrated against traffic counts data prior to the opening of the Thornton Link Road. The calibrated model was then used to forecast demand and operational characteristics for 2016 PM peak traffic. *Diagram 3.1* depicts the modelling procedures.

Daily trip tables in 2003 are based on those produced by the Northern Transport Planning and Engineering Pty Ltd using RTA Tranplan model. A zone-to-zone PM peak hour factor matrix was derived from traffic counts. The factor matrix was developed through an iterative process until a close match between counts and model was achieved.

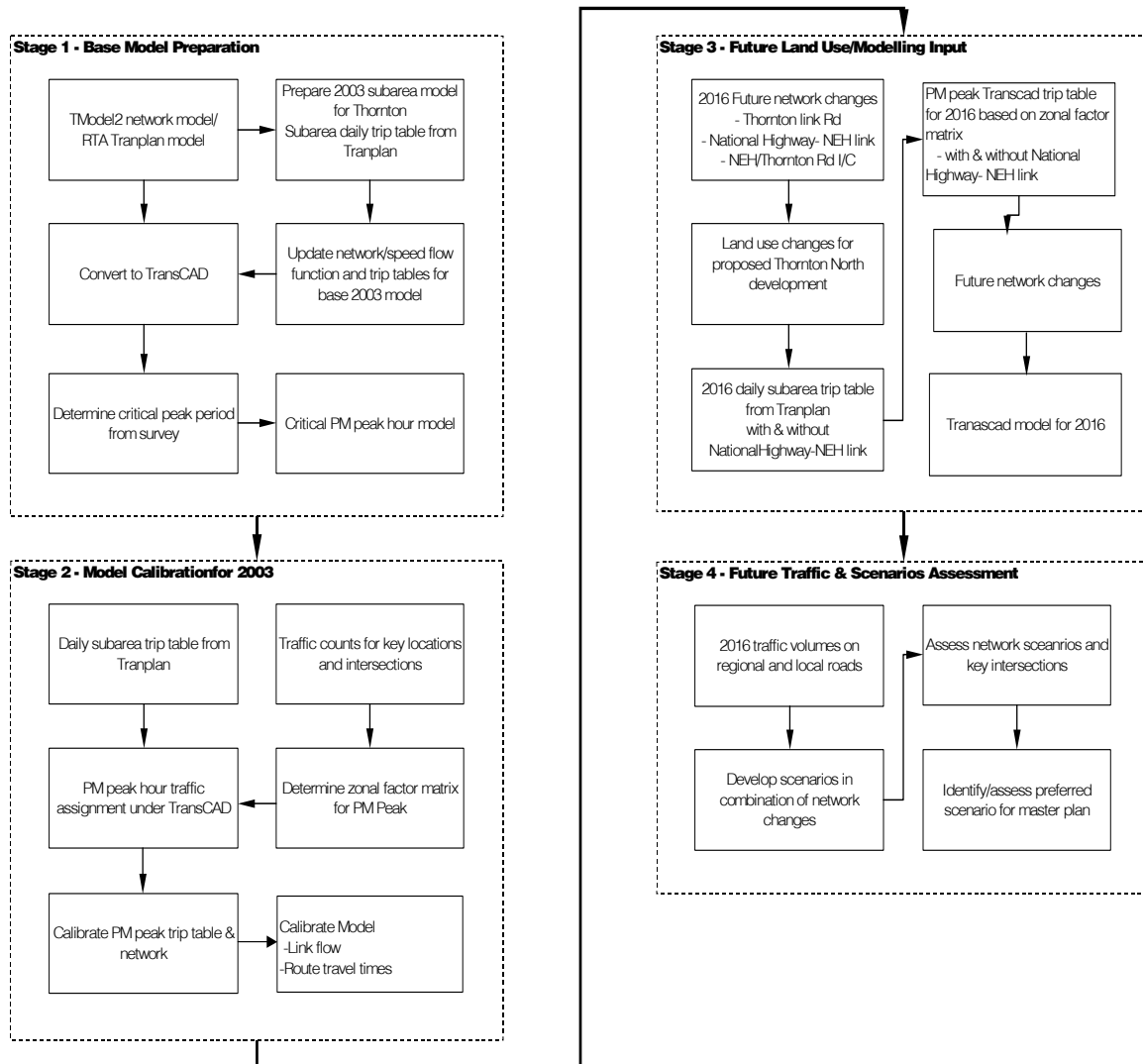


Diagram 3.1: TransCAD Traffic Modelling Process.

3.2 Modelling Objectives

There were several main objectives in developing the traffic forecasting model for Thornton North:

- create a tool capable of forecasting the traffic volumes on key road networks for full development; and
- provide input for the geometric design of intersections, interchanges and for pavement design, and to assist in the decision process regarding the network improvement options as a result of the proposed development.

3.3 Key Model Inputs

3.3.1 Networks

An assignment model uses a network to determine the path taken by traffic between its trip origin and destination. There are three important features of each road in the network that are required during this process:

- the capacity of each link, measured in vehicles/model period, in this case one hour;
- the free flow travel speed along the link; and
- the way the travel speed along the link responds to increasing traffic, expressed as a speed-flow curve.

The assignment process makes use of the congested travel time, which is a combination of free flow time reduced according to the level of congestion experienced.

3.3.1.1 Source of Network

The initial road network considered was the network adopted for Council’s Citywide Road. At that time the model was developed to assess a set of recommendations for future traffic-related initiatives in the Maitland CBD and surrounding areas. The network includes arterial, sub-arterial and collector roads, and some local roads. For the Thornton North traffic study area, a sub area network was extracted. During the building of the TransCAD model, comprehensive consistency checking and adding of other modelling attributes were undertaken to complete the network. *Diagram 3.2* shows the modelled road network for this project.



Diagram 3.2 Modelled Road Network

3.3.1.2 Travel Zones System

The PB model essentially used the same zoning system as the RTA Tranplan model, resulting in a total of 27 zones for sub area analysis.

3.3.2 Trip Tables

Trip tables are essentially a representation of the travel demand or number of trips that occur between each origin-destination pair (“O-D pair”) without having regard to the actual route taken through the physical network. Daily trip tables in 2003 are based on those produced by the Northern Transport Planning and Engineering Pty Ltd using the Tranplan model, resulting in a matrix of trips between travel zones.

PB used trip tables in two key areas:

- for model calibration purposes, current year trip tables, adjusted to match observed traffic volumes in key locations, were used; and
- future year trip tables were developed for 2016, taking into account the calibration adjustment to the base year.

The trip tables relate to travel during the evening peak hour for an average weekday. The evening peak was explicitly calibrated and modelled for this project.

3.4 Model Calibration

3.4.1 Overview

Model calibration is the process by which the initial model inputs and parameters are adjusted in a logical and controlled manner until the model matches a set of observed values. This calibration process confirms that appropriate parameters are chosen, thus ensuring that when the model is used in forecast mode that the results will be consistent with the inputs and current behavioural responses.

Two measures were computed as part of the Thornton model calibration. They are:

- The correlation coefficient (R^2) for region-wide observed traffic counts versus estimated volumes should be greater than 0.88; and
- The percent Root Mean Square Error (%RMSE)

$$\%RSME = \frac{\left(\sum_j (Model_j - Count_j)^2 / (Number\ of\ Counts - 1)^{0.5} * 100 \right)}{\left(\sum_j Count_j / Number\ of\ Counts \right)}$$

should be < 30 percent.

3.4.2 Travel Time Calibration

Travel time surveys along selected routes have been used to assess the performance of the VDF curves developed by PB for the model. PB undertook travel time surveys along six routes, in both directions, for a weekday in February 2003.

Table 3.1 shows a comparison of surveyed and modelled travel time for PM peak hour. Overall, the results indicate a very close match (less than one percent) between modelled and surveyed travel time.

Table 3.1: Comparisons of Travel Times (minutes) between Modelled and Surveyed on Selected Routes

Route Description	Surveyed		Modeled	
	Forward	Reverse	Forward	Reverse
NEH/Thornton I/S to Raymond Terrace Rd/Government Rd I/S via Thornton Rd	5.4	4.8	4.9	4.7
NEH/Thornton I/S to Raymond Terrace Rd/Haussman Drive I/S via Thornton Rd-Haussman Drive	4.9	4.6	4.6	4.4
NEH/Thornton I/S to NEH/Metford Rd I/S via NEH	6.8	6.9	5.7	5.5
NEH/Metford Rd I/S to Raymond Terrace Rd/McFarlanes Rd I/S via Raymond Terrace Rd	4.0	4.1	4.6	4.5
NEH/Metford Rd I/S to Morphet Rd/Tank St I/S via Metford Rd	3.0	3.2	3.6	3.5
Morphet Rd/Tank St I/S to Raymond Terrace Rd/McFarlanes Rd I/S via McFarlanes Rd	6.0	5.8	7.1	6.9
Total for all routes	30.1	29.4	30.5	29.4

3.4.3 Model vs Counts

In the Thornton model, the R^2 for observed, compared with modelled volumes, for 36 directional traffic counts is 0.99, which meets the criteria (see *Diagram 3.3*).

The calculated difference between model and count for Thornton is lower than the target RMSE above. For the study area the %RMSE is four percent, which includes arterial, sub-arterial and collector roads. This meets the recommended criteria as outlined in Section 3.4.1.

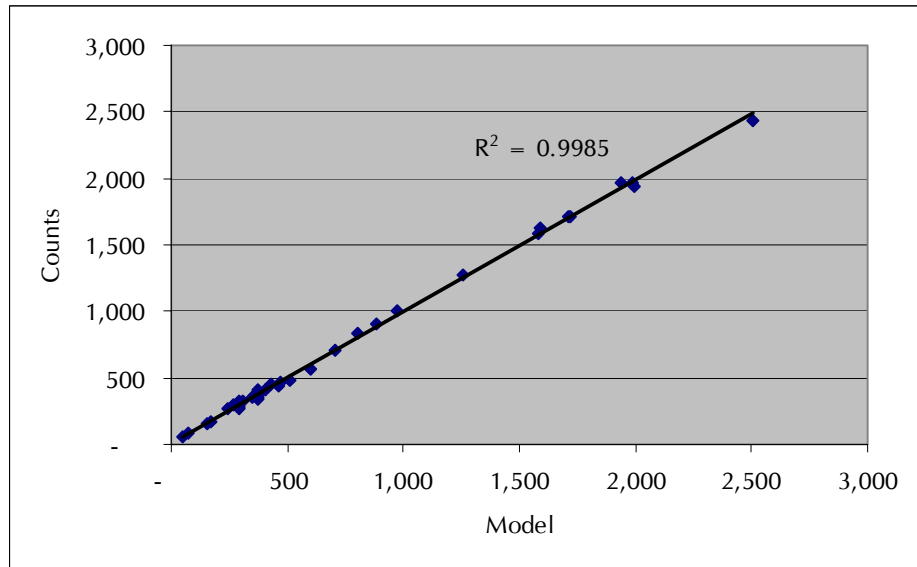


Diagram 3.3: Thornton Study Area Link Calibration.

Table 3.2 presents PM peak hour calibrated traffic volumes for year 2003. From Table 3.2 it is seen that total modelled volume for all types of roads in the study area varies by less than one percent from the actual volumes. Thus, it was reasonable to conclude that the calibration of the existing situation is acceptable and can form the basis for the modelling of future conditions.



Table 3.2: Comparison between Modelled and Surveyed Traffic Volumes (PM peak hour)

TCAD ID	Road Sections	Surveyed		Modelled		% Differences	
		North/East	South/West	North/East	South/West	North/East	South/West
609	Raymond Terrace Road West of Eales Road	267	349	309	385	15.7%	10.3%
608	McFarlanes Rd North of Raymond Terrace Road	78	53	71	48	-9.0%	-9.4%
607	Raymond Terrace Road East of Government Road	306	367	293	345	-4.2%	-6.0%
603	Government Road South of Raymond Terrace Road	152	176	147	175	-3.3%	-0.6%
544	Raymond Terrace Road West of Government Road	325	304	267	256	-17.8%	-15.8%
543	Hauszman Drive South of Raymond Terrace Road	322	268	319	246	-0.9%	-8.2%
542	Raymond Terrace Road West of Hauszman Drive	562	487	586	501	4.3%	2.9%
420	Metford Road North of Raymond Terrace Road	446	416	451	393	1.1%	-5.5%
395	Metford Road South of Raymond Terrace Road	443	335	444	353	0.2%	5.4%
419	Raymond Terrace Road west of Metford Road	348	280	353	301	1.4%	7.5%
563	New England Hwy west of Thornton Road	1,970	1,706	1,988	1,727	0.9%	1.2%
564	Thornton Road north of NEH	468	705	463	711	-1.1%	0.9%
561	New England Hwy east of Thornton Road	2,440	1,939	2,526	2,017	3.5%	4.0%
562	Weekly Drive south of NEH	1,010	829	963	807	-4.7%	-2.7%
559	New England Hwy west of Anderson Drive	1,965	1,276	1,919	1,253	-2.3%	-1.8%
1236	Anderson Drive north of NEH	369	404	383	400	3.8%	-1.0%
1239	New England Hwy east of Anderson Drive	1,629	905	1,560	877	-4.2%	-3.1%
Total		13,100	10,799	13,042	10,795	-0.4%	-0.04%

4. Transport Impacts

4.1 Public Transport

The study area in Thornton North has been designated as mostly residential, with one small commercial centre. The existing development in Thornton has the same characteristics. To estimate the future supply of and demand for transport in Thornton North, this analysis uses the existing characteristics of Thornton and applies it to the predicted population of the residential area.

According to 1996 census data, the population of Thornton travel zone (which includes residential areas of Thornton and Beresfield) is approximately 9,000 people. The population of Thornton's existing residential area is 4,231 people. The number of work trips from Thornton's existing residential area is estimated to be 1,734. By applying the mode share as outlined in Section 2.1, Thornton's existing residential area would have 66 rail work trips, 15 bus work trips, 37 walking work trips and 10 cycling work trips. Thornton's population would also impact rail use through the two nearby rail stations (Thornton and Metford) and bus demand in Thornton might increase.

The future population of the proposal is predicted to be approximately 9,500 people. This would double the population of Thornton travel zone to 18,500 people, representing an increase of 105 percent.

Assuming the new population adopts the same mode choice and trip profile as Thornton's existing population, the following reflects changes to trip patterns for the new and existing residential areas:

- 154 additional rail trips to work (220 rail trips in total from Thornton);
- 36 additional bus trips to work (51 bus trips in total);
- 87 additional walking trips to work (124 walking trips in total);
- 23 additional cycling trips to work (33 cycling trips in total);
- Increased demand for new bus services to the new development areas in Thornton North for all trip purposes; and
- Increased demand for rail trips on the Hunter Line for all trip purposes.

Various measures can be adopted, as directed by SEPP 66, to increase and promote alternative transport modes to the car, potentially increasing public transport use (i.e. buses and trains) from an existing level of five percent. Table 4.1 outlines the potential number of work trips from the development area for a base case scenario and two other scenarios, including: an increase of public transport use to 10 percent (eight percent rail, two percent bus) and an increase to 15 percent (12 percent rail, three percent bus). Walking and cycling trips would remain the same.

Table 4.1: Potential Public Transport Work Trips from Proposal

Mode	Number of Trips		
	Base Case (5% PT)	Scenario 1 (10% PT)	Scenario 2 (15% PT)
Rail	154	308	463
Buses	36	72	108
Walking	87	87	87
Cycling	23	23	23

4.2 SEPP 66 Requirements

Two of the aims of the *State Environmental Planning Policy No. 66 — Integration of Land Use and Transport* are to improve accessibility to employment, housing and services by walking, cycling and public transport, and to improve transport mode choice. To achieve these aims, the policy suggests better integration of land use and transport at the local level.

As indicated in Part 2 of SEPP 66, the Thornton North Master Plan must include measures to better integrate land use and non-private motor vehicle transport facilities and services. This can be achieved by:

- an urban form and structure that encourages walking, cycling and public transport use;
- parking standards that set maximum limits in order to discourage car use in areas with good public transport access;
- minimum residential densities that will help to achieve viable public transport services; and
- employment or floor space densities in commercial or employment areas that reflect the accessibility of the area by suitable public transport services and facilities.

The following section outlines infrastructure opportunities and constraints with regard to the requirements of SEPP 66.

4.3 Opportunities and Constraints

4.3.1 Trains

The addition of at least 154 extra daily work-related rail trips, with most using Metford Station (which is the closest station to the new development), would represent a significant increase in commuter numbers using local rail stations. However, in terms of overall patronage on the Hunter Line, the effect would be minimal. State Rail figures indicated that Thornton and Metford stations are under-utilised, and it is unlikely that the addition of 154 work trips would significantly change rail stopping patterns or result in demand for each train exceeding each train's capacity.

However, capacity problems might occur at Metford and Thornton Station car parks. Although both stations have under-utilised car parks, the capacity of each car park is small, and an increase of rail trips of this magnitude could result in overflow parking in local streets and potentially local traffic problems. Solutions to this problem include increasing the capacity of the car parks at Metford and Thornton Stations, and promoting other modes to access the Station particularly bus and cycling.

Walking to Metford Station is not as accessible as it is for existing residents in Thornton. Approximately 50 percent of the existing residential area in Thornton is within walking distance of Thornton Station (based on a walking catchment of within 800 metres of the Station). Only a small percentage of the new development at Thornton North is within walking distance of any station, with only the southwest corner of the study area within 800 metres of Metford Station.

In keeping with the aims of SEPP 66, the Master Plan should accommodate easy access to a rail station, preferably Metford Station due to its proximity to the new development, bus stop and relative under-utilisation. In real terms this translates to a pedestrian and cycle path from the development to the Station, and direct road access to the Station for motor vehicles, especially buses. These opportunities are discussed in the following sections.

Currently, access to Metford Station is only provided at the southern side of the rail line, meaning that rail passengers must cross the Hunter Line to access the Station. The proposed grade separation at Metford Road and the Hunter Line will improve accessibility and safety to Metford Station. However, consideration should be given to providing a northern access to the Station. This access would provide a more direct link to Thornton North residents. Further investigation and discussion with Rail Infrastructure Corporation should be conducted to address this opportunity.

4.3.2 Buses

The addition of an estimated minimum 36 bus work trips from the new development creates an opportunity for a bus company (such as current local service provider Blue Ribbon Bus Company) to expand into the new development and potentially create new bus services. Additionally, demand for bus trips for other trip purposes (such as shopping and education) would also be expected to increase.

As discussed in Section 2.1.1, the only bus route through the existing residential area in Thornton is Route 186. To access Thornton, this route uses Raymond Terrace Road, which is the principle access road to the southern areas of the development. This route could be expanded to provide a greater service to Thornton and Thornton North, potentially providing access to both Metford and Thornton Rail Stations.

The substantial increase in Thornton's overall population provided by the new development creates opportunities for more services and potential route changes. At this stage route 186 does not provide direct access to Maitland, which is the regional commercial centre for Thornton. Under current conditions, Thornton residents must either change buses at Greenhills Shopping Centre or catch a train to Maitland from Thornton Station. With new demand for bus trips from the new development, the increase in patronage on route 186 may justify a direct service to Maitland. Blue Ribbon

Bus Company should be consulted on the opportunities for new services and routes created by this increase in demand.

A key feature of any new bus service should be providing effective interchange with rail services for passengers with regional destinations. As Section 2.1 showed, the majority of work trips are destined for Newcastle CBD and its surrounding suburbs. A bus service that co-ordinates with rail services at either Thornton or Metford Stations would increase the desirability of using public transport from home to work. The interchange at Metford would be desirable, as its existing bus stop is under-utilised and its rail service frequency is as high as Thornton Station.

A dilemma faced in bus transport planning is providing services that reach people near their homes whilst ensuring that bus routes are not so meandering that the length of the trip discourages their use. A bus route that ensures that most of the population are within 400 metres walking distance of a bus stop would provide an extra incentive for residents to use a bus as their transport mode. The design of main roads in the development, such as adequate width and bus bays, would also affect the quality of bus services and consequently the desirability of buses as a transport mode for residents. Trip generators in the development, such as shopping facilities, should be accessible by bus to as many residents in the development as possible.

By providing infrastructure and services that make bus transport a meaningful alternative to other transport modes, it would increase the likelihood that bus patronage would reach the figures outlined in Scenarios 1 and 2.

4.3.3 Walking

The majority of pedestrian paths typically follow the road corridor, although pedestrian paths between private properties might provide better access in some circumstances. Most walking trips are likely to be one of two purposes:

1. Accessing other modes, particularly buses; and
2. Accessing trip generators within the development, notably shops.

As stated above, the potential to increase bus trips from the development is enhanced by providing walking access to bus stops for as many residents as possible. The open space network in the Master Plan has been designed to encourage walking and to provide linkages across the site to key activity areas such as schools and shops.

4.3.4 Cycling

On-road cycle paths, off-road cycle paths and shared use paths (paths for cyclists and pedestrians) provide an incentive for residents to use cycling as their transport mode. Cyclists in the new development should be able to effectively access the rail line, potentially by providing a cycle path to Metford Station. Either a dedicated path or an on-road facility should provide safe and direct transport to the Station for cyclists.

5. Future Network Capacity

5.1 Future Transport Projects

Future traffic conditions on approach routes to the study area will be influenced by a combination of natural background traffic and additional traffic generated by the proposal. The network performance is based on an assessment year of 2016 with full development. The effect of future road upgrades that have implications for vehicular access to and from Thornton North have been included in the future year analysis. *Table 5.1* shows the list of projects included in the 2016 model.

Table 5.1: Future Road Improvement Projects

Project Description	Completion Date assumed in the model
Thornton Link Road	By 2003
National Highway-New England Highway extension	By 2016
Weakleys Drive interchange	By 2016
Metford Road underpass to replace level crossing over main northern railway line	Approved and construction may begin by 2003

The Thornton Link Road was opened to traffic in July 2003. RTA has indicated “right turn ban from Weakleys Drive into NEH east” may be implemented with the opening of the Link Road to reduce the impact on this intersection.

Two other key transport projects include the National Highway-NEH extension and Weakleys Drive interchange, both of which would have an impact on the proposed development of Thornton North. Consequently, they have been assessed separately. At the time of preparing this report, it is envisaged that Weakleys Drive interchange will be constructed by 2007 and thus included in the 2016 network as a committed project.

5.2 Impact of Proposal on the Road System

5.2.1 Impact on Regional Roads

The additional traffic movements derived from the traffic generation assumed for the proposal were assigned on both existing and future committed 2016 network. This section demonstrates the impact of the full proposal on the existing network including Thornton Link Road. The Link Road is assumed to be a two-lane road in the model. The impact of the proposal on 2016 future committed network, including Weakleys Drive interchange, is discussed separately in *Section 6.2* of this report.

A maximum of 3,000 peak hour vehicle trips generated from full development was assumed in the model. In addition to this, the network model also assumed two access points that would load traffic to the road network from the proposal. One is on Raymond Terrace Road between Haussman Drive and Government Road. The second access is on McFarlanes Road. The traffic forecast results on the existing network, including Thornton Link Road, is shown in *Table 5.2*. For comparison, the 2003 traffic volumes are also shown in *Table 5.2* to determine level of increase in traffic volumes mainly from the full development. It is noted that all traffic counts in 2003 were undertaken prior to the opening of Thornton Link Road.

The forecasts indicate that the proposal would result in a significant impact in overall traffic generated in the long term (2016) on the existing network. The regional network, comprising Raymond Terrace Road, Metford Road, Weakleys Drive and the NEH, are expected to accommodate the greatest long-term increase in additional traffic as a result of the proposal.

5.2.2 Local Roads impacts

The RTA and PB model included the Railway Avenue/Edwards Avenue/Government Road and Haussman Drive routes. It is anticipated that with the full proposal, there would be some degree of impact on other local roads that are not currently in the model. With the growing future traffic along these two principal routes, local diversion would mainly take place on the following local roads seeking access to Raymond Terrace Road, Haussman Drive and Thornton Road. They are:

- Government Road between Glenroy Street and Edwards Avenue; and
- Taylor Avenue between Railway Avenue and Haussman Drive.

The above local roads would provide an opportunity for alternative access to and from the proposal if competing parallel routes of Railway Avenue/Edwards Avenue/Government Road and Haussman Drive reach capacity. The analysis assumed that a maximum of 15 percent of development traffic would divert to Taylor Avenue from Haussman Drive. Similarly, a maximum of 10 percent of development traffic would divert to Government Road (between Glenroy Street and Edwards Avenue) from Railway Avenue/Edwards Avenue route. *Table 5.2* also summarises the impact of full proposal on local area network. The following points are noted:

- Haussman Drive would have maximum impact. The increase in traffic would be in the range of 1200 to 1400 vehicles per hour compared to low level of current traffic volumes on this road;
- Edwards Avenue and Government Road would have an increase of approximately 600 vehicles during the peak hour;
- Government Road between Glenroy Street and Edwards Avenue would have an increase of approximately 100 vehicles during the peak hour; and
- Thornton Road would have an increase of 1600 to 1800 vehicles per hour.



The analysis indicated that there would be increased use of local streets including Government Road, Railway Avenue, Edwards Avenue, Taylor Avenue, Hausman Drive Anderson Drive and Thornton Road by the development traffic seeking to access NEH and Raymond Terrace Road. The railway overbridge at Thornton railway station would be a local bottleneck due to capacity constraint at the bridge. It is unlikely that this rate of increase in traffic could be sustained unless the key intersections and roads serving the proposed development are significantly upgraded.



Table 5.2 Forecast of Future PM Peak Traffic with Full Development

Road Sections	2003 Traffic Volumes			2016 Background Traffic Plus Full Development			Change			% Change		
	N/E	S/W	Total	N/E	S/W	Total	N/E	S/W	Total	N/E	S/W	Total
Regional Roads												
Raymond Terrace Road West of Eales Road	267	349	616	342	473	815	75	124	199	12%	20%	32%
Raymond Terrace Road East of Government Road	306	367	673	385	517	902	79	150	229	12%	22%	34%
Raymond Terrace Road East of Haussman Drive	325	304	629	2119	897	3016	1794	593	2387	285%	94%	379%
Raymond Terrace Road West of Haussman Drive	562	487	1049	1288	650	1938	726	163	889	69%	16%	85%
Raymond Terrace Road West of Metford Road	348	280	628	813	411	1224	465	131	596	74%	21%	95%
Metford Rd North of Raymond Terrace Road	446	416	862	547	554	1101	101	138	239	12%	16%	28%
Metford Rd South of Raymond Terrace Road	443	335	778	749	447	1196	306	112	418	39%	14%	54%
McFarlanes Rd North of Raymond Terrace Road	78	53	131	103	81	184	25	28	53	19%	21%	40%
Weakleys Drive South of NEH	1010	829	1839	1434	1058	2492	424	229	653	23%	12%	36%
New England Hwy East of Thornton Rd	2440	1939	4379	2690	3084	5774	250	1145	1395	6%	26%	32%
New England Hwy West of Thornton Road	1970	1706	3676	2404	1800	4204	434	94	528	12%	3%	14%
Local Roads												
Government Rd South of Raymond Terrace Road	152	176	328	657	313	970	505	137	642	154%	42%	196%



Road Sections	2003 Traffic Volumes			2016 Background Traffic Plus Full Development			Change			% Change		
	N/E	S/W	Total	N/E	S/W	Total	N/E	S/W	Total	N/E	S/W	Total
Edwards Avenue North of Singleton Avenue	188	171	359	705	315	1020	517	144	661	144%	40%	184%
Government Road South of Somerset Drive	219	206	425	690	336	1026	471	130	601	111%	31%	141%
Government Road North of Blakewell Crescent	163	48	211	235	75	310	72	27	99	34%	13%	47%
Hausman Drive South of Raymond Terrace Road	322	268	590	723	1353	2076	401	1085	1486	68%	184%	252%
Hausman Drive West of Forshaw CI	127	170	297	449	1085	1534	322	915	1237	108%	308%	416%
Taylor Av West of Thomas Coke Drive	184	203	387	343	390	733	159	187	346	41%	48%	89%
Thornton Rd North of Glenwood Drive	450	449	899	1947	834	2781	1497	385	1882	167%	43%	209%
Thornton Rd North of NEH	468	705	1173	1441	1036	2477	973	331	1304	83%	28%	111%

5.2.3 Road Capacity Impacts

Traffic increases of the magnitude forecast over the 13-year period would place significant demands on the existing highway network at Thornton. The capacity of roads affected by full development was evaluated based on the Austroads assessment criteria as discussed in *Section 2.1.2*. The upgrade requirements are based on the maximum nominal capacity for a level of service "E". Capacity improvements may be justified on most types of roads if projected traffic volumes exceed maximum nominal capacity. The projected traffic volumes as tabulated in *Table 5.2* on roads in Thornton were compared against maximum nominal capacity. *Table 5.3* shows indicative nominal capacities per hour and compares the capacity on selected roads to "2016 with full development" traffic volumes as shown in *Table 5.2*.

Table 5.3 Capacity Assessment of Roads in 2016 with Full Proposal

Road Sections	Effective Number of Lanes per Direction	Nominal Capacity per hour per direction	Exceeds Maximum Nominal Capacity
Raymond Terrace Rd West of Eales Road	2U	1500	
Raymond Terrace Rd East of Government Road	2U	1500	
Raymond Terrace Rd East of Haussman Drive	2U	1500	✓
Raymond Terrace Rd West of Haussman Drive	2U	1500	
Raymond Terrace Rd East of Metford Road	2U	1500	
Raymond Terrace Rd West of Metford Road	2U	1300	
Metford Rd North of Raymond Terrace Road	2U	1000	
Metford Rd South of Raymond Terrace Road	2U	1000	
McFarlanes Rd North of Raymond Terrace Road	2U	1100	
Government Rd South of Raymond Terrace Road	2U	900	
Edwards Avenue North of Singleton Avenue	2U	900	
Government Road South of Somerset Drive	2U	900	
Government Road North of Blakewell Cr	2U	900	
Haussman Drive South of Raymond Terrace Road	2U	900	✓
Haussman Drive West of Forshaw CI	2U	900	✓
Taylor Avenue West of Thomas Coke Drive	2U	900	
Thornton Road North of Glenwood Drive	2U	900	✓
Thornton Road North of NEH	2U	900	✓
Weaklys Drive South of NEH	2U	1600	
New England Hwy East of Thornton Road	4D	2700	✓
New England Hwy West of Thornton Road	4D	2700	

The analysis results in *Table 5.3* indicate that the following road sections may qualify for potential upgrade to four lanes as a result of the development traffic. The findings are

based on the assumption that Thornton Link Road formed the part of existing road network. They are:

- Raymond Terrace Road between Government Road and Haussman Drive;
- Haussman Drive between Raymond Terrace Road and Railway Avenue;
- Thornton Road between Glenroy Street and the NEH; and
- the NEH between Thornton Road and Weakleys Drive.

However, with the completion of Weakleys Drive interchange, traffic on the following sections of road would be significantly reduced (this is due to the closure of existing intersections at Weakleys Drive, Anderson Drive and Thornton Road. See *Section 6.2* for details network changes). They are:

- the NEH east of Thornton Road; and
- Thornton Road between Glenwood Drive and the NEH.

The analysis suggested that with Weakleys Drive interchange in place, no capacity upgrade would be required for the above two sections of roads.

5.2.4 Impact on Intersection Capacity

Changes in background traffic flows with the proposal would result in changed network performance. As indicated previously, a primary indicator of this performance is the operation of intersections. A capacity analysis was undertaken for five regional and eight local area intersections for 2016 traffic forecasts with full development.

5.2.4.1 Regional Intersections

The overall level of service for five regional intersections is shown in *Table 5.4*. The model included Thornton Link Road as part of the existing network. The new intersection of the Link Road with Anderson Drive would be a roundabout. Other intersections in the study area are assumed to operate under the existing traffic control system.

From *Table 5.4*, it can be seen that the following regional intersections analysed would operate at LOS F. They are:

- the NEH/Thornton Road;
- the NEH/Weakleys Drive;
- Raymond Terrace Road/Government Road; and
- Raymond Terrace Road/Haussman Drive.

Table 5.4: Intersection Performance in 2016 with Full Proposal

Intersections	Type of Control	PM Peak	
		Delay	LoS
Regional Intersections			
NEH/Thornton Road	Signal	>70	F
NEH/Weakleys Drive	Signal	>70	F
Raymond Terrace Road/Government Road	Sign	>70	F
Raymond Terrace Road/Haussman Drive	Sign	>70	F
Raymond Terrace Road/Metford Road	Roundabout	19	B
Local Area Intersections			
Thornton Rd/Thornton Link Rd/Glenwood Drive	Roundabout	>70	F
Thornton Link Rd/Anderson Drive	Roundabout	10	A
Railway Avenue/Glenroy Street	Sign	>70	F
Edward Avenue/Eurimbla Street	Roundabout	13	A
Government Road/Eurimbla St	Sign	33	C
Haussman Drive/Taylor Avenue	Sign	>70	F
Edwards Avenue/Somerset Drive	Roundabout	10	A
Thomas Coke Drive/Somerset Drive	Roundabout	12	A

5.2.4.2 Local Area Intersections

The results of local area intersections in Thornton are also shown in *Table 5.4*. From *Table 5.4*, it can be seen that the following intersections would operate at LOS F. They are:

- Thornton Road/Thornton Link Road/Glenwood Drive;
- Railway Avenue/Glenroy Street; and
- Haussman Drive/Taylor Avenue.

These intersections would be highly congested and would impact on future traffic conditions in the Thornton local area. At these critical intersections, intersection capacity improvement measures would be required to sustain the assumed full developments. Other analysed intersections in *Table 5.4* would have adequate capacity and expected to operate well with the development.

With the Weakleys Drive interchange in place, the following three intersections would be modified (i.e. closure of existing intersections at Weakleys Drive, Anderson Drive and Thornton Road. See *Section 6.2* for details network changes) and would operate at a better level of service than those shown in *Table 5.4*:

- the NEH/Thornton Road;
- the NEH/Weakleys Drive; and
- Thornton Road/Thornton Link Road/Glenwood Drive.

5.2.5 Impact on Intersection Capacity Prior to Weakleys Drive Interchange

RTA indicated that Weakleys Drive interchange would be constructed by 2007. A capacity analysis has been undertaken for two key intersections of Weakleys Drive/NEH and NEH/Thornton Road with the background traffic growth until 2007. The purpose of this assessment is to quantify spare capacity that may be available with the opening of Thornton Link Road. The model also assumed:

- right turn ban from Weakleys Drive into NEH east at NEH/Weakleys Drive intersection;
- NEH/Thornton Road intersection operates under existing condition; and
- no development in the Thornton North study area.

Table 5.5 shows the performance of intersection operation in 2007. An analysis of model results demonstrate that banning right turn on Weakleys Drive would have significant improvement on the intersection performance in the short term. As indicated in Section 2.1.4, currently the NEH/Thornton Road intersection is operating at a level of service “E”. In 2007, with the background traffic growth and changes to the network (i.e. with the Thornton Link Road), the intersection would operate at a level of service “E”. This translates to very limited development potential at Thornton North under assumed network changes.

Table 5.5 Intersection Performance in 2007 without Proposal plus Assumed Network Changes

Intersections/Critical Movements	Traffic Control	PM PEAK	
		Delay	LoS
New England Highway / Weakleys Drive	Signal	19	B
New England Highway / Thornton Road	Signal	59	E

6. Options Assessment

The development capacity of the Thornton North area is directly related to the traffic capacity at the critical intersections of the NEH/Thornton Road and the NEH/Weakleys Drive. The background traffic growth until 2016 is expected to take up any spare capacity. Analysis on both intersections indicates that the proposal (see *Table 5.4* in *Section 5.2.4*) would cause the intersections to operate at a very congested level (level of service “F”) during peak periods. A small increase in traffic beyond this level would create queues and traffic delays disproportionately greater than the traffic increase itself.

For the circumstances described above, there is expected to be very little or virtually no spare capacity at both intersections to accommodate growth in traffic generated from the proposal. A maximum level of growth would need to be supported by future road improvement projects. The following options have been tested, independently of each other:

- Option 1: National Highway extension;
- Option 2: Weakleys Drive interchange;
- Option 3: Widening existing road bridge at Thornton to four lanes;
- Option 4: New road bridge at Thornton with a connection with Hausman Drive; and
- Option 5: Other traffic management measures with Thornton Link Road, namely right turn ban from Weakleys Drive into NEH east after Thornton Link Road opens to traffic.

6.1 Option 1: National Highway Extension

Option 1 describes the National Highway extension from the F3 at West Wallsend to the NEH west of Braxton. *Figure 6.1* shows the tentative alignment of the National Highway extension. The impact of the National Highway extension was assessed based on a trip table obtained from RTA Tranplan model and does not take the proposal into account. The model results indicate that in 2016, through traffic on the NEH at Thornton will be reduced by between 17 percent and 20 percent during the peak hour. This would result in some spare capacity, which can be taken up by the Thornton North development. *Table 6.1* shows the impact of Option 1 with proposal on key intersections.

Table 6.1: Intersection Performance in 2016 with full Proposal and National Highway Extension

Intersections	Type of Control	PM Peak	
		Delay	LoS
NEH/Thornton Road	Signal	>70	F
NEH/Weakleys Drive	Signal	>70	F

The results demonstrate that the National Highway extension alone would not be sufficient for satisfactory intersection operation at Thornton. Both intersections would operate at a level of service “F” with full development.

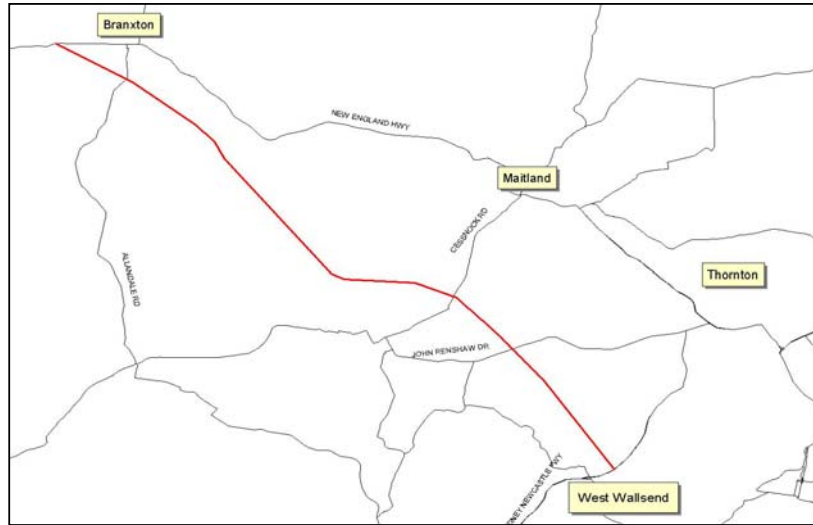


Figure 6.1 National Highway Extension

6.2 Option 2: Weakleys Drive Interchange

The Weakleys Drive interchange option assumes:

- an elevated two lane roundabout interchange over the NEH, located east of Weakleys Drive, incorporating a Beresfield/Thornton Link Road and a connection from the interchange to the Link Road;
- closure of existing intersections at Weakleys Drive, Anderson Drive and Thornton Road. Left turn in only at Thornton Road;
- Thornton Link Road is two lanes between Thornton Road and Anderson Drive;
- Connection Road between Weakleys Drive interchange and Link Road is a four-lane road;
- 2 lane roundabouts on the Link Road at its intersections with Thornton Road and the interchange connection road and
- 2 lane roundabout at Thornton Road with Thornton Link Road/Glenwood Drive intersection;

Table 6.2 presents the impact of Weakleys Drive interchange with full development in 2016. Only intersections to those performance are likely to be changed with Weakleys Drive interchange are shown in Tale 6.2. All other analysed intersections excluding NEH/Thornton Road, NEH/Weakleys Drive (assumed to be closed with interchange) would have similar level of service to those shown in Table 5.4.

The results in Table 6.2 demonstrate that the interchange will play a key role in determining future potential growth at Thornton North. The critical level of service at the key intersection of Weakleys Drive/Link Road extension would be “B”, indicating good performance with spare capacity.

Table 6.2: Intersection Performance in 2016 with Weakleys Drive Interchange and full development

Intersections	Type of Control	PM Peak	
		Delay	LoS
Weakleys Drive/Link Road extension	Roundabout	17	B
Thornton Road/Thornton Link Road/Glenwood Drive	Roundabout	24	B
Thornton Link Road/Connection Road (between interchange and Thornton Link Road)	Roundabout	>70	F

The intersection of Thornton Road/Thornton Link Road/Glenwood Drive would operate better level of service “B” due to the closure of Thornton Road/NEH intersection (Left turn in only at Thornton Road). However, a full length of right turn bay and a left turn slip lane would be required to accommodate heavy northbound and southbound traffic movements. at this intersection.

The Thornton Link Road/Connection Road intersection would operate at a level of service “F” This is because of the significant traffic increase on the Anderson Drive through Beresfield, Thornton Link Road and connection Road to Weakleys Drive interchange.

The capacity assessment as described in *Section 5.2.3* was reanalysed for the Weakleys Drive interchange option. *Table 6.3* presents resultant network upgrade requirements due to the full development plus Weakleys Drive interchange. Only road sections where demand would exceed capacity were shown in *Table 6.3*.

The results suggest that with Weakleys Drive interchange and the full proposal, the road sections identified in *Table 6.3* have potential for upgrading to four lanes.

Table 6.3 Capacity Assessment of Roads in 2016 with Full Proposal plus Weakleys Drive

Road Sections	Exceeds Maximum Capacity
Raymond Terrace Road East of Haussman Drive	✓
Haussman Drive South of Raymond Terrace Road	✓
Haussman Drive West of Forshaw CI	✓
Thornton Road North of Glenwood Drive	✓
Thornton Link Road between Thornton Road and Connection Road; and	✓
Connection Road between Weakleys Drive interchange and Link Road (assumed four lanes as part of the Weakleys Drive interchange)	✓

6.3 Option 3: Widening Existing Thornton Bridge

With the proposal fully developed, the model results indicate an expected long-term problem with traffic congestion along Government Road and the existing road bridge at Thornton. The volume capacity ratio (congestion level) on this bridge is about 1.3, thus justifying improvements.

The capacity constraint on this bridge would restrict the development potential of Thornton North. Modelling the effects of widening the bridge to four lanes demonstrates that with capacity improvement at the bridge, congestion would be at an acceptable level of 0.80. Therefore, this option may be justified from a traffic perspective; but detailed local impacts should be investigated further.

6.4 Option 4: New Bridge at Thornton

Option 4 describes a new bridge connecting Thornton Road and Haussman Drive that would enhance the local traffic route to the proposed development via Haussman Drive and Raymond Terrace Road, reducing traffic congestion on the existing bridge. The model results demonstrate that a second bridge connecting to Haussman Drive would have a positive impact on the existing bridge. In 2016, the amount of traffic reduction on the existing bridge would be about 47 percent. With a new bridge in place, the model indicates that Haussman Drive would provide a more direct route to the proposed development. However, the resulting reduction in bridge traffic may not warrant the construction of a costly new bridge. A more detailed investigation of the feasibility of a new bridge should be considered and compared with the cost and benefit of widening the existing bridge.

6.5 Option 5: Other Traffic Management

The RTA has indicated that a “right turn ban from Weakleys Drive into NEH east” may be implemented with the opening of the Link Road to reduce impacts on the Weakleys Drive/New England Highway intersection. Currently, critical movements at this intersection operate at capacity level. To test this option, a wider area trip table from the RTA’s Tranplan model including the Holmwood, Beresfield and Woodberry areas was used. This Option was tested for 2016 traffic with Thornton Link Road.

With Option 5 traffic management measures, the model demonstrates an increase in traffic on Anderson Drive through Beresfield. Traffic tends to switch to Anderson Drive at Tarro, because of congestion on Weakleys Drive/NEH and NEH/Thornton Road intersections. The likely traffic increase on Anderson Drive is about 20 percent compared to current traffic volumes. The corresponding decrease in traffic on NEH and Weakleys Drive would be about seven percent and five percent respectively. *Table 6.4* shows the impact on key two intersections on the NEH.

Table 6.4: Intersection Performance in 2016 with Full Proposal for Option 5

Intersections	Type of Control	PM Peak	
		Delay	LoS
NEH/Thornton Road	Signal	>70	F
NEH/Weakleys Drive	Signal	>70	F

Table 6.4 shows that the reduction in traffic on the NEH and Weakleys Drive as a result of banning the right turn would not be sufficient to enable the intersections to operate satisfactorily. The proposed development traffic would take up any spare capacity that could be achievable from Option 5. Both intersections would still be highly congested with the proposal during peak periods. Further investigation should be carried out to determine the impact on both intersections after the opening of Link Road.

6.6 Options Summary

In summary, the following network upgrades are considered necessary for the ultimate level of development in Thornton North to proceed:

- Weakleys Drive interchange is the most critical upgrade to the NEH/Weakleys Drive intersection. Without this upgrade, the full development of the Thornton North area cannot proceed;
- the current railway bridge at Thornton Station will constrain development and needs to be duplicated, either adjacent to the existing bridge or by providing a new crossing with Haussman Drive. Either option would provide adequate railway crossing capacity and the decision regarding the preferred option should be made during the project evaluation phase; and
- The National Highway extension (F3 to Braxton) has some capacity benefits, but is not an essential element in providing network capacity for the Thornton North development.

6.7 Development Potential Prior to Weakleys Drive Interchange

PB has undertaken a preliminary modelling to assess the impact on the Thornton Road/NEH and NEH/Weakleys Drive intersections in 2007 based on following planning assumptions:

- the first land in Thornton North will be released in year 2005;
- an average of 150 dwellings per annum will be released;
- right turn ban from Weakleys Drive into NEH east at NEH/Weakleys Drive intersection; and

- the NEH/Thornton Road intersection operates under existing condition.

As indicated in *Section 5.2.5*, limited development in the Thornton North area could proceed in the short term without further deteriorating the operation of critical intersections. To quantify the amount of development, the model was run iteratively until the intersection of Thornton Road/NEH reached “at capacity level E”. The model results demonstrated that some upgrade work at this intersection would be required to accommodate a maximum of 200 dwellings. The intersection upgrade would consist of one additional westbound right turn bay on NEH into Thornton Road. This upgrade work is essential prior to approving any development in 2005. *Table 6.5* presents the intersections performance in 2007. Key intersections would be operating at a level of service “B” to “E” with the assumed upgrade.

Table 6.5 Intersection Performance in 2007 with assumed network changes plus intersection upgrade

Intersections/Critical Movements	Traffic Control	PM PEAK	
		Delay	LoS
New England Highway/Weakleys Drive	Signal	20	B
New England Highway/Thornton Road-No improvements	Signal	>70	F
New England Highway/Thornton Road-With improvements	Signal	60	E

It is recommended that further modelling be undertaken to quantify the actual effect of the Thornton Link Road and right turn ban at Weakleys Drive in the short term, prior to the construction of the interchange.

7. Master Plan Assessment

7.1 New Access Points

The network model TransCad was refined in light of the internal road network and proposed access points on Raymond Terrace Road and McFarlanes Road. The performance of access points is related to the exact distribution of residential lots, which is unknown at this stage. A preliminary investigation suggested that 75 percent of the development would be located north of Raymond Terrace Road and the remaining 25 percent would be south of Raymond Terrace Road. Intersection analyses to test the performance of these five access points were undertaken using modelled 2016 PM peak traffic. The five proposed access points are (see *Diagram 7.1*):

- McFarlanes Road/New Access Road 1;
- McFarlanes Road/New Access Road 2;
- Raymond Terrace Road/New Access Road 3;
- Raymond Terrace Road/New Access Road 4; and
- Raymond Terrace Road/New Access Road 5.

These new access points were analysed either as a sign controlled cross intersection with the traffic on Raymond Terrace Road/McFarlanes Road having priority over the side street traffic, or as a T-junction (terminating road rule). It was also assumed that all movements would be possible. The intersection analysis results are summarised in *Table 7.1*.

Table 7.1: Proposed Access Points Intersection Performance (2016 PM Peak)

Intersections	Delay	LoS
McFarlanes Road/New Access Road 1	10	A
McFarlanes Road/New Access Road 2	10	A
Raymond Terrace Road/New Access Road 3	>70	F
Raymond Terrace Road/New Access Road 4	>70	F
Raymond Terrace Road/New Access Road 5	>70	F

As shown in *Table 7.1*, both of the McFarlanes Road access points would perform well, with LoS "A" during the critical PM peak period, which is in contrast to the performance of the Raymond Terrace Road access points at LoS "F".

The intersection analysis results indicate the intersection control and geometric layout for the Raymond Terrace Road access points would require further improvements to accommodate anticipated demand from full development.

It is recommended that additional modelling be undertaken at a later date, at the time that any development is proposed, to quantify the actual impact on these access points.

7.2 Potential Speed Management

The current speed environment on McFarlanes Road is 80 km/hr and on Raymond Terrace Road the current speed environment is 100 km/hr, except for the section between Haussman Drive and Government Road (this section is 80 km/hr). From a traffic perspective, the impact on McFarlanes Road due to the proposal is not sufficient to consider potential speed management measures. However, Raymond Terrace Road between Haussman Drive and McFarlanes Road would have a higher frequency of access points that may create potential safety issues. A reduced speed limit of 60 km/hr on Raymond Terrace Road on this section would clearly add safety benefit to road users. A detailed road safety audit would be required.

7.3 Preferred 2016 network

In the future, the surrounding road network would need to cater for traffic from the full proposal and for the growth in cross-regional traffic on the main road network. It has been assessed that the network cannot sustain such traffic increases and maintain a reasonable level of service without improvement works to roads and intersections. Five options (as reported in *Section 6*) tested as part of the Thornton North Master Plan suggested that a combination of options would provide adequate network capacity with the proposal. *Table 7.2* presents the summary of proposed road works to road and intersections that would be required to minimise the impact on road network from full development in Thornton North area.

Table 7.2 Potential Upgrade Works for Full Development.

Potential Upgrade Works

Weakleys Drive Interchange and associated works

Widening of existing Thornton Road bridge to four lanes

Potential road upgrade to 4 lanes

- Raymond Terrace Road between Government Road and Haussman Drive;
- Haussman Drive between Raymond Terrace Road and Railway Avenue;
- Thornton Road between Glenroy Street and Glenwood Drive;
- Thornton Link Road between Thornton Road and Connection Road and
- Connection Road between Weakleys Drive interchange and Link Road (assumed four lanes as part of the Weakleys Drive interchange)

Upgrade of regional intersections:

- Raymond Terrace Road with Government Road;
- Raymond Terrace Road with Haussman Drive;

Upgrade of local area intersections:

- Railway Avenue with Glenroy Street; and
- Haussman Drive with Taylor Avenue.

- Haussman Drive with Government Road/Glenroy Street
- Thornton Road with Glenwood Drive/Thornton Link Road
- Thornton Link Road with Connection Road (between interchange and Thornton Link Road)

Internal road system serving proposed development– likely to be two lanes

Five proposed access points on Raymond Terrace Road and McFarlanes Road

Possible future road extension through quarry and two access points with Government Road and Haussman Drive. Further investigations will be required to quantify the impact.

Diagram 7.1 shows the preferred network changes as part of the Thornton North Master Plan. The package of preferred network changes would deliver sufficient capacity to the arterial and local network with the full proposal. Further investigation should be undertaken to assess detailed upgrading works to roads and intersections including preferred type of intersection controls (Roundabout vs signals), turning bays, and slip lanes.

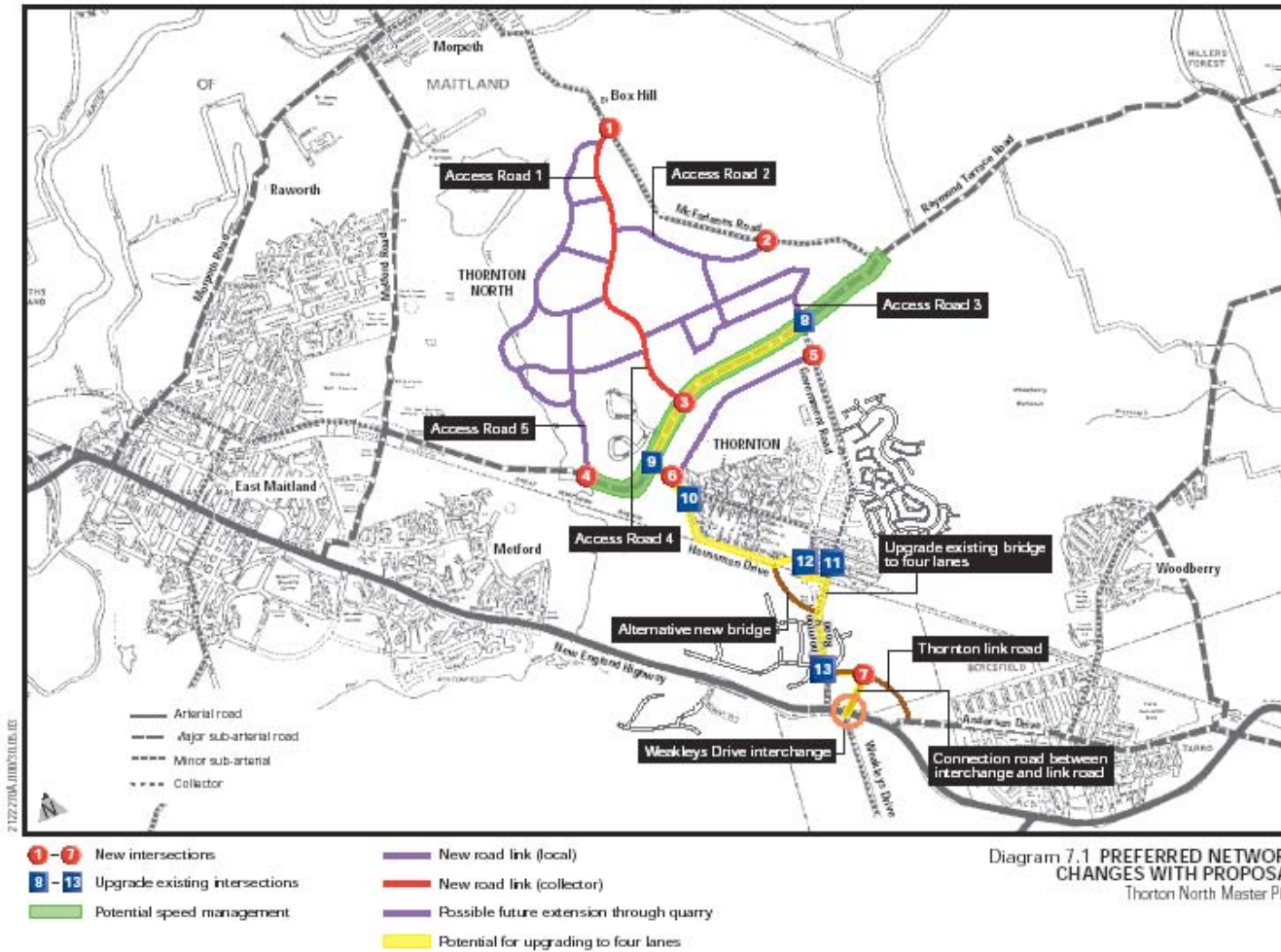


Diagram 7.1 Preferred Network Changes with Proposal

8. Conclusions

The following conclusions are made about the traffic and transport impacts of the population growth associated with the Thornton North Master Plan:

- the New England Highway currently has adequate capacity for through-traffic movements, although considerable traffic congestion is occurring during peak periods at both Thornton and Weakleys Drive intersections as a result of turning movements. Critical movements at both intersections are operating near or at capacity level;
- by 2016, background traffic growth will take up virtually all current spare capacity;
- the extent of future development in the Thornton North investigation area depends on the capacity of the key intersections at Thornton Road and Weakleys Drive along the NEH;
- when due allowance is made for all potential developments in the study area that will access the surrounding arterial and local road system, it is evident that significant road network improvements will be required in the future;
- Weakleys Drive interchange is the most critical upgrade to the intersection of New England Highway with Weakleys Drive. Without this interchange, the full development of the Thornton North area cannot proceed. At the time of preparing this report, it was envisaged that Weakleys Drive interchange would be constructed by 2007. Therefore this interchange assumed to be a committed project;
- in the short term, with the completion of Thornton Link Road and expected prohibition of right turn out of Weakleys Drive, a maximum of 200 dwellings could be developed in the Thornton North area, provided the intersection of Thornton Road/NEH is upgraded to a reasonable level. The intersection upgrade would consist of one additional westbound right turn bay on the NEH into Thornton Road. This upgrade work is essential prior to approving any development in 2005 in Thornton North; and
- Five options tested as part of the Thornton North Master Plan suggested that a combination of options would provide adequate network capacity with the full proposal. Below is the summary of proposed road works to road and intersections that would be required to minimise the impact on road network from full development in Thornton North area.

Potential Upgrade Works

Weakleys Drive Interchange and associated works

Widening of existing Thornton Road bridge to four lanes

Potential road upgrade to 4 lanes

- Raymond Terrace Road between Government Road and Haussman Drive;
- Haussman Drive between Raymond Terrace Road and Railway Avenue;
- Thornton Road between Glenroy Street and Glenwood Drive;
- Thornton Link Road between Thornton Road and Connection Road and
- Connection Road between Weakleys Dr interchange and Link Road (assumed four

lanes as part of the Weakleys Drive interchange)

Upgrade of regional intersections:

- Raymond Terrace Road with Government Road;
- Raymond Terrace Road with Haussman Drive;

Upgrade of local area intersections:

- Railway Avenue with Glenroy Street; and
- Haussman Drive with Taylor Avenue.
- Haussman Drive with Government Road/Glenroy St
- Thornton Road with Glenwood Dr/Thornton Link Road
- Thornton Link Road with Connection Road (between interchange and Thornton Link Road)

Internal road system serving proposed development– likely to be two lanes

Five proposed access points on Raymond Terrace Road and McFarlanes Road

Possible future road extension through quarry and two access points with Government Road and Haussman Drive

The package of road and intersection upgrade works described above would deliver sufficient capacity to the arterial and local network to accommodate the full Thornton North development.

9. References

- Gutteridge Haskins & Davey Pty Ltd, May 1995; *Maitland Integrated Transport Study*;
- PPK Environment and Infrastructure Pty Ltd, June 1998; *Citywide Road Study*;
- Maitland City Council, 2001; *A Strategy for Urban Growth in the Maitland Local Government Area, 2001-2020*,
- RTA Hunter Region, March 2000; *Traffic and Cost Details for at Ground Options for NEH at Thornton Rd, Weakleys Drive and Anderson Drive Intersections*,
- RTA Hunter Region, May 2001; *Weakleys Drive Interchange and*
- Austroads 1988, *Guide to Traffic Engineering Practice Roadway Capacity Part 2*.